Does Music Enhance Creativity in Children?

An Experimental Investigation Into the Relation Between Creativity, Mood and Music

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Abstract

Previous research has shown that listening to positive mood-inducing music can improve creativity measured by divergent thinking tasks. However, no studies have investigated the possibility of such an effect in young children. The aim of the present study was to observe if the mood-inducing properties of musical stimuli might elicit improvement in creativity scores in comparison to another auditory stimuli (book-reading). Participating children (3- and 4-year-olds recruited from two kindergartens in Oslo) were split between two conditions: music and book-reading. In the music condition, each child listened to familiar children's songs, while in the book-reading condition, each child listened to the experimenter's reading of a colorful children's book. Immediately after listening to music or book reading, the divergent creativity performance scores (fluency and originality) of the children were obtained through the Unusual Box Test (Hoicka et al., 2013). The results of the statistical analysis show a small, but not significant tendency for higher fluency and originality scores in the music condition. Possible reasons for the differences from previous studies are discussed in the thesis.

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Preface

Creativity is most often defined as an ability to produce novel and useful responses. That entails not only grand innovations, medical breakthroughs and epic operatic compositions, but also everyday creativity, even in routine tasks.

The idea that we can all be creative, all the time, is particularly stimulating for me. It means that we can make an ‘art’ of all that is ‘mundane’.

My experience with children, as a mother and as a teacher, has allowed me a glimpse into the world of child creativity, as they try to make ‘art’ from everything around them. Their eagerness to learn, their open-mindedness and courage to try new things is inspiring. I personally believe that we adults have the responsibility to foster these behaviors in any way we can.

The main aim of my master thesis project was to experimentally investigate if listening to music can benefit children’s creativity. Music is often used as a companion for reading, learning, painting, or working, and some believe that music can enable them to behave more creatively in those contexts. However, the evidence for music’s ability to improve creative thinking production is limited.

The experimental design for this study was based on the simple premise that listening to ‘happy’ music may enable greater creative task performance in children. To my knowledge, this approach has never been tried before, and although ‘novel’, or ‘original’ do not equal ‘useful’, I hope that the evidence presented in this study will provide some insights.

Table of Abbreviations

AUT	Alternative Uses Task
DPCM	Dual Pathway to Creativity Model
MIP	Mood-induction procedures
PFC	Prefrontal Cortex area
RAT	Remote Associates Task
RPG	Realistic Problem Generation
RPP	Realistic Presented Problem
TCAM	Torrance's Creativity in Action and Movement test
TTCT	Torrance Tests of Creative Thinking
UBT	Unusual Box Test

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1 Introduction

"Those who create are rare; those who cannot are numerous", stated Gabriella 'Coco' Chanel in an interview in 1961[1]. This opinion of one brilliant individual well represents a common understanding of creativity: that it is an attribute of special, gifted people, geniuses and artists, like Palestrina, Telemann, Liszt and… obviously, Mozart. Creativity is rather associated with the astonishing paleolithic pictures on the walls of the Lascaux cave, than with the ability of *homo sapiens* living in the same area and time period to survive environmental changes that drove their cousins Neanderthals to extinction (Banks et al., 2008). But creativity is present in both artistic expression and in the human ability to acquire solutions to the most pending problems of their survival.

Creativity allows us to deal with both challenges and opportunities in everyday situations as much as it enables artistic creation. It is a multidimensional and complex concept to define, but researchers generally agree that creativity means the ability to produce novel and useful responses to a problem or a task (Said-Metwaly, Van den Noortgate, & Kyndt, 2017). From an evolutionary standpoint, creativity secures human survival by facilitating innovation, flexibility and problem-solving of the most pending issues. The ability to adapt is a defining human feature. Without creativity, we would not be able to overcome threats related to a changing environment, new disease epidemics, or periods of economic recessions (Cropley, 2000). At the present time, the world focuses its attention and resources on solving the problem of the SARS-Cov-2 virus pandemic. Governments, international institutions, charities, private groups and citizens alike are investing large resources in order to adapt to the new reality. We are drastically changing the way we organize and socialize in order to overcome the pandemic (e.g. Paul, 2020; Stelter, 2020). Infectious viral disease is not the only problem that requires creative solutions. Global warming, economic recession, aging populations, and conflicts continue to threaten our existence and warrant creative solutions. However, creativity is not only recognized as a key ability of problem solving in a grand scale, but in everyday situations as well. Thus, no creativity should be deemed trivial, since even small products of creativity (e.g. a new recipe) can have a positive impact on life. Creativity is considered to be one of the most important mental competences for the twenty-first century (Ritter & Ferguson, 2017), as it not only aids thinking on solutions to global problems, but to everyday challenges as well. There is a great need for finding new ways to stimulate

[1] "Coco" Chanel's Style in Wit, THIS WEEK MAGAZINE, Aug. 20, 1961, art 19, sited after: Felice, 2011, p.247

and enable the improvement of human creativity, especially as some researchers in the areas of economics, engineering, and education, are speaking of a creativity crisis looming (Jones, Van Reenen, & Webb, 2017; Terkowsky & Haertel, 2016; Kim, 2011). Interest in increasing creative performance comes from organizations, educators, and private individuals, who all want to improve and foster creativity in order to achieve professional and personal success, and a high social standing (e.g. Zhang & Bartol, 2010).

Creativity has traditionally been a difficult term to define. Throughout the history of human thought on creativity, it has been perceived as either an effect of a godly intervention, or, with the advent of religious skepticism, a sign of an individuals' special giftedness. But alongside the development of studies of creative behavior and creative production, came an understanding that creativity is a basic cognitive process (e.g. Csikszentmihalyi, 1999; Sawyer, 2011; Gaut, 2010), and as such can be nurtured, practiced and improved (for review, see: Scott, Leritz, & Mumford, 2004). Recently, more focus is paid to the relationship between creativity and affective states. Several studies show that creative thinking performance is mood dependent (Callaghan & Growney, 2013; Chermahini & Hommel, 2012; Forgeard, 2011; Ritter & Ferguson, 2017; Yamada & Nagai, 2015, for a review, see: Baas, De Dreu & Nijstad, 2008). This implies that the creative thinking processes can be actively promoted on a short time basis, and further measured through divergent thinking tasks.

A 1993 study by Rauscher, Shaw and Ky sparked large public and scientific interest in exploring music's beneficial influence on cognition. The results received considerable attention in media and became widely known as the 'Mozart effect', since the result of improved cognition was largely attributed specifically to the clever music of a genius individual. Further studies established that other types of music do influence cognition in advantageous ways as well, and that the enjoyment and engagement with that music might play an important role (Nantais & Schellenberg, 1999). Hence 'Mozart effect' can be explained by the perceiver's mood and arousal level (Thompson, Schellenberg, & Husain, 2001). Despite the extensive research of music's impact on both musical and non-musical cognitive abilities, relatively little focus has been placed on music's ability to influence *creative* cognition. However, studies of creativity have recently included music as a possible divergent thinking activating tool. For now, the prevailing theory is that the music can enhance creative performance through its mood-inducing properties (Adaman & Blaney, 1995; Ilie & Thompson, 2011; Yamada & Nagai, 2015), and that music of positive valence can aid divergent thinking (Ritter & Ferguson, 2017).

Another area that has received little research attention is the early development of creativity, even though the advantages of such research would seem to be numerous. We still know little about where lie the origins of creativity, and how it emerges in toddlers. Children demonstrate that they are able to think creatively at a quite early age. We might argue that their flexibility of thought and the ability to use newly possessed knowledge are signs of their creativity. It has been observed that creative thinking production can be improved in children by specific instructions, or by practice (Ju Lee, Bain, & McCallum, 2007; Dziedziewicz, Oledzka, & Karwowski, 2013), although children in such studies are usually in the primary school age (e.g. Bateson & Martin, 2013; Zosh et al., 2017), with only few studies that involved children younger than 4 years (e.g. Dziedziewicz et al., 2013; Subbotsky, Hysted, & Jones, 2010). Most recently, the development of a new way of measuring divergent thinking in children has allowed further insight into the early creative thinking processes (Hoicka, Bijvoet-van der Berg, Kerr, & Carberry, 2013). Based on preliminary studies, children express creative behaviors in specific, often social contexts (Hoicka, Powell, Knight, & Norwood, 2018; Hoicka et al., 2016).

Music is a social and cultural creation that plays an important role in the early social life of humans as a part of enculturation (Hannon & Trainor, 2007). Music is also known to influence a large number of cognitive abilities, thus it is valuable to explore its' potential to influence creative thinking as well. Children are inherently musical from their early infancy (Trehub, 2001; Bergeson & Trehub, 2002), and even in the prenatal stages of their development (Virtala & Tervaniemi, 2017; Virtala, Huotilainen, Partanen, Fellman, & Tervaniemi, 2013). They are able to process basic features of music such as relations between pitches (Trehub, 2000; Trehub, 2001) and temporal patterns of melodies (Drake & Bertrand, 2001), which allows them to enjoy music and engage in musical behavior. There are some noted parallels between music perception of infants and adults (e.g. Trehub, 2000; Trehub, 2001), and since music of positive valence has been argued to increase divergent thinking in adults, this implies that happy music could have an influence on children's divergent thinking as well.

1.1 Aims of the study

The aim of this study is to investigate empirically the potential for music to be used as a creativity enhancing strategy for preschool children. I hope that my study will contribute to the general knowledge on creative processing in young children and enrich our understanding of music's potential in improving cognitive abilities. Despite extensive research on music's positive impact on intellectual,

social and developmental abilities in children, music takes very little space in the kindergarten and school education. In 10 years of Norwegian primary education ('Barneskole' and 'Ungdomskole'), only 370 out of a total of 7.762 school hours are reserved for music, which makes it the third least taught subject (after 'second foreign language' and 'food and health' education)[2]. That situation should be improved, and any new evidence of music's potential to enhance creativity might be helpful.

1.2 Outline of the thesis

The first chapter of this thesis (Introduction) presented the main concepts and findings within research into creativity, developmental psychology and affect in music that are relevant for the investigation of the relationship between music and creativity in children. The purpose of Chapters 2, 3 and 4 is to present in more detail the theoretical and methodological approaches within each of the relevant study areas, i.e., creativity, developmental creativity, the relation between creativity and mood, the relation between music and mood, and music's influence on non-musical abilities. The State of the Art chapter (Chapter 5) will give a detailed presentation of the methodologies and findings within the research into the music-creativity relation that provide the direct information to form the basis of the experimental design for my study. Chapter 6 will present the methods and the results of my study, and the possible explanations for the observations of the study and considerations for future studies will be discussed in Chapter 7. This chapter will end with Conclusions part, where all the findings will be restated.

[2] Information according to: http://www.skoledata.net/Planer/Kulo/Fagogtime/kap2.htm, accessed: 22.05.2012

2 Creativity: History, philosophy, and psychology of creativity

In its most general sense, creativity means the ability to form significant new ideas, methods, forms or interpretations, or in simpler terms, it means the production of novel and useful responses (e.g. Batey, 2012; Runco & Jaeger, 2012; Feldman, Csikszentmihalyi, & Gardner, 1994). Creativity is often used interchangeably with the terms originality, progressiveness, or imagination, and is applied in various domains of human activity, from history and the arts to science and technology, by both experts and laymen. The most emblematic of the creativity-describing terms is originality, suggesting that creative ideas are novel, infrequent and uncommon (Guilford, 1967; Amabile, 1996). However, novel ideas might be simultaneously original and useless, and altogether more bizarre than creative, therefore "an idea is creative when it is original *and* appropriate" (Baas, DeDreu, & Nijstad, 2008, p. 9).

Creativity is a complex and multifaceted concept that has proven repeatedly to be difficult to define (Mumford & Gustafson, 1988; Simonton 2003). The understanding of what creativity means has significantly changed throughout the history of Western culture. In the ancient times, creative production was limited strictly to artistic expression, and was believed to be inspired by gods. During the Renaissance, the idea of a hereditary capacity for creativity emerged (Dacey, 1999, p. 310), but more recent times have brought about a great transformation of the view on creativity. Now creativity has been acknowledged as a complex interaction between biological, psychological, and environmental factors. It is important to note that all humans in all cultures are and always have been creative, however this thesis focuses on Western views of creativity. The non-Western views (e.g. of the Taoists, Buddhists, Confucius, and of the Hindus) are less consequential for this discourse, as they vary substantially in their understanding of creativity from the theories of creativity of Western thinkers (Kearney, 2009, p. 425).

2.1 Historical background

Both ancient Greeks and Romans perceived creativity as a gift bestowed on humans by the gods. As argued by Plato, a poet is "never able to compose until he has become inspired, and is beside himself, and reason is no longer in him" (Plato, trans. 1961, p. 534b3-5). The ancient Greeks believed

that a human must submit oneself to the gods and their laws to be able "to make" (*poiein*) poetry, and believed that the mind has two separate chambers, where one is filled by the gods with creative ideas, whilst the second allows to express the godly inspiration through speech and writing (Jaynes, 2000). Since all creativity was an effect of godly interference, the poets were allowed to create as they wish. The Romans extended creativity onto painters, and invented a Latin term especially designated for "creating" (*creatio*). That meaning of the word is further used to describe the Christian God's creation of the world. When it comes to human creative production, Romans believed that all that is made was not only dependent on divine inspiration, but also restricted by a set of rules, as all that is new was supposed to be generated with the intention of glorifying God (Kearney, 2009).

Together with the development of new and more advanced techniques in writing, painting and music, came an understanding that humans have the potential to be creative. In the Renaissance, the Church's influence diminished and this allowed artists not only to gain new patrons and venues to perform their art, but also to use their increased motivation to create new works and take pride in their creation. Still, in the domain of the written word artists had not yet gained the agency of owning their own work until the term *create* was used by the 17th century poet and theoretician of poetry, Maciej Kazimierz Sarbiewski in his treatise *De perfecta poesi*, where he wrote that a poet "creates anew". At that time, creativity was still used exclusively in relation to arts, although that definition would later expand during the Enlightenment (Kearney, 2009).

Cogito, ergo sum, wrote Descartes in 1637 to challenge human acceptance of external authority over internally obtained certainty. His thoughts echoed through a Europe torn by religious wars, a direct result of Martin Luther's exercise in critical thinking on the state of the Christian religion (Bayer, 2008, p. 69-70). Traditional religious and cultural paradigms shifted and humans gained confidence in their abilities coming from within rather than from above. The scientific work of, among others, Galileo Galilei, Nicolaus Copernicus and Isaac Newton, contributed to a new perspective on creativity. Kant in his *Critique of the Power of Judgment* (Kant, 1790/2000, sec: 43-50) linked creativity to imagination, a connection that heavily influenced romanticism's understanding of this phenomenon, and which is still seen in the popular conceptions of creativity that we have today. At the same time, Kant maintained Plato's attitude that creativity cannot be explained, as there are no rules for the production of beautiful art. In Kant's position, art remains the domain of a genius who is unable to explain where the ideas come from (after: Gaut, 2010).

The systematic study of creativity began with William Duff (1767) and his investigation into the origin of the differences in creative abilities of different people. Francis Galton (1869) was the one who, for the first time, applied scientific methods in studies on the nature of creativity. Galton studied individuals he deemed *geniouses*, and used statistical analyses to compare cognitive capacities among individuals. He observed that a distinction exists between conscious and unconscious thoughts, and he based two of his main conclusions on that observation: (1) conscious thoughts are organized and cyclical, and (2) conscious thoughts are linked to unconscious thoughts through associations. The German theorists of the Gestalt school of psychology opposed that view. In their understanding, creativity was the result of a formation of mental form or patterns (*gestalts*) (Koehler, 1970). The creative thoughts about a problem would originate either in the conscious or the unconscious mind, and a problem could be solved by finding the organizing principle (gestalt) of those insights. However, the great turn in the perspective on creativity came with William James's *The Principles of Psychology* (1890). James was the first scientist to explore the influence of both nature and nurture on creativity. That new perspective opened a new area of research that focused on the potential mechanisms of stimulating creative performance.

The establishment of psychology as a branch of science in the 20th century and the development of its methods allowed research on creativity to become more specialized. The biggest change from the methodological perspective happened in the departure from qualitative, often retrospective studies based on the biographies and subjective individual experiences of special creative individuals. Instead, researchers turned their focus towards more disciplined and objective quantitative studies on the cognitive processes of creativity (e.g. Wertheimer, Kohler, Wallas), creative personality (e.g. Freud, Maslow, Rogers) and strategies for creativity (e.g. Osborn, Crawford, Eberle; after: Gaut, 2010; Kearney, 2009).

Different categorizations of creativity appear in psychological research, but a detailed description of all of them would be outside the scope of the present thesis. In general, studies can be classified according to cognitive, personality, developmental and social sources (e.g. Gardner, 1988; Sawyer, 2011; Simonton, 2000). The systematic studies on creativity are present especially within psychology research, and the next chapter describes the development of systematic studies on creativity and philosophical issues that have not yet been thoroughly addressed.

2.2 Modern philosophical perspectives on creativity

Even though historically important philosophers like Plato or Kant had something to say on the matter of creativity, this subject has been rather ignored in modern philosophic discourse. In an address to the American Psychological Association, Joy Paul Guilford (1950) pointed out the neglect of the subject of creativity by psychologists. Guilford advocated for the systematic study of creativity within psychology. His plea was answered in the development of many new significant theories of creativity and an abundance of studies. Different strategies and approaches were applied in research on creativity, including psychoanalytic, cognitive, computational, Darwinian, sociocultural and personality studies. Despite a growing amount of data on creativity coming from both laboratories and studies of historical works, philosophers have mostly ignored this material (Gaut, 2010). Most notably, Henri Poincaré provided an introspective report of his own experience of creativity (Miller, 1992). He described it in terms of swarms of ideas randomly moving and combining in his unconsciousness to be selected by their potential for usefulness according to aesthetic criteria (Poincaré, 1910). That theory had a direct influence on Graham Wallas' theory of four stages of creative process consisting of the stages of preparation, incubation, illumination and verification (or elaboration) (Wallas, 1926).

Berys Gaut (2010) in his survey of the central issues in the philosophy of creativity, has observed that theories formed by psychologists raise interesting philosophical questions about creativity, which he lists in four examples. Firstly, from a moral philosophy, epistemology and aesthetics perspective, the most important question is whether creativity is a virtue. Linda Zagzebski not only sees it as a virtue, but as a "stellar virtue" (Zagzebski, 1996, p. 167). This point of view connects to the psychological research of what constitutes a creative person. Gregory Feist, for example, in his meta-analysis of 50 years of research into the creative personality, summarizes that creative people are often "open to new experiences, less conventional and less conscientious, more self-confident, self-accepting, driven, ambitious, dominant, hostile, and impulsive" (Feist, 1999, p. 290). Clearly, some of those characteristics are identifiable rather as vices than virtues, which proves that the subject of morality and creativity is a mixed one and that the separation of intellectual and moral virtues might be necessary to protect the claim of creativity as a virtue. The problem might also lie rather not in creativity itself, but rather in the motivation of the creative individual, as according to Aristotle (1105a33-4)- the virtuous person decides on their own actions, and if they are virtuous or not.

A second important consideration named by Gaut is the issue of the rationality of creativity. Already Plato argued that creativity happens when rationality is abandoned, and linked it to madness (Plato, 1961). This is an association that recurs throughout history, and was recently challenged by e.g. Jon Elster, who sees creativity (understood as an artistic production) rather as a matter of rational activity of increasing value subject to constraints (Elster, 2000, p. 175-269). This view has received some criticism, as for example Levinson argues that artists find value in violating constraints as much as adhering to them. Artists are also more likely to suffer from all types of mental disorders than other professions (Ludwig, 1992). Bipolar disorder is heavily associated with creators, with such popular names like Mariah Carey, Demi Lovato, Kurt Cobain, Jimi Hendrix, Frank Sinatra, Sinead O'Connor, and many others rumored to have this diagnosis (WebMD, 2020). Some psychologists argue that "sane" forms of irrationality are beneficial for artistic creativity (e.g. Simonton, 1999, p. 94-104). Gaut pleads for a reconsideration of the claims for the rationality of creativity in view of that finding.

A third issue is whether creativity is "blind". Some theorists argue that the creative process consists of two stages: a "blind" stage when ideas are generated, and a further stage ("ideation") when the most promising ideas are selected for further use. The term "blind" here implies that ideas are generated at random. Campbell (1960) questions the idea of blindness in the creative process. The meaning behind this term varies between different formulations of the theory, and sometimes it implies randomness, and sometimes it is associated with *creative discovery* (Campbell, 1960).

A fourth issue that needs to be revised, according to Gaut, is creativity's opposition to tradition. What is creative is commonly judged as contrarian to what is traditional, but philosophers have argued that the tradition within a domain is necessary for creativity in that domain. Products of creativity are often judged by a field of experts using standards conditioned historically within that creativity domain (e.g. Amabile, 1996; Csikszentmihalyi, 1999; Sawyer, 2003), which gives creativity and creative products social relevance. In Gaut's opinion, even though the sociocultural theory of creativity is closely connected to claims about the important relations of tradition to creativity, it has not been properly considered by philosophers. The relation between tradition and creativity has become ever more complex in the area of global art market structures, social media and corporate entertainment providers.

Philosophers, sociologist, historians, and art critics are trying to answer the question of creativity's importance and place in society. The term creativity still refers to arts or eminent people, but not only. It refers to all people and multiple domains as well. In a postmodern creative society,

creativity is identified with culture, and is "that which allowed the society or civilization to rise above the others" (Kačerauskas, 2015, p.27). It is understood in both narrow and broad senses. In the narrow sense, it applies to the professional activity of an individual within society, while the broad sense refers to social creativity, that – among other dimensions – includes searching for an improved and happier existence and stability. Both historical actors and social theoreticians considered the importance of creativity, treating it as a measure of civilization, since creative advantage of a society assures its persistence in the world as well (Kačerauskas, 2015). Psychology offers a different perspective, as in the center of its pursuit is to answer "how?" creativity happens. In his meta-analysis of the research on creativity, Richard E. Mayer (1999) points out that a combination of research methodologies and perspectives is necessary in order to have a comprehensive understanding about what creativity entails and where it originates. His recommendation is an interdisciplinary approach that combines methodologies from the disciplines of psychology, neurobiology, artificial intelligence, and others. The model of "four-Ps" creativity developed by Rhodes (1926) represents one of the most common perspectives applied in psychology studies on creativity, and will be reviewed in the following chapter of this thesis. The observations made within those studies are crucial for understanding the influence that mood has on creative performance.

2.3 Creativity from a product, person, situation, and process perspective

Creativity is ubiquitous. We see creativity in everyday cleverness, especially among children, as it entails learning and everyday innovations, such as finding a better system for stacking the dishes in the dishwasher, or finding a new, faster way to work. We see creativity in the art and sciences, with a never-ending stream of new compositions, instruments, methods, theories and concepts. Creativity is also apparent in entrepreneurial innovations and technologies, like personal computers, smart phones, or fitbits. Creativity happens in social interactions, most recently especially through social media and an array of different apps. Creativity is also present in policy-making and education, with politicians reaching for novel ways to assure the effectiveness of their policies, e.g. by establishing Behavioural Insights Team, aka the "Nudge Unit" formed by the United Kingdom government[3].

[3] Now an independent social purpose limited company since 2014, https://www.bi.team/about-us/

One of the reasons why creativity is a difficult concept to define is that it has several functions. It facilitates our ability to adapt to changes in our environment, helps us when we deal with challenges and threats, but also when we use the opportunities of everyday life (e.g. Runco, 2004). Creativity is also crucial for organizational effectiveness and survival (Woodman, Sawyer, & Griffin, 1993). At the evolutionary level, creativity helps to achieve functional goals, like attracting mating partners (Griskevicius, Cialdini, & Kenrick, 2006). To summarize, creativity allows humans to survive, adapt, and prosper.

Research on creativity has established its own place among the traditional sub-areas in psychology, along with social, organizational, personality, cognitive, clinical and child psychology. The four most common perspectives within studies of creativity are (1) a focus on creativity as a cognitive *process*, (2) a focus on creative individuals (*persons*) and their personal characteristics, (3) a focus on *products* of creativity, and (4) a focus on the situational *factors* that influence creativity, understood as the interaction between the creative individual and the environment. The basis for this distinction of perspectives dates to Graham Wallas (1926) and his four-stage model of creative production: a preparation stage, an incubation stage, an illumination stage, and a verification stage. This model was later a basis for James Melvin Rhodes' four-Ps approach to creativity (1961, p. 305-10), in which creativity exists between four domains: *persons*, *process*, *product*, and *press.* Rhodes' approach was holistic, and well represents the attitudes of other, more recent studies that tend to treat creativity as a multidimensional phenomenon that requires interactive examination (e.g. Csikszentmihalyi, 1999), but one that can be studied, measured and manipulated as any other cognitive process (e.g. Alexander, Parsons, & Nash, 1996). This is highly relevant for this thesis since the investigation into the potential of mood for increasing creativity draws from different perspectives on creativity.

From the *creative product*, or "end-state" perspective, creativity is perceived in the product of creativity, and this product is evaluated for its novelty and usefulness (e.g. Runco, 2004). The products may differ extremely from one another, since they include such grand creations as Mahler's *Symphony No. 2*, Dante's *Inferno*, Einstein's *General Theory of Relativity,* but also any original solution to an everyday problem. The product perspective includes also the type of studies that try to assess the quality and quantity of works of, for instance, classical composers (Simonton, 1987; Corazza, Agnoli, & Martello, 2014) or, in the case of scientific and scholarly production, the number of citations as a measurement of quality (e.g. Simonton, 1992, 2003).

A variety of tests have been developed in order to measure creative ideas, insights, and products. In case of artistic products, such as poems, stories, or buildings, usually expert creativity ratings are used to assess the creativity of those creations (Hocevar & Bachelor, 1989; Simonton, 2003). When it comes to ideas and insights, researchers usually ask participants to generate ideas within a certain topic, and further rate them according to their sheer volume and rarity (Lamm & Trommsdorff, 1973). Another way of measuring creativity is to present participants with a problem that can be solved with only one correct solution. These kinds of problems typically require a mental reconfiguration and restructuring of problem information, which results with a sudden understanding of how to solve the problem (Gilhooly & Murphy, 2005). These different creativity measures will be discussed in more detail later in the thesis.

From th*e creative person* perspective, creativity is seen as a trait characteristic of a person. When we think about creativity, often individuals come to mind, either historical figures like Wolfgang Amadeus Mozart and Maria Skłodowska-Curie, or people prominent in our present time, like Kate Bush and Mark Zuckerberg. One of the purposes of research on creative people is to understand the development and career trajectories of creative individuals (e.g. Simonton, 2003; Csikszentmihalyi, 1996). Many useful ideas about creativity come from this type of research. For instance, Vivien Perutz, daughter of Novel Laureate Max Perutz, wrote that whichever activity her father was performing, his "mind would always be occupied by the latest problem… His approach was that of Isaac Newton who, when asked how he made discoveries, answered: By always thinking about them. I keep the subject constantly before me (...)" (Ferry, 2007; p. 224). The same approach we find in Thomas Edison. One of the most productive inventors and holder of over 1000 patents is reported to have said that creativity is 1% inspiration and 99% perspiration (Baas, 2010, p. 15). Such anecdotal observations can become a basis for studies, for example into the strategies of increasing creative performance, designed and carried out under strict and controllable conditions.

As a result of the studies on creative individuals, a profile of the characteristics typical for a creative person has been established (Simonton, 2003; Feist, 1998). According to the general observation, creative scientists and artists are less conscientious and more willing to try new experiences, more intuitive, autonomous and hostile (e.g. Barron & Harrington, 1981; Feist, 1998). Investigations into the cognitive abilities of creative people show that they are intelligent (Barron & Harrington, 1981), have increased ability to notice details that others might deem "irrelevant"

(Eysenck, 1993) and have flat associative hierarchies, which means that they are more often able to perceive distant and remote associations to any given stimuli (Simonton, 2003; Mednick, 1962).

There is also evidence that highly creative people are more prone to psychopathology. For instance, there is a link between creativity and traits underlying the disposition to develop psychoticism (Eysenck, 1993). When it comes to mood disorders, mild hypomanic or euphoric states (often related to bipolar disorder) are associated with higher levels of creativity (Shapiro & Weisberg, 1999). One probable explanation of this association might lie in an increased fluency of work (greater output in those states) and tendencies towards over-inclusion (less harsh judgment towards creation; Shapiro & Weisberg, 1999).

Studies on the career trajectories of creative individuals have observed them to be more motivated, highly goal-oriented, and with a great amount of persistence (Simonton, 2003). Just a sheer output quantity can be an appropriate predictor of the impact a single creator can have on her discipline, but as observed by Simonton (2003), there are some noteworthy exceptions to that theory. For instance, the highly influential, but relatively small list of compositions by Anton Webern, whose music became – in the words of such composers like Pierre Boulez and Karlheinz Stockhausen – a cornerstone for a new epoch. However, the lists of the most popular and influential composers of all time include names like Johann Sebastian Bach, whose legacy consists of over 1100 compositions. Another often mentioned composer, Ludwig van Beethoven, is known for over 700 compositions. Wolfgang Amadeus Mozart, despite having a shorter life span than the two previously mentioned composers, left behind around 600 musical pieces.

Studies that adopt a *creative situation* perspective target the situational factors and circumstances that are beneficial or detrimental to creativity (Amabile, 1983), focusing on the nurture aspects of creativity processing. Research within social and organizational psychology has focused on finding different variables that can influence creative performance. It has been established that increased levels of interest in the creative task and motivation lead to more creative output (e.g. Amabile, 1996). For instance, when rewarded specifically for original thinking, individuals display a higher degree of involvement in the creativity task, and generate more creative answers (e.g. Eisenberger & Rhoades, 2001). Examples of different situational factors that have been linked to creativity include motivational states and activation of global processing that facilitates more remote associations (e.g., Mehta & Zhu, 2009). But one of the least debated and most broadly recognized situational factors that have an impact on creativity is mood. Mood is highly relevant for this thesis,

since the main idea is that music may increase creativity through its effects on mood. This will be discussed in more detail in the Chapter 3 of this thesis.

Finally, the *creative process* perspective includes those studies that focus on examining the possible paths that lead to creation of ideas, solutions, discoveries, and other creative products (e.g. Mumford, 2001). Creativity in this perspective is understood as inherent to all human cognitive function, in opposition to the person perspective which regards only a few brilliant individuals as creative. Such everyday creativity can be expressed in the flexibility of language, in our ability to mentally manipulate objects, or in our ability to find new mental categories to organize our experiences (Ward, Smith, & Finke, 1999). One of the findings within studies on creative process is that an incubation period, when an individual is not actively thinking about the issue she is presented with, can enhance creative problem solving (Sio & Ormerod, 2009). The argument is that the inactivity in the initial stages of the attempt to solve the problem facilitates creativity due to the weakened fixation on potentially incorrect strategies. That, in turn, allows an individual to obtain a fresh view on the matter (Smith & Blankenship, 1991). With that fresh perspective, a reorder of information is possible and the correct solution pops up (Duncker, 1945).

One of the most prevailing findings on the process of creativity is that it involves two different thinking processes. On one hand, it requires flexibility (divergence), and on the other persistence (convergence). I will elaborate more on those two important aspects of creative thinking later in the next section of the thesis.

Although the four perspectives on creativity in research often involve different approaches and methods, they can be integrated in order to obtain a fuller picture of creative production (Amabile, 1983; Runco, 2004; Simonton, 2003). Baas, DeDreu, and Nijstad (2008) and colleagues presented, in a series of studies, a Dual Pathway to Creativity Model (DPCM, see Figure 1) which includes the most important perspectives on creativity. DPCM identifies two outcome variables of creativity: originality and creative fluency, since creative products are often assessed in terms of their uncommon and original features (Amabile, 1996; Guilford, 1967), but at the same time the sheer number of ideas, insights or solutions is considered as well (e.g., Torrance, 1966). Creativity can be achieved through enhanced cognitive flexibility or enhanced persistence. Flexibility, associated with cognitive divergence, involves broad cognitive categories, global processing of information and flexible switching among categories or approaches (e.g. Ashby, Isen, & Turken, 1999). Persistence, in the other of the spectrum of creative processing, is associated with cognitive convergence, and involves

prolonged effort and focused exploration of a few potential solutions and perspectives (Rietzschel, Nijstad, & Stroebe, 2007). According to the DPCM, cognitive activation and engagement is needed for the cognitive flexibility and persistence pathways to be activated. The activating variables might be either dispositional (connected to personality) or situational, and they might influence creative processes in different ways. When it comes to mood states, which have been shown to have an effect on creativity, the relation is complex. Some moods are activating for cognitive flexibility, while others activate cognitive persistence, and therefore we need to look more closely at the two cognitive thinking processes in question.

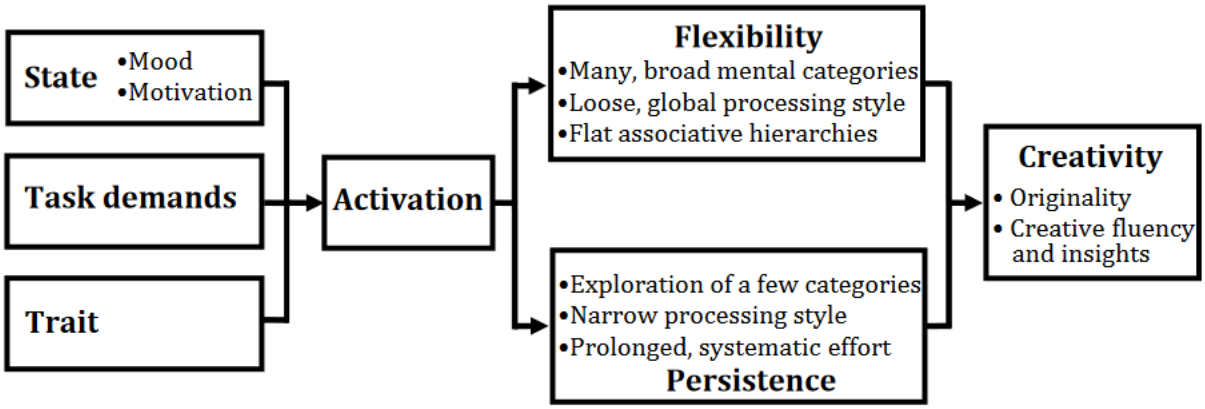

Figure 1: Dual Pathway to Creativity Model, taken from Baas, 2010, p. 14

2.4 Creative thinking: Divergent and convergent creativity

In 1956, Guilford presented his conceptualization of creative thinking processes by introducing his Structure-of-Intellect Model, where creativity is linked to intelligence, and treated as a basic mental function. Guilford considered creativity as a form of problem-solving and distinguished between two types of cognitive operations: divergent thinking and convergent thinking. The theory was adapted and expanded further by Ellis Paul Torrance, and the majority of creativity research has built on it. Divergent thinking is basically a process of generating a broad spectrum of alternatives within one issue or area of interest, and is associated with cognitive flexibility (Guilford, 1956; Torrance, 1977). In

the words of Guilford himself, divergent thinking is the type of thinking that "goes off in different directions" (Guilford, 1959, p. 381).

Convergent thinking, on the other hand, is a process of extracting the most logical solution to a problem, and it is most dependent on existing knowledge, and is associated with cognitive persistence (Cropley, 2006). It emphasizes accuracy, control, logic and decision-making strategies, while divergent thinking emphasizes transformation of the information into unexpected forms. Guilford characterizes divergent production to be more relevant to successful creative thinking (Guilford, 1975). Divergent thinking is most often regarded as true creativity, because it allows the mind to wander in search of many possible ideas/solutions. In some creative tasks, if we focus on targeting one correct answer, the solution we might come across will be correct, but possibly not as creative as to make it valuable. Some researchers point out that creativity can be only fully expressed through both unconventional thinking and the ability to arrive at the most effective and relevant ideas at the same time (Cropley, 2006; de Rooij & Jones, 2013; Runco & Jaeger, 2012). However, the two separate processes of creative thinking are still prevalent in creativity studies.

The difference between divergent and convergent processing is empirically noticeable at the neural level as well, as observed in the last two decades of neurological research into creative thinking processes. It is suggested that during mental operations of convergent thinking, neuronal assemblies interact between different brain areas in a more spatial-temporally limited capacity in comparison to divergent thinking (Razoumnikova, 2000). In an EEG study (where the electrical activity of the brain is measured through electrodes on the participant's scalp), divergent thinking was correlated with greater complexity of the EEG signal, which was explained as "the result of the concurrent activation of a greater number of independently oscillating processing units" (Mölle, Marshall, Lutzenberger et al., 1996, p. 64). The EEG connectivity of two areas is often taken as a good measure of the neuronal cooperation produced by mental exercises, and in comparison to other mental tasks, the acts of creative thinking are linked to a greater connectivity between the occipital and frontal cortices (Razoumnikova, 2000). Researchers have also investigated if any lateral dominance is associated with creative processing, and they have stated with fair certainty that the right hemisphere of the brain is specialized for creative task performance (e.g. Bhattacharya & Petsche, 2005; Jung-Beeman et al., 2004). However, contradictory evidence has also been presented (e.g. Razumnikova & Bryzhalov, 2006). In a literature review, Fiore and Schooler (1998) found evidence for the relative dominance of the right hemisphere in the context of problem-solving tasks. In their view, the right hemisphere is more

specialized to explore and to find new possibilities, while the left hemisphere is more likely to conduct negative or positive transfers of previously acquired knowledge to a new problem.

The lack of the consensus on the exact characteristics of creative thinking processes in the brain might be related to the limitations of the neurological method of inquiry. The conclusion of the abovementioned studies come from EEG and fMRI (functional magnetic resonance imaging) data, acquired in laboratory settings using tasks designed to activate and measure creativity. The choice of the correct test is crucial for observations of creativity, since different tasks can create different levels of activation, and might stimulate different types of creative processing. Any study of creativity is heavily reliant on the appropriate creativity measurement selection. Therefore, in the next part of the thesis, the different methodologies and approaches to measuring creativity will be presented and discussed.

2.5 Creativity measurement

The beginning of systematic studies of creativity dates back to the late 19th century, but a common definition of the term was never agreed upon. Treffinger (1996) lists more than 100 different definitions of the concept of creativity. Some studies avoid providing a definition of creativity at all (e.g. Kaufman, Plucker, & Russell, 2012), while some others use the term creativity loosely, applying terms like innovation, invention, imagination, talent, giftedness and intelligence interchangeably (for the review, see: Said-Metwaly et al., 2017). Just as no common definition of the concept was ever agreed upon, a variety of different tools and methods for measuring creativity have been established.

The approach focusing on the *process* of creativity dominates across the majority of published studies. In such studies (for a review, see: Said-Metwaly et al., 2017), creative performance is usually assessed with divergent thinking and idea generation tasks, insight tasks, and general creativity performance tasks. The creativity scores assigned in each task are dependent on the nature of the task itself, and each such score is generated through measurement and analysis of the responses generated while completing the task. The measurement is expressed in fluency, flexibility and originality scores, performance on insight tasks, and composite creativity.

The divergent thinking tests and ideation tasks are open-ended and often contain problems designed to evaluate the ability to form multiple alternative answers. The most widely used divergent thinking test is the Alternative Uses Task (AUT). The AUT is an open-ended test, in which participants

are asked to name as many different possible uses for a common object or a series of objects (e.g., a brick, shoe, or newspaper; after: Martindale & Mines, 1975; newspaper, knife, automobile tyre, button, shoe, key, cork, chair, Wallach & Kogan, 1965). The responses, e.g., different ideas about using a brick, are scored according to their Fluency, Creativity, Originality, Usefulness and Cognitive Flexibility (Guilford, 1967; Torrance, 1966).

The fluency score refers to the sheer amount of different ideas with no regard to their quality. For instance, applications of a brick in building something, like 'build a wall', 'build a house', will not be rated lower than examples from less conventional categories, like 'stepping stone', 'frying pan'. The originality score refers to the rarity of ideas, where the more uncommon solutions reflect an ability to find new ways of approaching a problem and independence from routine. In the case of original applications of a brick, using it as an instrument will be scored higher than using it to build something (a wall or a bench). The flexibility score refers to the amount of different semantic categories represented by the ideas and reflects one's ability to switch approaches. For instance, someone who is asked to name many uses for a brick might receive higher flexibility scores if his/her answers contained not only different examples of building with a brick (e.g. house, wall, path), but using it as a kitchen tool as well (e.g. pan, plate, potato masher). Some other tests include scores of elaboration (amount of detail; Mednick, 1962), so that the emphasis is put not only on the quantity, but also on the quality of the responses (Silvia, 2008). Some of the other tests that are used for measuring divergent creativity performance and target creativity-relevant skills include the Wallach-Kogan Creativity Tests (Wallach & Kogan, 1965), the Torrance Tests of Creative Thinking (TTCT; Torrance, 1966), and the Creativity Assessment Packet (Williams, 1993).

It is important to note that the scores of fluency, originality and flexibility are not the same. Someone who is fluent in idea production and came up with ten or more ideas, might produce less original ideas than someone who produced only two. Similarly, some might produce many original ideas within one category, while others might produce fewer original ideas across different categories. Each of these score types is assessed separately, and they reveal different components of creative performance.

Convergent thinking or creative problem-solving tasks have only one demonstrably correct solution (Simonton, 2003). They are often called insight or eureka tasks, and typically require a mental reorganization of the given information that can lead to finding the result (Gilhooly & Murphy, 2005). One of the most famous tests is Duncker's (1945) candle problem in which participants are faced with

the problem of attaching a candle to the wall by using only a few given objects and with the restriction to not spill the dripping wax on the table or floor. The correct answer to the test can only be realized if the participant recognizes the possibility of multiple uses of a matchstick box. Such a box, which stores matchsticks in its basic application, can be attached with a pin to the wall to support the candle as well. Another type of insight test is the Remote Associates Task (RAT, Mednick, 1962), and other similar analogy and anagram tasks. The RAT is designed to assess one's ability to identify nonobvious associations between three separate words, e.g. *cottage, swiss,* and *cake*. Participants are instructed to provide a fourth word related to all three words (in this example, *cheese*). In the RAT, only one possible answer is the solution to the problem, and in that it correlates with classic insight problems (e.g. the candle problem) and anagram solving (Mednick, 1962), where participants have to break and reconstruct the presented material to be able to identify the various attributes of an item (word, letters, or an object).

There is an ongoing discussion on the validity of tests measuring creativity. When it comes to divergent thinking tests, some issues emerge in case of the originality score. The weakness of this particular score is that it might be purely dependent on the sample size. As the research sample increases, the originality of any single response will become diminished, since the probability of repetition rises (Silvia, 2008). In addition, divergent thinking tests emphasize only the ideation phase of the creative process, neglecting the phases of problem analysis, evaluation and implementation, since the test participant never has to judge and use the creative responses generated during laboratory testing, in opposition to typical real-life creativity outcomes (Lubart, 2001; Zeng, Proctor, & Salvendy, 2009). In the case of convergent tests, like well-defined ill-structured problem tests (e.g., the candle test), they might have little in common with real-life creativity tasks, and a rating of the creative performance of one individual in this kind of test, might not only misrepresent their actual creative abilities, but even show lower creativity levels than this individual typically displays in daily life (Moreau & Engeset, 2016). It is also possible that different participants of such tests might produce similar responses, although the level of everyday outcomes of their creative production might be entirely different. For example, a person who is very structured and less inclined for creative behavior might solve the candle test as successfully as an inventor.

In addition, it seems that divergent thinking skills and convergent thinking skills may be crucial for creativity each on its own, but alone cannot explain the full variation in creative achievement (Baer, 2016; Batey & Furnham, 2006; Runco, 1993). Therefore, David and Adam Cropley (2010) suggest a

model of creative processing where both convergent and divergent thinking take place in various phases of idea production, and argue that both divergent and convergent thinking tasks have to be used for achieving a more complete measurement of an individuals' creative potential. The two tests most commonly used for measuring creativity are the AUT and the RAT. Most researchers focusing on the divergent and convergent thinking dichotomy of creative processing come from an understanding that AUT performance reflects divergent thinking, and that RAT performance measures convergent thinking, but such a conclusion might be somewhat premature. To some extent, any type of creative test requires employment of both types of thinking. As convergent thinking contributes to idea production (Cropley, 2006), divergent thinking is necessary in the RAT as well (Lee & Therriault, 2013). Therefore, researchers have begun to more often apply both of these tests in their creativity-related studies, to achieve a fuller representation of an individual's creativity profile.

This perspective is relatively new, and should be validated by empirical research, but it creates some issues when research on the development of creativity is considered. Most of the tools measuring creativity are designed to be used in studies on adults. How creativity develops in children, and how it can be measured, are issues that require a modified approach and understanding of the physical and cognitive differences in children's creativity.

2.6 Development of creativity

Fairy tales are full of examples of creative, resourceful children, who due to their unconventional ideas rescue themselves or adults from life-threatening situations. In a story collected by the Grimm brothers, Hansel and Gretel use a chicken bone to confuse the witch waiting for the boy to get plump enough to eat him. Many artists recommend to behave like a child while creating, and even Freud compered a creative writer to a playing child (Freud, 1959), but historically, the association of the child as an artist would have been rather dismissed (Gardner, 1982). Some would agree that children can behave, act, play and talk in a creative way, but what kind of evidence for the creativity of the youngest children can we find in developmental psychology research?

The early development of creativity has not received much research attention, and thus our understanding of creativity in young children is quite limited. Children are naturally curious and explorative (Bonawitz, van Schijndel, Friel, & Schulz, 2012; Shneidman, Gweon, Schulz, & Woodward, 2016) and they are competent imitators (Meltzoff, 1985; Nielsen, Cucchiaro, &

Mohamedally, 2012). However, those behaviors can hardly be classified as creativity according to a traditional definition of the concept that is driven by "dichotomies between creative and uncreative, extraordinary, and ordinary, exceptional and banal, art or science and everyday life, art and craft, and so on" (Glăveanu, 2011, p.123). As Glăveanu points out, "there are strong ideological barriers safeguarding the realm of creativity against those who are deemed unable of 'true' creative expression" (Glăveanu, 2011, p. 123). If children are unable to create at the same level as geniuses and giants of creativity, their creativity is given a secondary role of "low-range creativity" (Sawyer et al., 2003, p. 219).

Therefore, in the view of some researchers, young children are not good innovators, and are considered to be unable to produce novel and useful products and responses (e.g. Cutting, Apperly, & Beck, 2011). Moreover, they are even seen by some as unable to contribute in any way to humankind (Sawyer et al., 2003). Studies that come to such conclusions are often based on creativity measured by a child's ability to solve an ill-structured problem, such as the floating object task (Nielsen, 2013), the hook task (Beck, Apperly, Chappell, Guthrie, & Cutting, 2011) or the loop production task (Tennie, Call, & Tomasello, 2009), rather than divergent thinking measuring tests. In the floating object task, the child is required to retrieve a toy placed in a tube by filling the tube with water. In the hook task a child has to create a hook out of a straight pipe cleaner in order to retrieve a bucket placed in a tube. Success rates in neither of those tasks can be linked to divergent thinking (Beck, Williams, Cutting, Apperly, & Chappell, 2016), but rather to prior experience with the tool (Whalley, Cuting, & Beck, 2017). Such studies rely heavily on problem-solving abilities and convergent idea production, rather than on divergent creativity behavior.

Children learn from others by imitation (for a review see: Wood, Kendal, & Flynn, 2013), which is commonly judged as a non-creative behavior, but they also are imaginative and join in pretend play (for a review see: Lillard et al., 2013). Children's inability to solve ill-structured problems seem to misrepresent their innovation skills, since they are not faced with such problems on a regular basis and are not aware of what the expected solution to the problem is (Mursic, 2019). Children were observed to employ different strategies in succeeding in a task that they understand the solution to, even if they are shown a possible solution that they can further use by imitation (Nielsen & Blank, 2011). When infants of 12 months and 18 months are presented with a task of placing a mouse in a toy house, they will achieve the end result without copying the specific moves of the researcher. However, they will

imitate those moves and not behave creatively, if the destination of putting the mouse into a house is not clearly presented to them (Carpenter, Call, & Tomasello, 2005).

To fully recognize a child's ability to be creative from the 4Ps perspective (Rhodes, 1961), a revision of the characteristics of creativity is required. From the product perspective, children's creations can be deemed as creative only to some extent. For instance, the way young children portray and talk about the world surrounding them generates curiosity in adults. Children can behave spontaneously, curiously, and unconventionally, awaking great amazement in their viewers (Glăveanu, 2011). They are able to more readily disregard social conventions and display 'freshness' of perspective in their drawings, for example. But at the same time, their ideas and expressions, although interesting, are often already known to us, and from a historical perspective bear less importance, if the standard ratings of creative products are applied. For example, Csikszentmihalyi remarks that "children often appear to adults to be original, imaginative, or nonconforming", but that one "could just as well interpret such behavior as ignorance of rules or inability to follow them" (Csikszentmihalyi in Sawyer et al., 2003, p. 220). However, it might be inappropriate to judge the creative product of a child by the same criteria as the one made by an adult. Runco (2007) calls it a 'product bias' that needs to be consistently addressed. It seems that children's creativity might be categorized as little-c creativity, valuable on a personal level and for the surrounding cultural environment the child exists in, and founded on imagination, curiosity and play (Mursic, 2019).

It seems it could be much more beneficial to treat the creative output of a child as similar to *performance* and *improvisation*. As Sawyer noted, "because performance, particularly in the more improvisational genres, is ephemeral and does not generate any lasting ostensible product, it has been easy to neglect", but that performance "may actually represent a more common, more accessible form of creativity than privileged domains such as the arts and sciences". Moreover, "if one recognizes that all social interactions display improvisational elements, then everyday activities such as conversations also become relevant to creativity theory" (Sawyer, 1997, p.2).

From a person perspective, the first issue concerns how the child as a person is defined in general. Historically, children are not perceived as persons, rather 'future' or 'becoming' persons (Glăveanu, 2011) and that their creativity is rather a precursor of later creative achievement (Dudek, 1973). The creative expression of a young child will change over the lifespan, as the individual progresses from childhood to adolescence and adulthood. Those biological and mental shifts involve *maturational processes,* that are either a reflection of changes in motivation for creative efforts, or they

may be the result of unfolding genetic potential (Runco, 2014, p. 40). According to Kohlberg's (1971) theory of development, at a young age, children are in a *preconventional stage*. They have yet to develop the understanding of conventions and develop an ability to use them. With the process of learning, children partially lose their disregard for conventions, and even show an appreciation for conventions in the middle elementary school ages (Runco, 2014, p. 41). There is a mix of nature and nurture factors that influence the development of a child's creative expression, but nurture factors are especially important for studies that focus on the creative situation perspective of creativity (as does the study performed for this thesis).

From the creative situation perspective, a child's creativity is very much supported by social interaction. Children are creative from an early age, as they have to relate to the constantly changing (from their perspective) circumstances of their everyday life. They make efforts to engage with the world around them and to influence it. They engage and influence the world through micro-interactions with parents, families, peers and teachers, and those interactions are driven by creative involvement on both sides, in a constant feedback loop (e.g. Kuczynski & Navara, 2006). The notion that children passively model the people around them was challenged by the observations that children "build in innovative ways on the structure of the culturally organized information that they experience in interaction with others and in their exploration of the man-made physical environment" (Valsiner, 1997, p. 176). From a biological stand point, children might be seen as naturally creative, but Torrance points out that innate creativity can be lost due to experiences of rejection, abandonment, cruelty, lack of love or an early loss (Torrance, 1981). On the other hand, there are many examples of people recognized for their creativity, who flourished creatively despite the adversities in their childhood, like Gustav Mahler or Eminem. Some studies show that a given genetic endowment and a well-balanced amount of assistance and misfortune may lead to high levels of creative activity (Therivel, 1998).

The process perspective, rather than a product orientation, seems to more adequately represent the creativity of a young child. There are many common traits in creative behavior of a child and of an artist, like openness to shed conventions and willingness to experiment in artistic production or play (Gardner, 1982). One major difference between an adult's creative process and that of a child is *intentionality* (Glăveanu, 2011). Creativity without intentionality can be the effect of an accident, and as Weisberg (1999, p. 243) states, "novelty brought about by accident would not qualify as creative, no matter how valuable the outcome". Even though an infant randomly banging on a piano might create music closely resembling the beginning of Schönberg's Op. 23, no. 4, it should probably be disregarded

by creativity researchers (Weisberg, 1993). However, that notion is based on a view that human beings are always *rational* and *goal-oriented,* which is not the case, and according to that view, some important discoveries should be discarded as non-creative, such as the discovery of penicillin, or adding a delay effect to the famous X-Files opening theme song with an accidental placement of an elbow on a keyboard (Pasternack, 2016). Moreover, if we include into the process perspective creativity as a result of both divergent and convergent thinking, it becomes clear that children, especially in their preschool years, are inherently divergent thinkers.

In the first years of life, children's creativity is expressed in the generation of ideas, while the ability to evaluate ideas appears later in their elementary school years (Zachopoulou, Makri, & Pollatou, 2009). This specialization towards convergent thinking can to some extent be explained by the steady increase of experiences and knowledge, and it also has its manifestation on the brain processing level (Kleibeuker, DeDreu, & Crone, 2013). A difference between child and adult processing of creative tasks has been observed at the neural level, specifically in terms of higher activity in the prefrontal cortex area (PFC) in the brains of adults (e.g., Giedd et al., 2004). It has been hypothesized that with the structural changes in the PFC, a functional change follows. For instance, in adults the PFC is more associated with the cognitive-control network (Dosenbach, Fair, Cohen, Schlaggar, & Petersen, 2008). Interestingly, adolescent children have been found to produce ideas scored evenly with adults in terms of fluency and flexibility (even despite having less knowledge and experiences than adults), but lower in terms of originality. A possible explanation for comparable fluency and flexibility scores is that when using what they know, children process with less inhibition, but that lack of knowledge and experiences diminishes their ability to target the more original responses (Kleibeuker, DeDreu, Crone, 2013).

Some studies have shown that divergent thinking in children can be enhanced by both short-term and long-term applied strategies. In some experiments, divergent thinking was optimized by giving children extensive practice in divergent thinking (Cliatt, Shaw, & Sherwood, 1980; Dziedziewicz, Oledzka, & Karwowski, 2013), or by teaching them how to think divergently (Cartledge & Krauser, 1963; Ju Lee, Bain, & McCallum, 2007). The subjects have usually been in the primary school age (e.g. Bateson & Martin, 2013; Zosh et al., 2017), with only few studies involving children younger than 4 years (e.g. Dziedziewicz et al., 2013; Hoicka et al., 2013, 2016). Most existing tests of creative thinking may not be well-suited for younger children, given that the tests usually rely on knowledge of language and concepts that toddlers may not possess. There is also a scarcity of research

conducted in less formal spaces than laboratory rooms or school classrooms (e.g., Carr, Kendal, & Flynn, 2015). The conclusions of such studies might not be representative of the general tendencies in children's creative behavior, and similar results might not be observable in more naturalistic settings. The emergence of new, more age appropriate creativity measuring tools is necessary in order to gain a better understanding of young children's creativity.

2.7 Measurement of creativity in children

Standard tests measuring divergent thinking, like the Wallach-Kogan Test, the Torrance's Tests of Creative Thinking (TTCT) and the Torrance's Creativity in Action and Movement test (TCAM), have been successfully used in children from 3 years of age, but these tests rely heavily on the verbal abilities of the children. In the Wallach-Kogan Test, participants are asked to answer open questions (e.g., can you name all round things you can think of), and some preschool children do not possess sufficient linguistic fluidity to respond in a way that would allow generalization of the results. TTCT is the most widely used set of tests and consists of a verbal section ('Thinking Creatively with Words') and a nonverbal or figural section ('Thinking Creatively with Pictures'; Torrance, 1981), but it also requires certain verbal communication skills; therefore, the TCAM test is a version more suitable for preschool children.

Torrance developed the TCAM test based on the observation that younger children are most comfortable in expressing their creativity in the kinaesthetic modality. Thus, the TCAM is designed to measure creativity based on the originality of movement in four movement related tasks: for instance, a task where children are required to find as many uses for a paper cup as possible, or a task where children are asked to move between two floor lines in as many ways as possible. The responses are modeled to some degree, as the experimenter first shows an example of a movement or use. TCAM hs been used successfully with children older than 3 years (Torrance, 1981; Zachopoulou, Makri, & Pollatou, 2009), but children under 3 years do not possess enough control over copying responses, rarely producing original actions during the test (e.g. Jiangzhou et al., 2016; Rennie, Bull, & Diamond, 2004).

In one study, the researchers observed that children as young as 6 months are able to explore and acknowledge the affordances of different objects and surfaces (Bourgeois, Khawar, Neal, &

Lockman, 2005). Based on the assumption that toddlers have the capacity to be creative while interacting and exploring an object, a new method of measuring creativity was developed.

Figure 2: Box and novel objects used in the Unusual Box Test (taken from Hoicka et al., 2013)

Hoicka and Bijvoet-van den Berg and colleagues (2013) developed a non-verbal open-ended test to measure divergent thinking in young children and toddlers by exploiting their interest in the exploration of objects. The Unusual Box Test (UBT) consists of a colorful box of an unusual build (it contains holes, stairs, ledges, and strings), along with a number of additional novel objects (see: Figure 2). During the test, children are presented with the box and are encouraged to explore it, without any type of prior demonstration. Divergent thinking is measured through the number of action/box area combinations that toddlers produce in the duration of the test, e.g. hitting a stair, or placing a toy on the side of the box. Since the UBT is a non-verbal, non-representational divergent thinking test, it allows to test children in different stages of speech development and physical development. When compared to the TCAM test results, UBT results have been shown to be a reliable method of measuring divergent thinking in young children, and the results have revealed that divergent thinking is expressed by toddlers between the ages of 1 and 3 years (Bijvoet-van den Berg & Hoicka, 2014; Hoicka et al., 2016, 2018). In further exploration of the possible applications of UBT, it was observed that divergent

thinking can be increased even in 2-year-olds, and that it can be enhanced through social interaction (Hoicka et al., 2013).

The UBT, as a developmentally appropriate assessment tool for measuring creativity in the first years of a child's life, is valuable for several reasons. It allows the exploration of divergent behavior in very young children, since it is non-verbal and does not require developed problem-solving skills. Furthermore, it allows testing to be conducted in natural settings, like homes and kindergartens, where children spend most of their waking time, thus increasing the ecological validity of the study.

The UBT might contribute to research into the innateness of divergent thinking, as it enables observation and comparison of the development of creativity across many years of an individual's life. Some researchers have even suggested that there is potential for the application of the UBT in research on Artificial Intelligence and robotics, where computer programs may express divergent thinking emerging as a property of developing motor, language, and representational skills (Jordanous, 2012; Saunders, 2012).

By exploring the influence of different types of stimuli on the development of creative thinking in the early stages of human life, we could discover the most efficient way of increasing it. We still do not understand where creativity originates, and what assists the emergence and development of creativity. Some research shows that the level of children's divergent thinking at 7 years predicts their future accomplishments and careers up to 50 years later (e.g. Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005). Thus, it might have high applied value to learn if music can in any way increase divergent thinking in children of the preschool age, when neuronal development is highly plastic (Fox, Calkins, & Bell, 1994). Active exposure to music, by learning and performing music, is shown to enhance brain plasticity, as does training in divergent thinking (Ritter & Ferguson, 2017), but it is not known whether passive exposure to music may have any influence on divergent processing. A standardized test to measure divergent thinking in children, such as the UBT, could open a path to such knowledge.

3 Mood and creativity: Enhancing creative performance

At the moment, a lot of focus is given to developing a variety of new strategies for increasing creative performance. Innovation is important especially within the areas of education, sciences, art, and policy making, as well as in professional and personal life in general. TED talks have dedicated a separate page to creativity-related presentations and book stores are full of self-help books with advice on how to increase creative performance. To be more creative is a common ambition among people, since creativity is associated with both personal and professional success. We want to be more creative and we want our children to be more creative, because there is an idea that each of us has some creative potential that can be approached, if not entirely fulfilled.

The two main approaches to enhancing creativity present in the various studies devoted to that issue, are through creativity training (e.g., Nickerson, 1999) or through optimizing the creative environment (e.g., Fatt, 2000; Ekvall & Ryhammar, 1999). Furthermore, Runco (2014, p. 321) distinguishes between unsystematic and systematic enhancement efforts that in complementary manners help aid the realization of one's creative potential. The unsystematic enhancement efforts to increase creative performance might be a part of development, education, and every-day experiences that influence creativity because they are supportive and inspiring in nature (Runco, 2014). For instance, finding a mentor who fosters creative potential, or coming across opportunities to work creatively. In the other end of the spectrum lie systematic enhancement efforts and tactics and strategies developed specifically in order to boost creative performance.

Runco (2014, p. 322) lists several specific strategies for reaching creative potential that require "a certain level of *metacognition*", which is manifested in self-awareness and self-control. The list of those strategies includes a shift in perspective, finding analog traits between problems or situations, using ideas or tactics generated by others, observing the natural world, simplifying a problem, experimenting, being persistent, traveling, constantly questioning assumptions, redefinition, brainstorming, and more (Runco, 2014). Those tactics can be applied in the moment of creative production and they usually result in enhanced creative performance within one domain (e.g. writing, composing music). But what about enhancing creativity at the cognitive level? Are there strategies that we can apply in order to optimize creativity processing?

A variety of studies on ways of improving divergent thinking abilities suggest that a range of variables may have indirect influence on divergent thinking and creative production (e.g., Ritter, Strick,

Bos, Van Baaren, & Dijksterhuis, 2012; Steidle & Werth, 2013). One of the activities that can enhance divergent thinking is improvisation. Research within the domain of musical improvisation has shown a strong relation between improvisation and divergent thinking. For example, in a neuroimaging study on the neural correlates of improvisation, activation was observed in the brain areas strongly associated with divergent thinking in creative idea generation tasks (Beaty, 2015). Sowden and Clements, Redlich and Lewis (2015) observed that simple art improvisations have general benefits for divergent thinking that transcend the improvisation domain, even after a short improvisation. Limb and Braun's (2008) study on piano improvisation, and Liu, Chow and colleagues (2012) study on the improvisation of freestyle rappers suggests that during improvisation, prefrontal activity changes in a way that enables spontaneous creativity. The dorsolateral prefrontal cortex, when active, has a supervisory and executive control role. It not only affects our impulse control, but also hinders the free flow of novel ideas to our consciousness (Liu et al., 2012). During musical and lyrical improvisation, the brains of the tested musicians showed decreased activity in the dorsolateral prefrontal cortex (Limb & Braun, 2008; Liu et al, 2012). Further support for the finding that a temporary decrease in activation of the prefrontal cortex may be beneficial for creativity comes from studies of relaxation (Reverbi, Toraldo, D'Agostini & Skrap, 2005; Luft, Zioga, Banissy, & Bhattacharya, 2017). This observation agrees with Epstein's idea of *resurgence* (Epstein, 1990). Epstein (2014) suggested that most people have their best ideas while in bed, in the bath, or on a bus. Relaxation can allow the brain to reach the desired focus state for optimized creativity and resurgence of creative ideas.

Relaxation and other mood states have been used successfully as creativity-inducing strategies. The next part of this thesis will focus on what mood is and how it influences cognition and creative cognition.

3.1 What is mood and how can it influence cognitive performance

Cognition and emotion have long been regarded in science as two separate entities, and respectively studied in separation, but the growing body of research on neural function makes it increasingly clear that they not only coexist, but that there is no cognition without emotion, and vice versa, and that these are two integral aspects of human psychological experience (after: Zelazo, Qu, & Kesek, 2010, p.99).

A variety of approaches have been used to study human emotions and their components, but a consensus is emerging that emotions are multifaceted, multicomponent episodes that generate a readiness to act (e.g., Nolen-Hoeksema, Fredrickson, Loftus, & Wagenaar, 2009). When referring to different emotional phenomena, the most generally used terms are affect, mood, and emotion. The term with broadest meaning is affect, with mood and emotion seen mostly as subtypes, but closely related phenomena. *Affect* refers to a subjective feeling state, and encompasses both long-lasting mood states, such as depression or cheerfulness, and more categorical emotions such as anger or happiness (Frijda, 1993). *Emotions* are regarded as "prototypical emotional episodes" (Russel & Barrett, 1999), and are associated with a specific stimulus they are directed towards, like a person, an event, or an object (Frijda, 1993), for example fear towards a dangerous or unknown animal. *Moods* are regarded as "core affects" (Russel & Barrett, 1999) and might lack such directedness; for instanve, one can be in a bad mood without necessarily knowing what is the reason behind this negative state. Even though moods might be characterized as low-intensity affective states, they are often more lasting and pervasive (Frijda, 1993), and can last for minutes to hours, while emotions last for seconds or shorter (Lazarus & Lazarus, 1994).

The development of mood-induction procedures (MIPs) has enabled more controlled research into the influence of mood on different cognitive abilities. MIPs are used in order to momentarily change a participant's emotional state in an artificial, reliable and controlled way (Jallais & Gilet, 2010). It is imperative that the induced mood is equivalent to naturally occurring moods. The two main categories by which MIPs can be classified are: simple MIPs, if they use only one mood induction technique, or combined, if they use two or more techniques at once (Jallais & Gilet, 2010). When it comes to simple MIPs, autobiographical recall (e.g., of a time one felt happy or sad) is one of the most commonly used and regarded as most effective (Baker and Gutterfreund, 1993), particularly for inducing positive mood (Strack, Schwarz, & Gutterfreund, 1993). In the Velten MIP (Velten, 1968), participants are asked to read self-referent statements composed to induce a specific mood state. In the music MIPs (Mayer, Gayle, Meehan, & Haarman, 1990; Västfjäll, 2002), certain classical music examples are chosen according to the expressed emotions and their estimated ability to evoke corresponding affective reactions in the listener.

It is believed that combined MIPs are more effective than simple MIPs (Bower, 1981), therefore later studies have often used two or more techniques at once, usually introducing one induction method in the foreground of attention, while the second one contributes to a background atmosphere. For

instance, showing participants photos of emotional facial expressions eliciting a certain affective state, while music associated with the same state plays in the background (e.g., Hammers, 2018). One of the most applied combined MIPs, developed by Mayer, Allen and Beauregard (1995), consists of a guided imagery task combined with music (e.g. Corson & Verrier, 2007).

Neuroimaging studies of executive function in adults show evidence that even very mild fluctuations in mood can have a significant influence on cognition (e.g., Mitchell & Philips, 2007). Both positive and negative mood states are linked to increased activation of widespread associative neuronal networks, by which moods may 'load up' cognitive resources and impair some executive function measures, while enhancing others (e.g., Mackie & Worth 1989). For instance, mild positive affect has been found to lead to more creative problem solving (e.g,. Estrada, Young, & Isen, 1994), improved memory (e.g., Nasby & Yando, 1982) and improved strategies used in decision-making tasks (e.g., Estrada, Isen & Young, 1997). Based on a large amount of studies comparing positive moods with affect-neutral control conditions, Ashby, Isen and Turken (1999) concluded that "it is now well recognized that positive affect leads to greater cognitive flexibility and facilitates creative problem solving across a broad range of settings" (p. 530). In view of the observed relation between mood and cognitive performance in a variety of tests, they proposed a neuropsychological theory of positive affect. According to their theory, positive affect increases release of dopamine from the ventral tegmental area and the substantia nigra, and improves the function of the prefrontal cortex and the anterior cingulate cortex. The role of dopamine in the feeling of reward has been established in several robust studies (for reviews, see: Nieoullon, 2002), and there is fairly strong evidence that dopamine plays a significant role in the function of the lateral prefrontal cortex and the anterior cingulate cortex (for a review, see: Arnsten & Robbins, 2002). Slightly elevated dopamine levels in lateral prefrontal cortex may facilitate working memory (Ashby, Isen, & Turken, 1999), whereas elevated dopamine levels in the anterior cingulate cortex may improve executive attention (Ashby, Valentin, & Turken, 2002).

Positive mood results in more global or holistic processing, since it communicates that the situation is positive and thus allows more flexibility and global consideration in idea generation. In contrast, negative mood supports more localized or focused processing (e.g., Fredrickson & Branigan, 2005). It has been argued that negative mood promotes more analytic processing (e.g. Park & Banaji, 2000) through signaling of a problem that needs a systematically considered solution. The effects of negative moods on cognitive processing are complex and cannot be simply described as opposite to the

effects of positive moods (Ashby et al., 1999). There is evidence that negative moods are mediated in the brain not by lower dopamine levels, but by low serotonin function (e.g., Neumeister, 2003) and that they can improve some cognitive functions. Negative mood has been found to have a beneficial influence on some types of memory (Forgas, Goldenberg, & Unkelbach, 2009), and it seems to hinder the incorporation of false details into memories (Forgas, Vargas & Laham, 2005) in comparison to a positive mood control group. In studies comparing the impact of negative and positive mood on judgment accuracy, negative mood has for example been found to decrease the effect of introduced pre-judgment biases in forming impressions about a person (e.g. Forgas, 2011). Some studies have shown that individuals in negative mood achieve better results in demanding cognitive tasks (due to the improved motivation and increased perseverance; Goldenberg & Forgas, 2012) and are better at forming more persuasive arguments (Forgas, 2007).

Thus, positive and negative moods can influence cognition in a variety of ways. Increased knowledge of the distinctive properties of different moods in relation to cognitive processing enables us to consciously apply them as strategies in challenges that come in everyday life. Depending on the demand of the creative task, different moods can be either beneficial, or detrimental in creative thinking tasks. Evidence from the research on the relation between affective states and creativity will be described in more detail in the following sections of the thesis.

3.2 Mood and creativity

Hermann von Helmholtz, the physicist, psychologist and philosopher of science, described how after a period of a thorough consideration of a problem, “happy ideas came unexpectedly without effort, like an inspiration” (cited after: Wallas, 1926, p. 80). The ideas came to him when he was taking a break from the task, rather than at his working table (Wallas, 1926). Being relaxed is often rated among the top stimulants of creativity (Ten Hoopen & Janssen Groesbeek, 2008). Many corporations invest large financial resources into creating relaxation zones in their headquarters. And yet, we seem to have a picture of the distressed and depressed artist as the perfect example of an accomplished creative individual. Although Fryderyk Chopin did not give his Etude op 10 no 12 the descriptive *Revolutionary* title (Smialek & Trochimczyk, 2015, p. 138), it confirmed his status as a deeply emotional artist that agonized over the fate of his countrymen. While longing for his war-torn homeland, he produced one of the most well-known and accomplished musical compositions for piano ever written. Steve Jobs is

commonly perceived as one of the most creative entrepreneurs of recent decades, but the success of his products was achieved by a group of employees working in a constant state of stress and anxiety (Lehrer, 2011).

Such observations and quotes imply that the relation between mood states and the human capacity for creativity is pervasive. Vast research has focused on the effects of mood states on creative thinking, and to this day, mood stands out as one of the least disputed predictors of creativity (for review, see: Mumford, 2003). In a series of publications, Isen and colleagues investigated the possible relation between mood and creative performance. They established that positive mood can enable individuals to think more creatively and perform better in creative tasks (e.g., Isen, 1984; Isen, 2000), and that performance on creative problem-solving tasks, complex decision-making tasks and heuristics tasks was significantly better following manipulations that induce a positive mood compared to manipulations that represent a neutral mood (for a review, see: Baas, De Dreu, & Nijstad, 2008). As an example of one such study, primary-care physicians randomly assigned to a positive affect group received a small package of candy. They registered not only higher scores on a creativity measure of their work, but also reported greater satisfaction from their work in comparison to a neutral group (Estrada, Isen & Young, 1994).

Lyubomirsky, King and Diener (2005) state that "people in a positive mood are more likely to have richer associations within existing knowledge structures, and thus are likely to be more flexible and original" (p. 840), although exceptions have also been observed. A few studies even show that people in positive mood were less creative than those in mood-neutral control conditions (e.g. Kaufmann & Vosburg, 1997).

Far more contradictory findings appear in the line of study on the effects of negative mood vs. neutral-mood on creativity. While some studies provide evidence that negative moods benefit creative performance (e.g., Carlsson, 2002), others demonstrate a negative effect (e.g., Vosburg, 1998), or no difference at all (e.g., Verhaeghen, Joorman, & Khan, 2005) in comparison to neutral mood conditions. The generalized conclusion might be that negative moods have no clear influence on creativity (Grawitch, Munz, Elliott, & Mathis, 2003), or rather that new theories need to emerge on the basis of those studies, so that the complex relationship between creative performance and negative affect will be fully considered.

Another line of studies investigating the relationship of mood and creativity are those that focus on the comparison between negative and positive affective states on creativity (see: Kaufmann, 2003).

The same lack of methodological consensus and inconsistencies that plague research on the impact of negative affective state on creativity can be observed in those studies as well. Whereas in some studies negative moods have been associated with a greater increase in creativity scores than positive moods (e.g., Gasper, 2003), some other studies have found the opposite effect (e.g., Grawitch, Munz & Kramer, 2003). Sad moods have generally been found to decrease creative performance (O'Hanlon, 1981), although the amount of studies is insufficient to assess the validity of that claim.

De Rooij and Jones (2013) argue that the mood-creativity research has not conceptualized moods in enough detail, which is detrimental to the aim of explaining the relationship between mood and creativity. They advocate towards an appraisal tendency perspective on moods. According to the appraisal tendency theory, moods serve a role as dispositions to congruent emotions (Scherer, 2009). For example, we are more likely to experience happy emotions if we are in a happy mood, even if the situation we are in only slightly lends itself to it (Scherer, 2009). Different appraisals (evaluations) promote different creative behaviors as adaptive responses. For instance, moods associated with certainty (like happiness or anger) tend to promote less systematic approaches to problem-solving, hence more creative and uncommon responses can be generated. On the other hand, moods associated with uncertainty (e.g., anxiety) elicit a more systematic approach to information processing, which might be beneficial in the later stages of the creative process (Scherer, 2009).

The research on the relationship between mood and creativity has many inconsistencies, which are rooted mostly in the way moods have been conceptualized. Despite those issues, an optimizing effect of a happy mood on creativity has been well established and reproduced across many studies.

Most of the research on mood and creativity has focused almost solely on the valence of specific mood states, that is, whether the mood is positive vs. negative (hedonic tone). Baas, DeDreu and Nijstad (2008) conducted a meta-analysis in which they synthesized 102 effect sizes published across 25 years of research on the relation between mood and creativity. They suggest a new approach to the study of the relationship between mood and creativity. In their view, other dimensions of mood states should be included, such as the level of activation (activating vs. deactivating) and regulatory focus. In the hedonic tone focus, moods are characterized as either positive in tone and pleasant (e.g. happy, relaxed, cheerful), or negative in tone and unpleasant (e.g. sadness, anxiety, anger). From the perspective of the level of activation or mobilization of energy, the same moods can be characterized by high arousal (e.g. happy, elated, anger, fear) or low arousal (calm, relaxed, sad, depressed, see also: Heller, 1993). Even if moods are defined as usually less intense than emotions (e.g. Forgas, 1995), it is

still possible to distinguish between positive moods of higher (e.g. happiness), or lower (e.g. relaxation) level of arousal, and respectively, and between negative moods of higher (e.g. anger), or lower (e.g. sadness) level of arousal.

While some of the conclusions of the studies on mood-creativity relation seem general and potentially relevant also in context of studies on children, we need to confront them against what we know of how children experience mood and how it influences their general cognition.

3.3 Children and mood

Despite the importance of emotion regulation in a child's development, relatively little is known about the associated brain mechanisms in children. Forgas, Burnham, and Trimboli (1988) speculated that "there are likely to be profound, and as yet not fully explored differences between adults and children in the way mood states influence their cognitive abilities" (p. 703). The importance of emotions for human development lies in their role. Emotions have a biologically-prepared adaptive function and are emerging as rapid responses to different stimuli (Cole, Martin, & Dennis, 2004). They contribute to the formation of a child's understanding of the surrounding world and, consequently, to the development of a child's behavioral response patterns (Bradley & Lang, 2007). On the level of the brain, neural development continues across the first 25 years of life, and possibly extends into adulthood, but the tempo of maturation varies across different brain regions (Giedd & Rapoport, 2010). For now, little is known about the neurophysiological changes in emotion experience and regulation of young children, but there are some relevant observations made within behavioral research.

Children start developing mood-regulating strategies in an early stage of their development (Thompson & Goodman, 2010). During the first years of life, children develop from fully dependent beings that are focused solely on the fulfillment of their most basic needs, into complex and intellectual individuals (Lagattuta, 2014). As Katherine Bridges (1932) wrote in her highly influential paper on emotional development, emotions of infants differentiate at first only between states of delight and distress, and only later more distinct emotions, such as fear, anger, elation and affection. According to Izard's (2009) differential emotions theory, emotion is hard-wired with systems of motivations, that emerge in specific stages of development of a child and turns into an elaborate cognitive affective "scheme" that links the emotion to associated eliciting situations. In contrast, in Campos' functionalist view, emotion is formed as a result of an individual's relation to assess him/herself in relation to the

external or internal environment (Barrett & Campos, 1987; Campos, Walle, Dahl, & Main, 2011). Thus, emotional responses are functional, and not preprogrammed or fixed.

During the first years of their lives, children increase their conscious control over own behavior (cognitive control), which in turn allows them to plan ahead, consider alternating perspectives and act in a goal-directed manner (Miyake et al., 2000). Processes that may lead to emotion elicitation in young children are usually dependent on their temperament and socialization. Rothbart, Sheese, Rueda and Posner (2011) propose temperament as "constitutionally based individual differences in reactivity and regulation in the domains of affect, activity and attention" (p. 207). Although temperament has an inherent basis, the environment (especially parenting) and the experiences that it brings are responsible for changes in the characteristic tendencies in emotional responses. For instance, over time, anger levels remain consistent in the children who have experienced negative parenting, but lower for children who have experienced positive parenting (Smith, Calkins, Keane, Anastopoulos, & Shelton, 2002).

Across the literature, seven different types of mood induction procedures have been employed in studies with children (for review, see: Brenner, 2000). The most utilized method is the self-generated imagery procedure, during which children are asked to recall and dwell on one or more experiences from the child's own life, that most likely would elicit the desired mood (e.g. Potts, Morse, Felleman, & Masters, 1986). The time that a child would spend on remembering and reminiscing about a situation varies between studies, but no clear effect on the intensity of the evoked moods has been observed despite the differences in the length of the procedure or the number of recollections (Brenner, 2000). Mood manipulation has been applied not only on valence dimensions, but arousal dimensions as well: Masters, Barden and Ford (1979) asked children in the positive mood- high arousal condition to recall a situation that made them feel "so happy that you just wanted to jump up and down". In contrast, children in the positive mood-low arousal condition were supposed to think about a situation that made them "so happy that you just want to sit and smile" (Masters et al., 1979, p. 382). The effectiveness of the procedure was validated by rating the children's facial expressions, and it has been shown to be adequate in eliciting both high arousal and low arousal positive moods.

There are examples of music used in order to enhance the effect of imagery, but only with the addition of other strategies. For example, Carlson and Masters (1986) used an interactive videotape containing music and a puppet that would talk to the children and taught them how to do the self-generated imagery procedure. The knowledge about the effectiveness of those different MIPs is still

inconclusive. Little research has measured how long the effect of mood-induction lasts in adults (most recently, Ribeiro, Santos, Albuquerque, & Oliveira-Silva, 2019), and even less has been measured in younger children. Facial and vocal expressions remain the most valuable source of mood measurement, as they are present from birth, but their ability to represent more discrete emotions is controversial, especially in studies concerning populations from different cultures (Camras & Shutter, 2010; Camras & Shuster, 2013).

It has been observed that mood-inducing stimuli can facilitate performance in young children in ways that might indicate improved cognitive control (see: Isen, 2003). In a study published in 1990, Isen showed that 3-year-old children on average nested successfully more cups after receiving a gift of stickers, than those that did not receive any gift before testing (Isen, 1990). Interestingly, children in a positive mood more often stacked the nesting cups as towers, even though such behavior was not expected of them. In other words, they were more able to behave in a different, more exploratory way. In another study with 3- and 4-year-old children, it was observed that positive stimuli promoted cognitive flexibility that might be analogous to the effect of increased dopamine levels in the prefrontal cortex in adults (e.g., Qu & Zelazo, 2007). Other studies have demonstrated that school-age children in a positive mood demonstrate improved performance on an array of different cognitive tests, like Piagetian class-inclusion problems (Isen, 1990) or Block Design (Rader & Hughes, 2005), but it is inconclusive if those observations can be translated onto small children.

When it comes to the relation between mood and creative thinking, Isen (1990) asked first-grade students to sort 24 pieces that could be characterized in terms of three dimensions: color (blue or white), shape (squares or triangles), and structure (one line or a line with two dots resembling a smiling face). On average, children that received a gift of stickers prior to the test (and therefore were presumably in a more positive mood) spontaneously sorted all the stimuli into more subcategories than children who did not receive a gift (control group). In other studies, positively stimulated children performed better in word fluency and creativity tests (e.g., the RAT and Duncker's Candle Task; e.g. Bryan & Bryan, 1991; Green & Noice, 1988).

The studies reviewed above provide some evidence that positive moods can have an effect on cognitive processing in young children that is analogous to adults, including creativity. If divergent thinking skills can be enhanced in children by inducing a positive mood, music might be a valuable tool in aiding higher scores in idea generation tasks when it comes to fluency and originality. Music is a well-recognized mood-inducing tool (de Rooij & Jones, 2013), and a large body of research on music

processing and its influence on non-musical cognitive abilities, strongly suggests that music is an all-brain engaging and influential stimuli.

4 Music, mood and creativity

Humans are able to perceive and enjoy music from the earliest stages of their lives. Children already in their infancy are able to detect shifts in meter (Hannon & Trehub, 2009), tempo (Baruch & Drake, 1997) and timbre (Trehub, Endman and Thorpe, 1990). Exploration of the neurological processing of music in infants of Western background show that they are able to perceive music already in utero (Partanen et al., 2013; Virtala, Huotlainen, Partanen, Fellman, & Tervaniemi, 2013), and show indications of processing of minor and major chords (Virtala et al., 2013). As early as at the age of 6 months, Western infants show preference for consonant sounds (Trainor & Heinmiller, 1998), and even 2-month old infants prefer sequences of consonant harmonic intervals over those build of dissonant intervals (Trainor, Tsang, & Cheung, 2002). This chapter contains theories and findings into the purpose and function of music listening from a child's perspective. The significance of music making and music listening for non-musical abilities will be presented. Also, the chapter describes the musical meanings that are involved in the communication of emotion, and how music is able to induce affective states.

4.1 The psychological functions of children's music listening

To say that music plays an important role in human life, maybe even more so in its earliest stages, might be judged as obvious, but it is nonetheless vital to consider in how many valuable and varied ways music forms a child and connects it to its environment. Music is ubiquitous and a constant companion to the everyday life of the vast majority of children, and it is apparent that music is a source of joy and interest for them. It seems that every society has special songs for infants (Trehub, 2003), and music plays a crucial part in the early development, since a child's readiness to join in musical activity is fostered by families, kindergartens, school, communities, and the media. Over time, children grow more musical through cultural interactions and education, and music has an important function in the process of formation of their identity.

Based on the wide research into the functions of music, Schäfer, Sedlmeier, Städtler and Huron (2013) propose four most general dimensions and basic ways in which people use music in their daily lives: *social/cultural functions* that are related to one's need to express identity and personality or

parent-child bonding; *cognitive/self-related functions* like escapism; *physiological/arousal-related functions* such as calming down in a therapeutic session or activating during physical exercise; and a fourth, *emotional function* such as induction of positive mood, which relates to the cognitive and arousal-related functions of music as well (Schäfer et al., 2013). But are those functions represented in the life of a child as well?

Patricia Shehan Campbell (1998) noted that "up until a decade ago, the music culture (or cultures) of children had been largely overlooked and under-researched by ethnomusicologists, and had rarely been studied ethnographically by educators" (p. 17-18). The main assumption was that 'culture is learned, not inherited', thus children are treated as incompetent actors until they mature in the culture through the process of enculturation (e.g. James & James, 2012). And yet, scholarly work on the features of the music of childhood shows that children are not just passive recipients of music, but rather participate actively in forming their own music culture by choosing the music they will spend time to listen and respond to, and to choose to preserve, reinvent or discard (Campbell & Wiggins, 2012).

But to acknowledge the existence of music cultures in the context of young children, we need to clarify which concept of music represents most accurately the musicality of children. Most theoreticians agree that music is a cross-cultural phenomenon, a universal human trait that has the ability to alter emotional and psychological states (Juslin & Västfjäll, 2008). Historically, musical meaning was studied and searched for strictly within the compositions and works of music that were deemed worthy of study, in contrast to the 'social action' of music making (Dalhaus, 1982). However, Christopher Small (1998) argues that, since everyone is musical in nature, every experience of music is worthy of inclusion in the consideration of what constitutes of music culture. He proposes that the concept of *music* should not be restricted to *musical objects,* but rather to the *performance* of music. He introduced the term *musicking*, a verb that he argues, encompasses a broad spectrum of music making, like performance, the act of listening, rehearsing or practicing, providing material for performance/composing, or dancing (Small, 1998, p. 9). Children's music culture consists of songs, chants, rhythmic speech, movement and dance, listening interests, sociomusical interactions and expressions (e.g., Campbell, 1998; Marsh & Young, 2006). Therefore, Small's theory is most useful in the context of child musicality, as it does not value some types of musical activities over others.

The modern discourse on the origins of music begins with the establishment of evolutionary theory. Darwin himself, in *The Descent of Man, and Selection to Sex* (1871), compared human music to

bird song, viewing both as a result of a sexual selection. He argues that humans used musical notes and rhythm in order to express affection even before they were able to articulate it in speech. Several adaptationist theories support Darwin's initial thought, focusing on the characteristics of music that indicate its potential to be an 'evolutionarily adaptive behavior' that could change under selective pressures (e.g., Cross & Morley, 2009). The prehistoric roots of music will remain a source for pure speculation, but some scholars have related music and its functions to presumed evolutionary roots, by considering multiple ways in which music is used in everyday lives (e.g., Chamorro-Premuzic & Furnham, 2007). Mothers use singing to sooth their crying babies, or stimulate them with play-songs (e.g., Schenfield, Trehub, & Nakata, 2003). According to 'attachment theory', music has an important role in building that very first of social bonds, the infant's bond with her parents, and that bond-building function of music will remain throughout an individual's life (Ainsworth, Blehar, Waters, & Wall, 2015). Similarly, Falk (2004a, 2004b) proposes a 'putting-down-the-baby hypothesis' according to which music arose from the humming performed by mothers in order to maintain infant-mother attachment. There is some empirical evidence for the benefits of parental use of music, as it was observed that music improves bonding between parents and infants, lowers parental stress levels, and even improves infant post-partum recoveries (e.g. Loewy, 2015; Creighton, Atherton, & Kitamura, 2013).

Merriam (1964) in his seminal work, *The anthropology of music*, proposes 10 social functions music can serve, including emotional expression, communication and symbolic representations. His theories point strongly towards the social and cultural benefits of music, and his work influenced the next generations of musicologist to focus on the social role functions of music above others (e.g., Dissanayake, 2006; Misenhelter & Kaiser, 2008). Music has a relevant social bonding function not only in respect to the infant-parent relationship. Further in development, music is present when children play with their peers, and in education. As music aids in the acquisition of social skills (Schellenberg, 2012), the engagement in musical activities can be also an important transmitter of cultural resources that one generation passes on to the next (e.g., Chen-Hafteck, 1997; Cole & Nash, 2000). The social and cultural role of music enables an individual to form bonds with a larger group of people, outside of the immediate family group (e.g., Boer et al., 2011).

Some theorists turn towards finding more hedonistic functions of music. Schubert (2009) argues that the fundamental function of music is its ability to produce a feeling of pleasure in the listener, and all the other possible functions are simply subordinate to music's pleasure-inducing capacity.

Dissanayake (2009) has argued that music was used by humans to help cope with a fear of death and the knowledge of life's fragility. The evidence that music can reduce anxiety and stress levels in adults, children, and even newborns, can be seen as consistent with that perspective.

Schäfer, Sedlmeier, Städtler and Huron (2013) made the interesting observation that the social cohesion and communication function of music has diminished today, with a more private mode of music listening. It appears that "people today hardly listen to music for social reasons, but instead use it principally to relieve boredom, maintain a pleasant mood, and create a comfortable private space", which they attribute to an emphasis on individuality (Schäfer et al., 2013). It seems that, on the surface, music consumed by an individual in the isolation of his house, or in isolation provided in public spaces by noise canceling earphones, is deprived of social connection building function. However, the selection of the repertoire we choose to listen to is still very much informed by the experiences of our lives that are inherently of social nature. The music of our parents, music of our peers, music that we learn about and music that we get to know by attending concerts throughout our lives still remains the point of reference to the music we choose to consume privately. Additionally, a steadily growing portion of the world population accesses music through online services, like Spotify, Youtube, or Apple Music, and even though those platforms rely on the technology of algorithms, they connect people by the function of 'following' or 'subscribing', and their recommendation functions are built on the socially dictated norms of music genres and popularity lists. Nonetheless, Schäfer and colleagues (2013) rightfully point out that the usual ways by which individuals listen to music is an important consideration for studies using music as stimuli, as it can influence how people respond to the stimuli.

On a cerebral level, listening to music is a complex process that involves auditory, cognitive, motor, and emotional functions, while soliciting activation of multiple neuronal networks (Sihvonen et al., 2017; Koelsch, 2014). Music provides neurodevelopmental benefits that will be discussed in the next chapters of this thesis.

4.2 The Mozart effect controversy

There is a body of scientific work showing that music has a beneficial influence on cognition and cognitive functions, even on functions not directly related to music processing (for a review, see: Benz, Sellaro, Hommel, & Colzato, 2016). This research shows that active participation in various form in music training results with pronounced and long-lasting effects on different domains of human

cognition. Effects of passive exposure to music (listening to music) have been observed to some extent as well, although they seem to be temporary and small.

A series of studies popularized by media as the "Mozart effect" tried to answer the question, if simply listening to classical music composed by a celebrated genius, namely Wolfgang Amadeus Mozart, can make an individual more able to solve certain cognitive tasks. The original studies (Rauscher, Shaw, & Ky, 1993; for review, see: Rauscher & Shaw, 1998) established that a brief exposure to Mozart's Sonata for Two Pianos in D Major, K. 448, can help adult students in spatial-temporal reasoning tasks. Even though the first studies did not focus on general intelligence, an overgeneralized interpretation was quickly spread that IQ scores could be increased simply by listening to Mozart's music. The further generalization was made that listening to Mozart's music can make smarter not only adults (like the college student participants of the original study), but babies as well, even those *in utero* (Goode, 1999; Eerden, 2017). The seminal 'Mozart effect' study received some criticism for the study design and scoring procedures, and its inability to be replicated (e.g. McCutcheon, 2000). However, a meta-analysis of 36 studies found the Mozart effect to be moderate and robust, but that "it is limited ... to a specific type of spatial task that requires mental rotation in the absence of a physical model" (Hetland, 2000, p. 136). Thompson, Schellenberg and colleagues established a link between the enjoyment from the music and improvement, and proposed an alternative interpretation of the Mozart effect in the 'arousal and mood hypothesis' (Thompson, Schellenberg, & Husain, 2001; Husain, Thompson, & Schellenberg, 2002).

Although the primary findings of Mozart effect were questioned and revised many times (for a review, see: Pietschnig, Voracek, & Formann, 2010), the theories presented in the original series of studies by Rauscher and colleagues are still being applied and investigated in different contexts and on different populations (e.g., most recently: Mohan & Thomas, 2019; Padulo, Mammarella, Brancucci, Altamura, & Fairfield, 2019; Zimmermann, Diers, Strunz, Scherbaum, & Mette, 2019). Despite their flaws, the Mozart effect studies caused a surge in studies on music processing by turning the attention of psychologists towards music's potential to improve general cognition in children.

4.3 The effects of active music exposure on non-musical cognitive abilities

Playing an instrument is an activity that engages multiple senses and requires different skills, including the ability to decipher music notation, transferring of that information into a motor activity coupled with metric precision, memorization of passages and an engagement of multisensory feedback (Schlaug, 2009). Studies have explored the structural brain changes between professional musicians and non-musicians and observed an increased amount of gray matter in several brain regions, including in the primary sensorimotor cortex and in the primary auditory cortex (Gaser & Schlaug, 2003), and also a training-associated increased brain plasticity (e.g., Lee, Chen, & Schlaug, 2003). The abovementioned brain regions are closely linked to the skills developed in the process of learning to play an instrument, but some of the cognitive changes resulting from active music participation lead to improvement of non-music related cognitive skills as well.

Active participation in structured musical training can have long lasting effects on other domains of human cognition (Schellenberg, 2006). Music has an ability to enhance cognitive performance in non-musical domains by the rule of *transfer*. That process is usually defined as the ability to use in a new context what was learned previously in a different context. Such transfer can arguably occur if different tasks share cognitive elements, so that transfer can happen by the generalization of a process or strategy (Schellenberg, 2001, p. 356; Singley & Anderson, 1989). However, such mechanism is difficult to observe without previously identifying components of the tasks. For instance, a musician's skill to follow and understand the rhythmical structures of a musical piece is similar in essence to the skill required to solve a problem posed mathematically. This might explain why children that are trained to play rhythmical instruments, are able to solve mathematical problems more successfully than children who received piano or singing instructions (Rauscher, LeMieux, & Hinton, 2005). Similarly, melodies and words are distinct, but the operations that are used to manipulate and order these representations of music and language are shared across domains, thus music training is observed to benefit linguistic abilities (Patel, 2011).

In the language domain, evidence confirms that musicians perform better than non-musicians in speech perceptions tasks (for review, see: Asaridou & McQueen, 2013), they are better at recognizing words in a noisy environment (e.g. Parbery-Clark, Skoe, & Kraus, 2009) and they are better at remembering lists of words or lyrics that are spoken or sung (e.g. Kilgour, Jakobson, & Cuddy, 2000).

Children with musical training have larger vocabulary (Forgeard, Winner, Norton, & Schlaug, 2008), and 6- to 9-year- olds improved performance in a reading comprehension test is parallel to the extent of their music training (Corrigall & Trainor, 2011).

Some studies have found that music training benefits abilities necessary in education. It was observed that longer periods of music lessons (months to years) can improve a child's verbal memory (Ho, Cheung & Chan, 2003). Additionally, such children learn faster (Gardiner, Fox, Knowles, & Jeffrey, 1996) and have better motor coordination (Kalmar, 1982). Musically trained children have also been found to be better at reading, to have better selective attention (Hurwitz, Wolff, Bortnick, & Kokas, 1975), and to perform better in math (Cheek & Smith, 1999). Many of the studies mentioned here have randomly assigned children to the groups receiving musical instruction, which indicates a causal relationship between music and an improvement of the aforementioned skills, and that those changes cannot be explained simply by socio-demographic or cultural background (e.g., Schellenberg, 2004).

Some of the studies focused on examining the influence of music on cognitive abilities associated with intelligence. It was observed that children who receive instrumental instruction tend to score significantly higher on spatial-temporal tasks, they have better hand-eye coordination, and better arithmetical abilities (e.g., Rauscher, 2001; Rauscher et al., 2005; for review, see: Hetland, 2000). A study by Schellenberg (2004) showed an increased generalized IQ for children that received music instruction, as compared to children who were assigned to receive drama instruction or no training at all. Such results can be observed even two years after the instruction ended (Rauscher et al., 2005). Children that receive a substantial amount of music learning, e.g., learn to play an instrument or read musical scores, show improved visuospatial skills in reaction time tasks (Brochard, Dufour, & Després, 2004), and improved skills are observable in higher scores on such tasks like folding paper, mental rotation, and three-dimensional reasoning. Such abilities can transfer to other domains, e.g., mathematical, even though the child would not receive specific instruction in the target domain (after: Rauscher & Hinton, 2006).

To summarize, there is good reason to believe that active participation in musical training over a prolonged period of time, can have beneficial effects for a wide variety of cognitive abilities. Although the effects are not as strong as in case of music training, passive exposure to music can benefit some types of cognitive processing as well.

4.4 Passive exposure to music and non-musical abilities

In the research on the relation between passive exposure to music and other cognitive abilities, the effect can be achieved by *priming,* which means that exposure to a stimulus affects subsequent processing of a different stimulus (Tulving & Schacter, 1990). We can distinguish between studies that measure change in performance either *after* exposure to the stimuli, or *while* listening to music where music is used as background stimuli (Schellenberg, 2016).

Music listening is a complex cerebral process that involves many neuronal networks and activates various different cognitive functions (e.g., Koelsch, 2014). It has been established that listening to music can reduce stress and anxiety in healthy adults (Panteleeva, Ceschi, Glowinski, Courvoisier, & Grandjean, 2018) and newborns (Rossi et al., 2018), and also that music listening can reduce pain levels in postoperative patients (Hole, Hirsh, Ball, & Meads, 2015) and chronic pain disease patients (Linnemann et al., 2015a). The current evidence suggests that neonatal and fetal brains have basic music-processing functions at as early as 24 gestational weeks, and unborn infants react to and experience external sounds, like the mother's voice or ambient music (Birnholz & Benacerraf, 1983). It was also observed in neurological studies that newborn infants react to melodies heard by the mother on a regular basis in the third trimester of pregnancy, but not to the same melodies played backwards or similar unfamiliar melodies (Hepper, 1991). A number of randomized medical studies have explored the influence of music intervention in a neonatal intensive care unit (NICU) care and have shown short-term beneficial effect on the newborns. For instance, Anderson and Patel in their review paper (2018) note observations that passive exposure to music had positive effects on premature infants, including stabilizing their heart and respiratory rate, improving feeding, aiding in better weight gain and more mature sleep patterns (e.g., Qui et al., 2017; Arnon et al., 2014; Loewy, 2015). The type of musical stimuli used in these studies varies, from recorded nursery rhymes and lullabies, the mother singing, a 'Baby Mozart' CD, to orchestral music (Anderson & Patel, 2018). Furthermore, music has been shown to activate in premature infants brain regions related to emotional processing that is parallel to the processing in full-term newborns (Perani et al., 2010), and even in adults (Koelsch, 2014). Music listening also had beneficial effects on stress and anxiety reduction in premature infants, even though they are expected to have lesser emotion regulation abilities than full-term babies (Van Goethem & Sloboda, 2011; Linnemann et al., 2015b).

The majority of music listening that people engage in daily is done *simultaneously* with doing something else, like driving (North, Hargreaves, & Hargreaves, 2004). Background music means that listening is a secondary activity of lesser importance than the *primary* task (e.g., driving). In this case music can influence the listener in two ways. Firstly, it can regulate her mood in a positive way (e.g., activate a sleepy driver with an up-tempo rhythm) or negative way (e.g., cause the driver to fall asleep with a monotone melodic and rhythmic structure). Secondly, music can take up some of the cognitive resources needed to perform a task (for example driving), and that effect is independent from its emotional effect on the perceiver. Working memory has its boundaries, and the amount of information that people can process at one point in time is finite (e.g., Morey & Cowan, 2005), therefore music difficult to ignore may lead to worsened performance in the primary task. For instance, Thompson, Schellenberg and Letnic (2012) observed that students listening to a loud and fast version of a sonata in the background scored lower on reading comprehension than their peers who listened to quiet or slower versions. In a study by Shih, Huang and Chiang (2012) music with lyrics would lower listeners' attention to other stimuli more than the same music without lyrics. Similarly, music strongly liked or disliked by listeners capture attention more than more music they are more neutral towards (Huang and Shih, 2011).

The effects of passive exposure to music on children have not been fully explored yet. In the earliest stages of development, children are mostly interacting with music passively, and active participation in music making (like singing or rhythmical rocking motion) increases proportionally with the advancement of the vocal and motor abilities. Within the last hundred years, time spent on passive listening to music has increased exponentially (especially in Western societies), possibly to the detriment to active music making.

The exploration into effects of music as a type of stimuli that can prime performance on some cognitive tasks began with the Mozart effect studies and the consecutive attempts to replicate the observed improvement on some spatio-temporal tasks after music listening. Nantais and Schellenberg (1999) were able to show improvement of spatial abilities after listening to music by Mozart in comparison to silence, but they also observed the same effect after listening to music by Schubert. When Mozart's music was compared with listening to a narrative story, the effect disappeared, but the improvement on spatial tasks was registered if the participants expressed preference for the stimuli. Due to the new evidence emerging from the follow-up studies, Schellenberg and collaborators proposed an alternative explanation for the improved cognitive performance in their 'arousal and mood

hypothesis'. The higher scores on different cognitive abilities tasks were not a result of listening to music *per se*, they argued, but a product of positive affect and arousal induced by the properties of music applied as a stimulus. The same effect of improved cognition was observed in studies on performance of a wide range of cognitive tasks, and a series of papers confirmed the validity of the arousal and mood hypothesis (Thompson, Schellenberg, & Husain, 2001; Husain, Thompson, & Schellenberg, 2002; for a review, see: Schellenberg, 2012).

When it comes to the Mozart effect in children, a number of studies on primary school children failed to observe an improvement in spatio-temporal tasks (e.g., McKelvie & Low, 2002; Črnčec, Wilson & Prior, 2006), and the effect was not observed for preschool children either (Hui, 2006). There are several possible explanations for the lack of the Mozart effect in children as compared to the adult population. On the one hand, it might simply mean that short-term exposure to music is unable to improve children's spatial reasoning. On the other hand, the choice of stimuli might be inappropriate for children. Mozart's music is generally not favored by adolescent population (e.g. LeBlanc, Sims, Siivola, & Obert, 1996), and one could speculate that more age-appropriate music could have a more beneficial effect.

However, to fully understand the effect of mood induction by music and how it is relevant for the study of the relation between creative thinking and music, we need to consider why music is considered a language of emotion, and which properties of music can elicit specific moods.

4.5 Music and mood

We don't really know when is it that humans discovered that the music can alter mental states, but we know that they were using it for that purpose at least since ancient times (Budd, 2002). Philosophers like Plato and Confucius considered the influence of music on human emotions and its beneficial effect on mental health. The Greeks believed that music, among other therapeutic properties, had the function of arousing or soothing in order to relieve from a deficit or excess of emotions (Schäfer, 2017). The ability to elicit emotional responses have been reported as one of the main reasons people listen to music (Schäfer et al., 2013; Reybrouck & Eerola, 2017). Music is also applied in studies into the influence of mood on other cognitive processes (as mentioned in the sections 4.2, 4.2 and 4.3 of this thesis), as it allows controlled elicitation of an affective state.

Studies on musical emotion cover a broad spectrum of research questions, perspectives and approaches poised from the perspective of the composer, the performer, or the listener. This thesis focuses on the listener as a *perceiver* of music, and on music's ability to alter affective states and further influence cognitive processes, including creativity. There are two main perceptions of music's connection to emotion: that music *conveys* emotion and that it *influences* a listener's emotion (Juslin & Sloboda, 2010). One of the pioneers of studies on emotion in music, Meyer (1956) proposed that emotion in the listener is a result of his expectations of the order of tensions and relaxations in music, which are being either fulfilled or violated. Music is an abstract symbolic language, devoid of specific references and associations, but its' structure and inherent patterns are processed as meaningful in our brains (Hargreaves, MacDonald, & Miell, 2005). Even the abstract intellectual meanings contained in music can communicate extramusical meanings, e.g., emotional states or personal memories. Research into the behavioral, physiological and neurological basis of music processing confirms that music does activate the brain structures associated with emotion (e.g., Blood and Zatorre, 2001; Peretz, 2001), and that perceivers do respond to music affectively (e.g. Krumhansl, 1997), and that they experience physiological responses to music, e.g. shivers down the spine, tears or laughter (Sloboda, 1991).

When it comes to the origins of emotion in music, Trainor and Schmidt (2003) argue that it lies in the infant-directed singing and that it served a role of strengthening infant-parental bond. Neurological studies show evidence that infants are able to process pitch and simple rhythms from a very early age (Corigall & Trainor, 2010). Infant-directed speech has characteristics of singing, with higher pitch and exaggerated pitch contours (Trainor & Zacharias, 1998), and both infant-directed speech and singing regulates mood in infants and communicates emotion (Trehub & Trainor, 1998). Moreover, infants are shown to engage more with maternal singing than with maternal speech (Nakata & Trehub, 2004). The effectiveness of music rather than speech for emotion regulation in young infants was also observed in a study comparing speech with singing. Trehub, Peretz and Corbeil (2016) placed 7- and 10-month-old French-speaking infants in an empty room, with no other person or stimuli that could soothe them, and played them tapes of either someone singing a Turkish song, or someone reading the lyrics of that song pronounced in an infant-directed manner. Based on the facial expressions registered during the test, infants that were exposed to the song recording remained calm twice as long as the children that listened to the reading. The same effect was observed in a version of the study when the unfamiliar voice in the recording sang or spoke in French, the children's native language (Trehub, Peretz, & Corbeil, 2016).

The important consideration is which aspects or dimensions of music are able to elicit certain affective states. The dimensions of music, like tempo, mode, loudness, pitch height and others, are able to influence emotional responding in different ways. In a study on the perception of musical emotions, Hevner (1935) revealed that tempo and mode were the strongest cues of perceived emotion in music. Specifically, fast tempos and major modes are associated with happiness, and slow tempos and minor modes are associated with sadness (for reviews, see: Juslin & Laukka, 2004; Gabrielsson & Juslin, 2003). Loudness is often associated with anger (Balkwill, Thompson, & Matsunaga, 2004) and can evoke negative feelings (Kellaris & Rice, 1993), but those emotions are usually detected less consistently by the listeners (Krumhansl, 1997). Changes of loudness (i.e., crescendos and decrescendos), timbre and harmonic and rhythmic complexity have been associated with some affective states, but those distinctions are less definitive and more subjective (e.g., flutes associated with peacefulness, Balkwill & Thompson, 1999; or sadness, Balkwill et al., 2004).

Infants are not able to perceive musical emotion on the same level as adults, especially in the context of instrumental music, and that ability will develop and mature through the process of enculturation (passively) and through education (actively), until their teenage years (Trainor & Corrigall, 2010). However, infants are able to process basic emotional cues in music, and make a distinction between 'happy' and 'sad' music (Nawrot, 2003). Young infants seem to be unable to recognize emotional meaning from some more complicated, instrumental music, but children as young as 4 year of age can associate music with non-musical references (e.g., pictures of animals with exerpts from Saint Saen's *Carnival* and Prokofiev's *Peter and the Wolf,* Trainor & Trehub, 1992). 5-year old preschoolers were found to rely on tempo in making the happy-sad distinction (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001), and the major-minor mode sensitivity to emotional cues appears further in the development, around 6-8 years of age (Gerardi & Gerken, 1995; Della Bella et al., 2001).

It has been also observed that young infants are reacting to arousal cues in the music as well. For instance, 6- to 7-month-old infants behave differently when they listen to lullabies compared to when they listen to play songs, as they tend to look down, more inward in the case of the first, and at their parents in the case of the latter (Rock, Trainor, & Addison, 1999). This observation suggests that the infants recognize the difference in arousal of those songs, as lullabies are calming, and play songs are activating.

There is some disagreement between scholars on what emotions music evokes, whether music evokes any emotions at all, and if they are uniquely musical emotions (Juslin & Västfjäll, 2008). Two

types of emotions are in question here: the 'perceived emotions' represented or communicated by music, and the 'felt emotions', i.e. the emotional reactions in the listener. Some theorists representing the *cognitivist* side of the debate on music and emotion (e.g., Kivy, 2001) argue that the emotions experienced when listening to music are not full emotional reactions (as *emotivitsts* claim), but rather an effect of the listener's evaluation of musical features. For instance, music is not making us *feel* sad, it just has features that *express* sadness. However, the dominant view is that emotion perception and emotion induction can take place at the same time, but that the perception of emotion does not have to lead to the feeling of emotion (e.g., Gabrielsson, 2002).

According to the *appraisal theory,* possibly the most common position within the research on affect, emotions cannot be explained in terms of objectively defined stimuli, but as a result of a *cognitive appraisal* of a target, such as a musical piece (see. Smith & Lazarus, 1993). Thus, music gains significance from how it is processed by a particular individual in a particular context (Juslin & Sloboda, 2013). Juslin & Västfjäll (2008) propose, in addition to cognitive appraisals, six other ways that explain how music can evoke emotions in the listener: 1) brain stem reflexes, such as reactions to dissonance; 2) conditioning, i.e., a particular piece or genre is associated with a positive or negative emotion, 3) contagion, i.e., perceptions spread to feelings; 4) visual imagery, i.e., images evoked by music act as cues to an emotion; 5) episodic memory, e.g., an association between a piece of music and a specific autobiographical event of emotional significance; and 6) after Meyer (1956), expectancies that are fulfilled or denied.

The distinction between emotions and moods is blurred in the context of affective states evoked by music. Matravers (1998) argues that musical affect consists solely of a subjectively felt component of an emotion, and not one of a full emotion. Moods are usually defined as relatively long-lasting feelings with no clear target (e.g., Frijda, 1994) that are linked with a disposition towards certain kinds of cognitions (Frijda, 1993), and mood is the most common affective state associated with listening to music.

When considering different dimensions that can contribute to the mood-inducing effect of music, Hunter and Schellenberg (2010) include the influence of *liking* and *familiarity*. Music's positive effect on a listener's mood can be stronger if it matches her musical taste and preference for certain types of music, or even her preference for specific pieces of music. Some music preferences are subjective, based on previous musical experiences and knowledge about music, but some preferences appear to be more universal. For instant, the preference for consonant music, associated with music

eliciting positive mood, seems to be more universal than other musical features, like harmony or timber. Even very young infants respond more positively towards consonance over dissonance in music (Trainor et al., 2002; Zentner & Kagan, 1998). There are reasons to believe that this preference might be biological and innate, since the liking for consonance has been observed in children as young as 2-month-old infants (Trainor et al., 2002) and in a cross-cultural study (e.g., Fritz et al., 2009; for a review, see: Plantinga & Trehub, 2014).

Music's ability to alter affective states has been utilized in different studies on the processes connected to emotion, and in studies on non-musical cognitive abilities, including in studies on children. Most recently, a new line of research has emerged which investigates the influence of music on divergent and convergent creative production. Previously, music has been implemented as a mood-inducing tool to strengthen the effect of other mood inducing procedures in some early studies on mood induced creativity. For instance, Kavanagh (1987) induced in the participants a sad or happy mood through combining music excerpts and a recollection of a past emotional experience. Music was found to change mood and arousal of children before (Rock, Trainor, & Addison, 1999; Trehub, Peretz, & Corbeil, 2016). There is some evidence that music can enhance creative processing, with some indication that it can be a beneficial contributor in improving children's divergent creativity.

5 Effect of music listening on creative thinking: State of the art

The effect of music on creative processing has until recently been largely unexplored, despite evidence that music can improve cognition, including non-musical cognitive processes. Mood and arousal level can affect performance in a number of cognitive tasks (Thompson et al., 2001), and music can be an effective tool in inducing and controlling mood (Phillips, Bull, Adams, & Fraser, 2002), so it has also potential to benefit creative thinking in divergent and convergent ability tasks.

In one of the first studies that included music as single mood-inducing stimuli in order to boost creativity, Curnow and Turner (1992) split participants between four 20-minute conditions: exercise, exercise with music, listening to music and a silent control condition (reading sports magazines). The music stimuli consisted of a tape recording of "acoustic and electronic instrumentation". Creativity was measured by the Torrance Test of Creative Thinking and took approximately 30 minutes to complete. The authors observed an increase in the fluency scores for all three conditions in comparison to silent magazine-reading.

Adaman and Blaney (1995) tried to induce 'depressed', 'elated' or 'neutral' mood by using music, after which participants were asked to complete a divergent creativity task, the alternative uses task (AUT) for a household item. Interestingly, both the depressed and elated conditions showed a significant increase of the fluency score in comparison to the neutral condition. However, the originality score increased only in the depressed mood condition, while no effect for the flexibility score was found. Unfortunately, the stimulus used in this study is not precisely described, as it constitutes of 20-minute-long musical tapes created by Pignatiello, Camp and Rasar (1986), who observed the selected music's mood-inducing ability by measuring the heart rate of the perceivers, and by assessing the inter-rater reliability of mood induction.

Ilie and Thompson (2011) measured the creative performance of participants after exposing them to musical stimuli in the form of of 8 manipulations of a Serenade in D Major by W. A. Mozart, 3 part (7:18). The separate versions (in a factorial 2x2x2 design) were achieved by manipulating intensity (loud or soft), rate (fast or slow), and pitch height (low by two semitones down or high by two semitones up). A pilot study ensured that the manipulated excerpts sounded natural, as the participants in the pilot study positively assessed that the excerpts could be encountered in a regular music experience. Creativity was measured by Duncker's candle problem and Maier's two-string problem

tasks (Maier, 1931), which are problems associated with the convergent type of creativity. The analysis revealed that the high-pitched music increased the success rate of the creativity insight tasks. That effect was linked to the positive emotional valence the participants associated with high-pitched music, as was demonstrated by the answers to additional questions on the perceived emotional valence of the stimuli.

Yamada and Nagai (2015) explored the effects of positive mood on creative performance by examining both divergent and convergent thinking. In this case, positive mood was induced by positive music stimuli with the additional instruction to think about happy events (happy group). The music example chosen for that condition consisted of a 10 minutes long jazz interpretation of Bach's Brandenburg Concerto No. 3, performed by flautist Hubert Laws with an ensemble. The control group listened to a 10-minutes-long recording of the Japanese Constitution being read aloud (neutral group). Participants' emotional arousal was measured before and after mood induction, after which all the participants were asked to generate new names for rice. A manipulation was introduced by naming five non-existent examples of rice-names involving the suffix 'hikari', which is typical for Japanese rice names. This design forced participants to focus on the more common names for rice. All the listed responses were then assessed as generated due to a divergent or convergent type of thinking, where all the names containing the suffix 'hikari' were classified as convergent (Dijksterhuis & Meurs, 2006), while others were classified as unconventional and divergent. The positive condition group was on average more successful in generating unconventional ideas than the neutral group, although no difference for convergent ideas was observed. The authors concluded that positive mood facilitates divergent thinking, but not creativity understood in terms of convergent thinking. Further research could explore the possibility that negative moods (e.g., anger) might enhance convergent performance.

A highly relevant study for this thesis was done by Ritter and Ferguson (2017), who measured the influence of music on creative cognition by using both divergent and convergent creativity tasks. The aim of their experiment was to investigate whether listening to specific mood-inducing music might facilitate creative cognition in opposition to a silence control condition. What was particularly novel about this study was that the creativity tasks were performed at the time of the exposure to the music stimuli, as a background music. For the stimuli, four musical pieces were selected. They were chosen for their mood-inducing properties, previously confirmed in other research (Jefferies, Smilek, Eich, & Enns, 2008). The five musical pieces were expected to elicit moods referred to as *calm* (positive valence, low arousal), *happy* (positive valence, high arousal), *sad* (negative valence, low

arousal), *anxious* (negative valence, high arousal), and *silence* (for a list of the musical examples, see: Figure 3).

Valence	Arousal	Condition	Title	Composer	Average RMS Amplitude
Positive	Low	Calm	Carnival of the Animals: XIII. The Swan	Saint-Saens, Camille	-30.15 dB
	High	Happy	The 4 Seasons, Op. 8, No. 1, RV 269, Spring–Mvt 1. Allegro	Vivaldi, Antonio	-27.05 dB
Negative	Low	Sad	Adagio for Strings, Op. 11	Barber, Samuel	-37.23 dB
	High	Anxious	The Planets: Mars, Bringer of War	Holst, Gustav	-27.96 dB

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Figure 3: Details of the music stimuli played during calm, happy, sad and anxious condition (Ritter & Ferguson, 2017)

To measure creativity, two tests were used: AUT for divergent thinking, and for convergent thinking the Idea Selection Task, the Remote Associates Task and the Creative Insight Task. In the AUT portion of the study, participants were asked to present as many applications of a 'brick' as possible. During the Idea Selection Task, participants were supposed to select the three most creative out of 10 different kitchen inventions and grade those items by their level of creativity. An idea selection score and a mean idea selection score is given based on expert ratings of the answers generated in the Idea Selection Task. The Remote Associates Task (adapted from: Chermahini, Hickendorff, & Hommel, 2012) was completed in English or Dutch (chosen by the participant). The Creative Insight Task consisted of the 'Two-string problem' and the 'Duncker candle problem'. Participants were questioned about their mood pre-testing. At the end of the testing, participants rated how much they liked the music and described the emotions evoked by the music (by indicating valence and the arousal level of the pieces).

After statistical analysis, a significant difference was observed on the overall divergent thinking scores between the happy music and the silence conditions, which supports the hypothesis that positive mood can enhance divergent creativity. No comparable difference was observed between the other conditions in comparison to silence. Also, no change between conditions was observed for convergent creativity tasks, but that effect could be attributed to the lack of randomization of the distribution of creativity tests between participants. The possibility of an order effect on the result cannot be excluded.

Based on the findings of Ritter and Ferguson (2017) that happy music induces divergent creativity, Threadgold, Marsh, McLatchie and Ball (2019) conducted a study designed to examine the

effect of background music on creativity thinking in terms of joined convergent and divergent thinking production measured in a Compound Remote Associate Tasks (CRAT, e.g. Bowden, Jung-Beeman, Fleck, & Kounios, 2005). In the CRAT task, participant is being shown three words (e.g. dress, dial, and flower) as asked to find fourth word that can be combined with each of the other three words and form a common word or phrase (e.g. adding word 'sun' can form words 'sundress', 'sundial' and 'sunflower'). The authors argued that the effect observed by Ritter and Ferguson (2017) might be statistically insignificant when controlled for all the music conditions in their between-participants design, since the statistical analysis that produced the evidence for an effect was conducted only between the 'happy music' condition and the silence condition, with disregard to the other mood conditions.

Threadgold and colleagues turned to the research into impact of noise on creative cognition measured in RAT performance (e.g. Hillier, Alexander, Beversdorf, 2006; Mehta, Zhu & Cheema, 2012), with the basic premise that auditory distraction created by changing elements of the music (frequency, pitch, timbre and more) can disrupt short-term memory performance (e.g., Jones & Macken, 1993). In this understanding, background music would rather lead to lowered creativity performance scores. Three experiments with adult participants were conducted for the study designed to compare CRAT scores in the silence condition against music conditions. In all three experiments, participants performed better on the CRAT when there was no music (silence condition) than when there was background music, whether this music was a Spanish translation of a UK pop song (Experiment 1), an instrumental version of the same pop song (Experiment 2), or a mid-tempo soul/neo-soul song (Experiment 3). The songs were either meant to "be-ignored" (Experiment 1) or elicit positive mood and high arousal.

Another study investigated the influence of music on divergent and convergent production in comparison to physical exercise and silence. Firth and Loprinzi (2018) designed an experiment with three conditions, where each of the adult participants took part in three 15-minute study sessions: treadmill walking, listening to self-selected music, or a seated social media browsing control condition. After each session, participants completed four creativity tests: AUT, Realistic Presented Problem (Runco & Okuda, 1988), Realistic Problem Generation, and the RAT. Each of the participants completed all four tests with randomized questions/tasks per session. The results of the analysis did not show any significant effect of neither exercise nor music on creative performance. The music used in this study was self-selected by participants, and the assumption was that it will be enjoyable. However,

the possible *arousal potential* of a stimulus might be tinted if the exposure to a certain stimulus is too frequent, as fatigue and boredom sets in (an inverted-U shaped function, Berlyne, 1970; Stang, 1974). The addition of some experimenter-selected music could be helpful to boost the arousal potential of well-known musical examples.

All groups sampled in the beforementioned studies consisted of students of similar mean age, which makes the studied population quite homogenous, but some evidence for the effect of music-induced mood on creativity has been observed in a study with children as well. Schellenberg, Nakata, Hunter and Tamoto (2007) conducted experiments in order to further test the validity of the *arousal and mood hypothesis* (Thompson et al., 2001), and investigate its potential influence on cognitive abilities *other* than spatial-temporal for children as well. There were 39 participants, all of them 5-year-old preschoolers, who were divided between four different conditions. Two groups listened to classical music (Albinioni or Mozart), the third group listened to familiar children songs, and the fourth group sang two of those songs. Each child was asked to make a drawing some days before (to establish a baseline) and right after listening to music, and those drawings were subsequently compared for each child by adult judges on three different scales (creativity, energy and technical proficiency). The difference in scores from the comparison became the rating for each child, and it was observed that children listening to or singing familiar children's music had longer increases in drawing times relative to baseline and that their drawings were considered to be more creative, energetic and technically more accomplished. In summary, the study provided evidence that the arousal and mood induced by music has influence on some aspects of creative performance, and thus, even though creativity was not measured by divergent or convergent thinking tasks, Schellenberg et al.'s study has direct implications for the study performed in this thesis.

Across the few studies exploring music's influence on creativity defined by divergent and convergent processes, several different approaches were used in the experimental design. An uneven amount of space in the writing is dedicated to the description of the musical stimuli and the process of its selection. Most of the studies have used classical music examples for their stimuli and one have used popular music examples, but little is known about which specific musical pieces were used as stimuli (with the notable exception of: Yamada & Nagai, 2015; and Ritter & Ferguson, 2017). All of the above-mentioned studies have used music that was meant to induce positive mood, but the criteria they employed for choosing the stimulus were different. The described auditory stimuli examples represented studio-recorded instrumental music, although some of them were manipulated in order to

control their mood-inducing features. The subject of ecological validity has been mostly ignored in all of the aforementioned studies. It seems that it would be beneficial to introduce a more varied approach to the selection of stimuli (i.e., to include popular music examples, or to allow participants to select their own music according to the specified criteria; Schubert, 2007). Except for the study by Illie and Thompson, none of the studies performed additional measurements in order to confirm the reliability of the stimuli as a mood-inducing tool. Ritter and Ferguson (2017) asked participants to describe the mood of the stimuli examples during the experiment, but as they point out themselves, observing heart rate and diastolic condition could prove to be more reliable than self-reported data. Threadgold and colleagues utilized popular music, which could potentially increase the positive mood-induction, but they do not explain the stimulus in enough detail, focusing rather on the dimension of lyrics in the song, rather than musical content. They even refrain from naming the songs used in the study, and make it difficult to understand indeed if it was one or more songs.

Although the amount of studies on the music-creativity thinking relation is relatively small, the results generally support that music which induces positive mood can increase divergent creativity. Such results were observed in Yamada and Nagai (2015) and Ritter and Ferguson (2017). Although some other studies failed to find any influence of music on creativity, it still seems like there is potential to reproduce an effect of positive music on creativity. The differences in methodologies and applied stimuli makes it impossible to generalize any of the reached conclusions. The findings reported by Schellenberg and colleagues (2007) indicate that music *does* seem to induce creativity in children, and therefore exploration into the mechanisms of that effect is necessary and valuable.

6 The present study

The research into the influence of music listening on creativity is relatively new, and there is still potential to deepen the understanding of that relation. The methodological approaches across the studies vary when it comes to the musical stimuli and creativity measurements, therefore evaluation of the reported results presents some difficulties. However, some evidence indicates that music can be used to improve divergent thinking performance (Yamada & Nagai, 2015; Ferguson & Ritter, 2017) and that it can enhance picture-drawing creativity in preschool children (Schellenberg et al., 2007).

Based on the fact that music can increase divergent thinking in adults and some types of creativity in children, the present study aims to investigate the possibility of divergent thinking enhancement in young children with the use of positive mood-inducing music. The significance of music for child development as an emotion-regulating tool and a facilitator of social bonding (Kopp, 1989; Thompson, 1994), makes it an especially useful stimuli for positive mood-induction in small children, and possibly a more effective strategy for enhancing creativity than among adults. To my knowledge, this will be the first attempt to investigate whether positive music can enhance divergent thinking in preschoolers. Preschool children in the age of 3- and 4-years old have not yet reached the higher level of emotion regulation (Miyake et al., 2000), and their processing of emotional music cues resembles still that of an infant (e.g., Della Bella et al., 2001). At the same time, their abilities to communicate, follow instruction and focus on the stimuli is better than that of an infant. The development of an age appropriate, reliable creativity measuring instrument called the ‘Unusual Box Test’ makes it possible to conduct studies on such young participants and measure their divergent performance (Hoicka et al., 2013).

In the present study, 3- and 4-year-old children will be asked to play with an “Unusual Box”, and their divergent creativity will be measured by recording how creatively they play with the box. Importantly, the children will be randomly assigned either to a music condition, where they will hear popular children’s songs, or to a reading condition, where they will hear reading of a popular children book. Both music and language feature prominently in the auditory environment of young infants, and they both play important roles in the acquisition of communication, social bonding and play, as well as in cognitive development in early childhood (Trehub & Trainor, 1998). There is a link between child-directed speech and child-directed singing, and children use cues from both speech and singing for emotion-regulation purposes. Choosing both a singing condition and a book-reading condition allows

the comparison between two auditory stimuli and possible observation of the effectiveness of one over the other. Trehub, Peretz and Corbeil (2015) have observed that singing, even in a foreign language, keeps young infants in a stressful situation calm for a significantly longer period of time than infant-directed speech. Thus, one-voice children songs have the potential to be more successful mood-inducing stimuli than book-reading.

I propose two hypotheses based on the previous findings from the research on divergent thinking creative production:

1) Children performing the UBT in the music listening condition will receive higher fluency and total originality scores in the divergent thinking test than children placed in the book reading condition, as previous research indicates that music can induce divergent creativity (Ritter & Ferguson, 2017; Wolff, 1978).

2) Children with a higher fluency score in the UBT will also receive a higher originality score, supporting an observation that increased fluency can lead children to be more original (e.g. Mednick, 1962; Clark & Mirels, 1970; Torrance, 2008).

This study is unique in its approach. It is the first known attempt to investigate if music of positive valence and high arousal can actively promote divergent thinking in young children in the same ways, as it has been observed in adults (Yamada and Nagai, 2015; Ritter and Ferguson, 2017).

The study has been approved by the Norwegian Centre for Research Data (NSD), and the collection of personal information has been permitted (see: Appendix 1).

6.1 Method

6.1.1 Participants

Twenty-one children participated in the experiment. There were 11 children in the music condition. They had a mean age of 51 months *(SD* = 5.76), with age ranging between 39 – 58 months. Six of them were boys and five of them were girls. There were 10 children in the book reading condition with a mean age of 51.10 months (*SD* = 4.82), with age ranging between 40 – 57 months.

Eight of them were boys and two were girls. One additional child refused to continue with the play in the middle of a session and was thus not included in the analysis. Data were collected in May 2019 and in February 2020. All children recruited to the study came from two Oslo kindergartens, where the experimenter worked as a temporary kindergarten assistant in the time between August 2016 and May 2019. Each participating child knew the experimenter as a member of the teaching staff, and voluntarily joined the experimenter for individual study sessions. All parents gave written consent for their child to participate in the study (see: Appendix 2), and completed a questionnaire about their child (see: Appendix 3). Parents reported their education as postgraduate degree (25), undergraduate degree (9), high school diploma (2).

6.1.2 Materials

The Unusual Box (see: Figure 4) is a colorful wooden box (33.6x18x14.4cm) with the following features: (1) ledges: additional small blocks and a small shelf attached to the frontal long side; (2) strings: 21 hanging tie-wraps tied across a wire on the short left side of the box, (3) rings: 7 tie-wraps rings in different sizes and colors on the long back wall, (4) a round hole (5.7cm in diameter) cut on the right short side that leads to (5) an open rectangular space (10x5x8cm) with (6) two steps in the middle leading to a small edge (around 2/3 of the box). The version of the Unusual Box used in this experiment was made based on specifications provided by Elena Hoicka (personal communication). The box was placed on a table (25cm diameter), and was easily reachable for the children from all sides. During the test, children were given in turns five novel objects to interact with the box (spiral-shaped egg holder, Kong rubber toy, hook, spatula, feather roller, see: Figure 4). Two cameras placed at approximately 1m height on two sides of the children recorded the sessions.

Children could participate in the study after parents had delivered written consent and filled out the questionnaire. The questionnaire was designed to allow parents to share their observations on their child's musicality (e.g. willingness to participate in a song or a dance) and to report to which extent their child is exposed to music (e.g. how often the child listens to radio or attends music concerts).

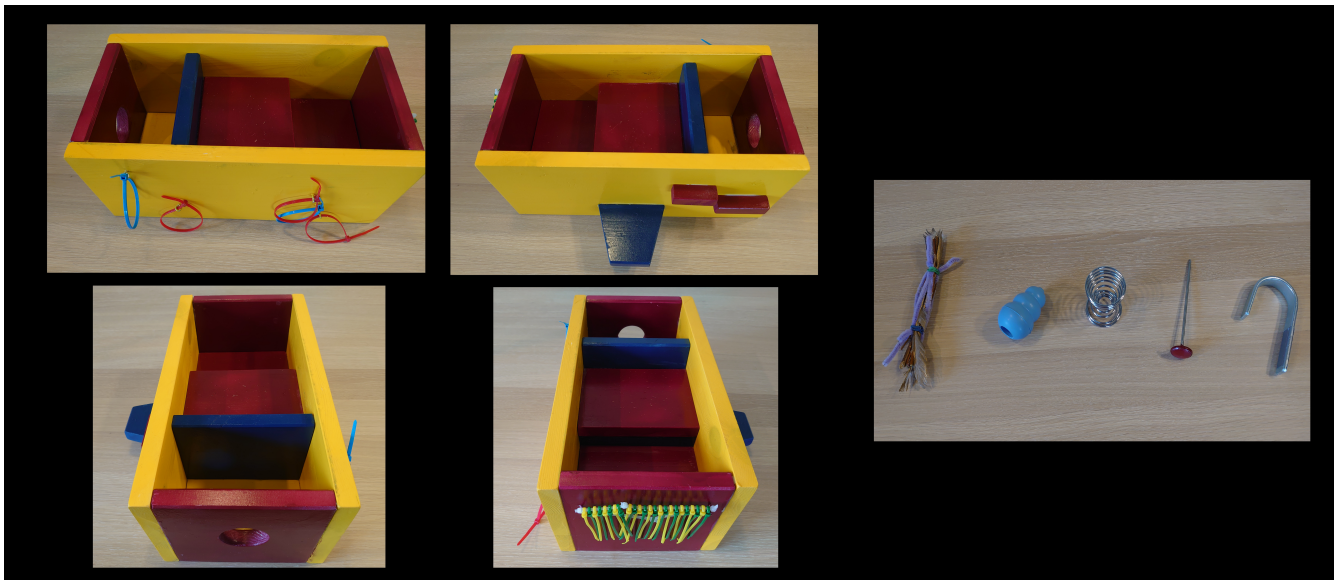


Figure 4: Version of the unusual box used in the experiment (based on: Hoicka et al., 2013)

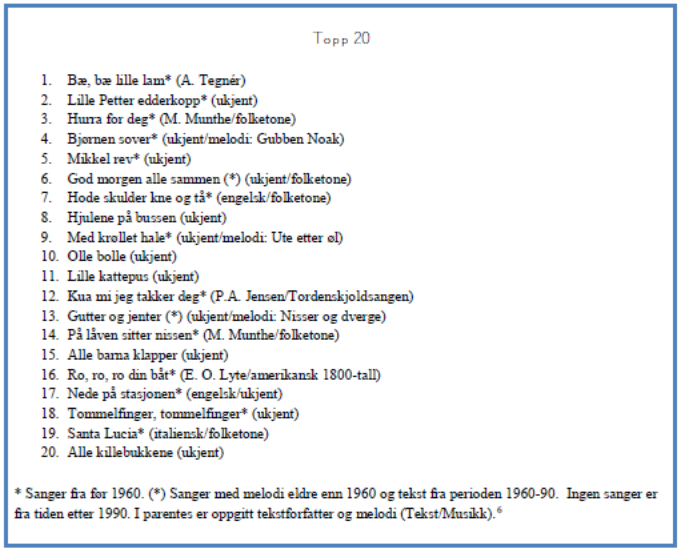
6.1.3 Design

A between-subjects design was used with different children in different conditions. In the *music* condition, the experimenter performed for the child an approximately 10-minute-long set of children's songs, after which the Unusual Box Test (UBT; Hoicka et al., 2013) was performed. To ensure that participants were familiar with the music, the songs were chosen from a list of the most popular Norwegian children songs performed by teachers in the kindergartens of the Oslo area (Oslo og Viken nee. Akershus; Haukenes, & Hagen, 2017). The set consisted of 10 songs (see: Figure 5) selected for their familiarity, high arousal and positive mood inducing properties. Some of the chosen songs are typically performed in kindergartens with the addition of hand gestures, so the experimenter included that choreography in the performance to ensure the ecological validity of the session[4]. To assure similarity in the stimuli between sessions, the experimenter would each time begin singing from the D5 tone according to a pitchfork.

The length of the stimuli was set to 10 minutes to ensure the proper level of mood induction, but not tire and cause boredom in the children (e.g., Schellenberg, 2007). A set of ten different songs assures enough change during the stimuli that would stimulate interest and allow the child to maintain

[4] *Lille Petter edderkopp*, *God morgen alle sammen*, *Hode skulder kne og tå, Hjulene på bussen*, *Med krøllet hale* are the songs usually peformed with hand gestures.

focus for the required time of the exposure to the musical stimulus similar to the book reading, where each new page sparks renewed interest in the story (Berlyne, 1970). Those strategies are particularly important for younger children and children with a less developed ability to maintain attention.



Topp 20

1. Bæ, bæ lille lam* (A. Tegnér)
2. Lille Petter edderkopp* (ukjent)
3. Hurra for deg* (M. Munthe/folketone)
4. Bjørnen sover* (ukjent/melodi: Gubben Noak)
5. Mikkel rev* (ukjent)
6. God morgen alle sammen (*) (ukjent/folketone)
7. Hode skulder kne og tå* (engelsk/folketone)
8. Hjulene på bussen (ukjent)
9. Med krøllet hale* (ukjent/melodi: Ute etter ol)
10. Olle bolle (ukjent)
11. Lille kattepus (ukjent)
12. Kua mi jeg takker deg* (P.A. Jensen/Tordenskjoldsangen)
13. Gutter og jenter (*) (ukjent/melodi: Nisser og dverge)
14. På låven sitter nissen* (M. Munthe/folketone)
15. Alle barna klapper (ukjent)
16. Ro, ro, ro din båt* (E. O. Lyte/amerikansk 1800-tall)
17. Nede på stasjonen* (engelsk/ukjent)
18. Tommelfinger, tommelfinger* (ukjent)
19. Santa Lucia* (italiensk/folketone)
20. Alle killebukkene (ukjent)

* Sanger fra før 1960. (*) Sanger med melodi eldre enn 1960 og tekst fra perioden 1960-90. Ingen sanger er fra tiden etter 1990. I parentes er oppgitt tekstforfatter og melodi (Tekst/Musikk).[6]

Figure 5: Most popular songs from the kindergartens in the Oslo area (taken from: Haukenes & Hagen, 2017)

The children assigned to the *book-reading* condition listened to an approximately 10-minute-long book reading performed by the experimenter. Both conditions (singing and book-reading conditions) involve auditory stimuli that are quite similar, since they are both vocal, similar in the way they are produced, but different in the ways they are processed cognitively. To ensure a large enough difference between stimuli, the book was read with a relatively monotonous recitational tone. A reading condition has successfully stimulated convergent production in another study, but not divergent production (Yamada & Nagai, 2015). A third, silent condition should have possibly been included as a control condition, but here it was omitted because of the limited scope of the study. Instead, the two chosen conditions allow to determine if there is a detectable difference between how non-musical, possibly mood-inducing vocal stimuli vs. musical stimuli might influence the creativity score.

The flip-flap book *Bukkene Bruse på badeland* by Bjørn F. Rørvik (2015) was chosen for the book-reading condition for its popularity[5], and because it has positive mood inducing properties. The book is filled with child-like drawings with bright colors and has a humoresque story based on a well-known traditional Norwegian folktale. The addition of flip-flaps created a possibility for the child to engage physically in the reading, similar to the hand choreography of the songs in the singing condition.

6.1.4 Procedure

Testing took place in the participating child's kindergarten, usually in between common meals or in the time of free play. Only rested and content children were tested, since tiredness could have a negative effect on divergent thinking. Each child participated individually in the experiment, and only the experimenter was present in the room beside the participant. The children considered the experimenter as a part of the teaching stuff and no child expressed any sings of uneasiness during the experimental sessions. Children were randomly assigned to either the music condition or the reading condition. Before the experimenter began singing/book reading, children were informed that they may join in the singing or open the flip-flaps of the book, if they wanted.

Immediately after the child was exposed to the stimuli (singing or reading), the child was presented with the unusual box. The previously disguised box was revealed and placed on the stool before the child, and the experimenter highlighted all the properties of the box by pointing to them. The child was then encouraged to get familiar with the box by looking at it from all sides for an additional 10-15 seconds. Then the experimenter picked up one of the objects and gave it to the child while encouraging the child to play with the object and the box. After a trial of 90 seconds was over, the toy was taken back with praise and a smile, and a new toy was given to the child. The procedure was identical for five different objects/toys. The objects were given in a randomized order. If the child expressed unwillingness to play with an object, the experimenter would encourage it to play a little longer. If any questions came up during the test, the experimenter would use standardized responses, like 'play a little longer', or 'now it is time to play'. If additional questions came from the child, the

[5]It was the most popular children's book in Norway in the years after its original release in 2009, and it is present in the libraries of most Norwegian kindergartens (Bjørnskau, 2014)

experimenter answered: ’I don’t know’, or ’we will talk about it later’. If a child would move away from the box for a longer period, the timer was paused and resumed immediately after the child came back to play with the box. Such breaks were rare, and were usually caused by the necessity to retrieve a toy after it was lost during play.

6.1.5 Coding

The coding was performed by the experimenter by analyzing the video recordings from each experimental session. Typically, one video recording angle was used for the coding, with the other angle used as a control for instances when the child obscured the view of the camera. Each coding session took around 20 minutes. Optimally, the videos should have been coded by another rater as a quality control and to check inter-rater agreement, but it was not possible for this study due to resource constraints.

Each time a child received a toy and started moving towards the box with the intention to play, a new trial started and lasted for 90 seconds. Following the procedure described by Hoicka et al. (2013), two types of divergent thinking scores were calculated for each child: a fluency score and a total originality score. The fluency score was based on the number of different actions that the child performed for all trials combined. Those actions were recorded on two elements: the type of executed action (e.g. place, hit, move, with altogether 18 different actions[6].

The originality score is based on the frequency of certain actions among all the participants. First, an originality index was created by listing all the novel actions performed by all the children in the experiment. The actions performed by fewer than 5% of participants received a score of 3; actions performed by 5-20% of participants would receive a score of 2; actions performed by 20-50% of participants received a score of 1; and actions performed by more than 50% of participants received a score of 0. Adding up the originality scores of all the actions of one participant makes a total originality score for each child.

In addition to divergent thinking scores, a musicality score and music exposure score were calculated for each child based on the answers given by the parents in the questionnaire (see: Appendix 3). The musicality score was created by summing points given according to the answers about the

[6] The scoring sheet for the procedure and the list of all possible actions were made available by one of the authors, Elena Hoicka.

child's musical behavior (spontaneous singing, dancing, and readiness to join in a song). The music exposure score was based on the ratings of how frequently the child would spend time on perceiving music (e.g. listening to radio, attending a concert) or on musical behavior (playing music). Those scores will be included in the analysis in order to explore if other musical related activities might have an effect on the child's divergent thinking performance.

6.2 Results

First, the data was analyzed in order to detect any possible outliers. Descriptive statistical analysis of the fluency and total originality scores did not show any outliers that could cause skewness of the data. The scores were approximately normally distributed, and all of them have been included in the further statistical analyses.

In order to investigate the main hypothesis of a difference between the music and the reading conditions with regards to divergent thinking, means of fluency scores and total originality scores were compared in two separate independent samples t-tests (for an overview of the results, see: Table 1). Participants in the music condition (N = 11) received on average higher fluency scores (M = 47.18, SD = 9.42) than participants in the reading condition (N = 10; M = 45.20, SD = 9.66). This difference gives a small effect size, Cohen's d = 0.21, but the effect was not statistically significant with a conventional alpha-level of .05, since $t(19) = .48$, $p = .64$. Similarly, total originality scores for children in the music condition were higher (M = 29.82, SD = 10.51) than those of the children in the reading condition (M = 26.50, SD = 9.77). The effect size here is still relatively small, Cohens d = 0.33, and this effect was also not statistically significant, $t(19) = .75$, $p = .46$.

To explore the possibility of a long-term impact of music on divergent thinking test performance, further statistical analysis confronted the data from the UBT with both musicality and music exposure scores. Children in both musical and reading condition had on average comparable musicality scores, where those in the music condition had M = 11.00, SD = 1.18, and those in the reading condition had M = 10.00, SD = 1.56, with no statistically significant difference between the groups, $t(19) = 1.66$, $p = .11$. Children in the music condition had higher values of exposure to music scores (M = 1.40, SD = 3.00), than their reading condition counterparts (M = -1.54, SD = 1.73). In this case, the difference between the groups was statistically significant, $t(19) = 2.70$, $p = .01$, which is

lower than the alpha level of .05. This indicates that in a possible ANOVA analysis, exposure to music score should not be used as a covariate.

Condition	Singing condition	Reading condition
Fluency	47.18 (9.42)	45.20 (9.66)
Total originality	29.82 (10.51)	26.50 (9.77)

Table 1: Mean fluency and total originality scores in the singing and reading conditions with standard deviations in parenthesis.

The fluency, total originality, musicality and exposure to music scores were further investigated for correlations. The bivariate Pearson correlation indicated that there was a strong and significant positive association between fluency and originality scores ($r = .81$, $p < .001$). The other results of the Pearson correlation were not statistically significant (see Table. 2). An additional correlation analysis, investigating correlations separately for the two conditions, revealed only that there was a statistically significant correlation between higher exposure to music scores and fluency scores in the reading condition ($r = .65$, $p = .04$).

Correlations			
	Total originality	Musicality	Music exposure
Fluency	$r = .81, p < .001$	$r = .07, p = .76$	$r = .06, p = .79$
Total originality		$r = -.08, p = .75$	$r = .22, p = .33$
Musicality			$r = .37, p = .10$

Table 2: Correlations between fluency, total originality, musicality and music exposure scores.

Finally, a univariate ANOVA was performed for both fluency and originality score in order to explore the possibility of an influence of additional variables (musicality scores, age and sex) on the

divergent thinking test performance. No significant effects were found. Furthermore, no effect of the children's age, parents' education or sex on divergent thinking was found.

Overall, the results of this study do not support the hypothesis that exposure to music can actively promote divergent thinking in children. However, the results do seem to demonstrate that the Unusual Box Test is a relevant divergent thinking measuring tool.

7 Discussion

The present study is the first to assess the efficacy of music listening as a strategy for increasing divergent thinking performance in preschool children. The means of doing so involved using the Unusual Box Test (UBT) procedure to measure divergent thinking performance in 3- and 4-year old children right after they listened to music. The divergent creativity performance of the children, as measured in their fluency and originality scores, seems to support the effectiveness of the UBT as a divergent thinking measurement, since higher fluency scores were associated with higher originality scores, as expected in the second hypothesis. However, the first and most important hypothesis, namely that fluency and originality scores would be higher in the music condition than in the reading condition, was not confirmed. While mean fluency and originality scores did show a slight improvement in the music condition in comparison to the book-reading condition, the effect was not statistically significant. This suggests that the effects of listening to music on creative performance in preschool children are at best small, at least when compared to book-reading. Although previous work has demonstrated the benefits of music-induced positive mood on divergent thinking (Yamada & Nagai, 2015; Ritter & Ferguson, 2017), this study failed to produce a similar improvement. There are several possible ways to interpret this difference from previous studies. My three main suggestions are that (1) affective states do not influence creativity measured with UBT, (2) the music did not effectively induce a positive mood, or (3) both book reading and music listening induced positive mood to the same degree.

The results of the study do not categorically exclude the possibility that music can enhance creativity in children. Most of the studies on creativity induced by passive music exposure include a silence condition (i.e., a condition where the participants are not exposed to any music stimuli). In this case, such a control condition was omitted, due to the limited scope of a master thesis study. The purpose of using two very similar auditory stimuli was to highlight key differences between music and speech and emphasize the arousal potential of music over speech. Both reading and singing are already used by kindergarten teachers for enrichment of group activities and for mood control, and it is possible that both stimuli were equally activating and both improved performance in the creativity test. Introducing a silence control condition would make it possible to compare the effectiveness of both auditory stimuli against no stimuli.

Music has been observed to elicit more positive mood in infants in comparison to speech (even infant-directed speech; Trehub, Peretz & Corbeill, 2015). A study by Schellenberg and colleagues (2007) managed to observe an effect of *familiar* music listening and singing on the creativity of drawings created after singing/listening to music. From an evolutionary perspective, familiar music might signify the presence of a caregiver and communicate safety. Even newborns respond to familiar music and it lowers their stress (Trehub, Becker & Morley, 2015). The songs included as the music stimuli in this study belong to the most known and widely performed in the kindergartens in Norway. The first of the songs, *Bæ bæ lille lam*, is often the very first song that Norwegian children learn to sing with words ('ba' is typically one of the first pronounced sounds by infants; Kuhl & Meltzoff, 1996). In other words, the songs should be highly familiar to the participants. However, it is possible that children of 3-4 years of age are not as interested in those songs anymore, and that the inverted-U function peak has been reached and passed, and that such well-known songs elicit feelings of boredom rather than of joy and interest (Berlyne, 1970; Stang, 1974). Thus, it is possible that the children songs did not elicit positive mood intensive enough to produce an improvement of creativity.

According to the findings of the Schellenberg et al. (2007) study, children who listened to children songs or sang children songs, performed better in a picture-based creativity test than children who listened to pieces by Mozart or Albinioni. This finding indicates that children songs are indeed a proper selection for participants of the age that took part in the current study. However, in the Schellenberg et al. study, children listened to the music and sang the songs (in two respective conditions) together in a classroom, since measuring creativity by picture-drawing allowed the test to be administered with everyone present. Adding this social aspect could possibly strengthen the mood-inducing effect of the music in both the singing and the listening condition. Group music-making involves empathy-related responses that allow coordination and synchronization of behavior through prediction and imitation (Cross, Laurence, & Rabinowitch, 2012). Joined music-making facilitates group cohesion and social bonding (in children as well; Kirschner & Tomasello, 2010), which allows musical emotion to spread more contagiously across the group. Group music listening may also serve a surrogate role for social interaction (Elvers, 2016; Lee, Andrade & Palmer, 2013). Thus, it is possible that the effect observed by Schellenberg et al. was in part due to the social aspect of music making and music listening in groups, which resulted with a higher intensity of the elicited mood.

When it comes to the book-reading condition, visual and tactile stimuli are powerful, and it is possible that the colorful pictures and flip-flap components in the book used in this study are a more

positive-mood inducing stimuli and potentially encouraging of explorative behavior than reading a book without pictures and flip-flaps would have been (Werner, 2011; Howard-Jones, Taylor & Sutton, 2002). In the music condition, the experimenter was singing with an engaging expression of joy on her face and expressively performed the choreography during some of the songs to counterbalance the activating aspects of the book, and most of the children kept eye-contact during singing. However, many of the children in the book-reading condition remarked that they knew of the book and that they had read it, but that they had never seen it with flip-flaps before. The new feature of a familiar stimuli might have elicited a stronger than expected feeling of excitement, in comparison with the interesting, but perhaps somewhat too familiar compilation of songs.

The permanence of the mood induced with music in children have not yet been measured, and inclusion of such measurement should be considered in future research. Firstly, researchers disagree if the effect of a positive mood induction can even be observed in children long enough to benefit performance in tasks measuring creativity. There are unquestionable developmental differences between children and adult brains, and they might be cause for differential responses to positive mood and arousal induced by music. Dopaminergic projections to the frontal cortex that can account for positive mood, are underdeveloped in children (Lee & Goto, 2015), which might lead to a reduction of the effect of mood improvement with music. The affect regulation and attentional systems of children are immature (Manly, Kim, Rogosch & Cicchetti, 2001) and the mood states induced by music might subside more or less immediately after the music stops (Črnčec, Wilson, & Prior, 2006). The same argument may provide an explanation for the unsuccessful attempts to replicate the Mozart effect in children (e.g. Črnčec, Wilson & Prior, 2006; McKelvie & Low, 2002).

One of the reasons to not include a measurement of the effectiveness of the mood induction in the current study was to keep the experiment as simple as possible. The measurement of divergent thinking applied in this study, the UBT, is supposed to be administered individually, so as to eliminate the modeling of responses between children, therefore only one child at a time could participate in the study session. In studies including young children, one of the acceptable ways to measure the effectiveness of a mood induction procedure (MIP) is self-report, but using it in this study would add an additional distraction and could possibly diminish the effect of the MIP (Brenner, 2000). With children as participants, it is crucial to design simple and easy to perform study sessions. A child's affective state can change rapidly from one moment to another, and additional steps in the experiment sessions might produce false effects. In a larger study, separate coding of the facial expressions of the

children could be added to create mood scores. Although the mood of the participants were not measured in this study, every child except for one followed singing and reading with interest or calmness, or altogether joined in, and only two children expressed indifference during the UBT (wanted to finish quickly, but continued after a standard encouragement). This could be interpreted as showing that the children in general were in a positive mood. At the end of each session of the study, every child was asked if they liked to play with the box, and all affirmed, which could be treated as another confirmation of the whole experience bringing a positive affective state.

Another possible explanation for the lack of a statistically significant effect of positive music listening on creativity performance in this study might be related to the fact that the overall effect of positive mood on creativity is quite ephemeral in comparison to effects of more structured music training on cognition (Schellenberg, 2006). The sample of the present study is rather small (21 children). Power analyses determined that 76 participants were needed with an alpha level of .05, a beta (statistical power to detect an effect) of .80, and a large effect size, $f = 0.4$ (Faul, Erdfelder, Lang, & Buchner, 2007). This means that the sample used is too small to reliably obtain statistically significant results in such a study, if there in fact is an effect of positive-mood inducing music on creativity in preschool children.

In addition, the implementation of two positive auditory stimuli creates a difference between conditions that might be small. With such a slight manipulation, even a small effect on creativity could be seen as relevant and even impressive. The effect sizes observed in studies on mood-induced creativity performance are overall small (Baas, DeDreu, Nijstad, 2008). Cohen (1988) proposed a heuristic consideration of effect sizes, where those above $r = .50$ are considered as large, those around $r = .30$ as moderate, and those around $r = .10$ as small. Baas, DeDreu and Nijstad (2008) in their meta-analysis of 102 different studies on the relation between creativity and mood, noted the largest overall effect size between positive and neutral mood at $r = .15$. Although such an effect could be deemed small, it is comparable to larger trends observed in social and personality psychology. Richard, Bond and Stokes-Zoota (2003) compared different meta-analyses derived from studies on a variety of topics, such as aggression, stereotyping, attitude change and social influence, and concluded that the mean effect size was $r = .21$, with a standard deviation of .15. It seems that the findings within research on the mood-creativity relation often fall in the same category when it comes to the strength of the effect (Baas, DeDreu, & Nijstad, 2008). In case of this study, the effect size for music compared to book reading is $r = .10$ for fluency scores and $r = .16$ for originality scores. Thus, one could speculate that

music might indeed have an effect on creative performance of 3-4 year-olds as measured with the UBT, but that this effect is small, and that a larger sample is necessary to reliably detect such an effect.

When it comes to the measurement of creativity, the UBT seems to be an effective measuring tool of the creativity of preschool children. The present study demonstrated a very strong correlation between fluency and originality scores typical for divergent thinking tasks, i.e., children who perform more actions are more likely to produce more original actions. A similar effect has been observed in other studies using the UBT (e.g. Bijvoet-van den Berg & Hoicka, 2014). Mednick (1962) suggested an explanation for the link between fluency and originality in *associative theory,* in which he argues that the more original ideas are also remote and can be produced after more obvious ideas have been depleted. On the other hand, we cannot exclude that it is also a result of the originality score being based on the amount of actions performed in total in the study (e.g., Silvia, 2008). When it comes to the effect of arousal on creativity, the box itself could potentially induce positive mood in children. The UBT is a colorful, toy-like box, that children are able to play with on their own terms. The only restriction to their creative play is the time limit, imposed by the experimenter, of which they have little understanding of due to the lack of any visual cue of passing time. The goal is to play with the toy, and promotion focus can be engaged. Activating promotion-focused states like happiness and joy, which can be characterized as elated arousal, have been found to broaden the view, and promote responsiveness to peripheral cues on the perceptual level (cf. Fredrickson, 2001; Isen, 1999). In turn, more novel ideas can be generated. For studies on creativity induced by music, it might actually be that the box itself induces arousal and positive mood which would obscure any possible effect of the music.

Some possible improvements of the study come to mind. It has been observed in other studies that structured, long term music training can benefit creative performance (Simpson, 1969; Wolff, 1978). The current study attempted to control the fluency and originality scores against musicality and music exposure. However, the musicality and music exposure scores were created based on answers to an intuitively formed questionnaire. A more theoretically supported method of measuring musicality in children might potentially reveal a link between musicality and creativity. Scores for musicality could provide a necessary context of a child's predisposition to music's mood-regulative characteristics. Subsequently, it could also provide more evidence to the relation between musical abilities and susceptibility to the mood-inducing properties of music. Some musicality assessment methods have been created to examine music perception abilities in children, like Gordon's Musical Aptitude Profile tests and The Early Childhood Musical Behavior Measure (ECMBM, see: Yi, 2013). The ECMBM is a

novel musicality measuring tool that rates twelve musical dimensions using continuous rating scales, and was designed specifically for assessing the musical abilities of children in kindergarten and preschool age (Yi, 2013).

Another consideration for improvement of the study is to change the experimental design to a within-subject design. It would allow the measurement of divergent thinking in both the music and the reading condition for each child, and could allow the detection of a smaller effect with a smaller number of participants. The assessment of multiple uses of the UBT for one child has shown that administering the UBT test multiple times does not seem to have an effect on children's divergent thinking scores (Bijovet-van den Berg, Hoicka, 2014). A within-subjects design was used by Firth and Loprinzi (2018), where each of the adults participated in three study sessions and performed creativity measuring tasks after exposure to every one of the three stimuli in respective sessions.

Despite the lack of any statistically significant findings, I would still argue that this study has several strengths. I believe that the criteria for the selection of the musical stimuli is well supported by the theoretical background, both from studies on music's influence on cognitive performance and from the studies on the specific dimensions of music that can alter affective states. The melodies are of positive valence (major modes and upbeat melodies) and are often used in group activities in kindergartens in Norway. The songs are both familiar and liked by children, and were performed by the administrator in an engaging way, to ensure focus of the child on the stimuli. The study was also designed to ensure the highest level of ecological validity possible to obtain in a controlled study. The administrator was introduced and treated as a part of teaching staff in the week of the data gathering, and all the study sessions were conducted in rooms dedicated to pedagogical activities, like organized play and book-reading. Both the music and the book-reading conditions involved stimuli that are familiar to children and are expected to be used in kindergarten. Additionally, the UBT used to measure divergent thinking is a colorful, toy-like box, and does not stand out in the kindergarten environment. A study performed in such familiar and natural conditions for children has potential to avoid producing a result that could only be observed under strictly controlled, laboratory circumstances, thus making it relevant for everyday situations.

This study extends the body of evidence examining the effect of passive listening to music on creativity performance of preschool children, and is distinct from the only other experiment observing picture-based creativity in 5-year-old children (Schellenberg et al., 2007). The features of this study had potential to uncover if music bears any particular benefits for creativity over other similar stimuli. The

lack of compelling evidence might simply mean that the mood induced by music does not influence creative abilities to a larger extent than reading a joyful book. However, music still remains one of the most pleasurable, engaging and effortlessly available stimuli out there.

7.1 Conclusion

The purpose of this study was to expand the currently limited knowledge of the relation between passive exposure to music and creativity by assessing if listening to positive mood-inducing music can enhance divergent thinking in preschool children. No differential effect on creative thinking performance was observed between the music listening and the book-reading condition. Various reasons for this observation have been discussed, and several areas have been highlighted in need of consideration in future research. The lack of a control group, as well as the possibility that a positive mood was elicited to the same degree in both music and book-reading condition, make it hard to draw a final conclusion for the result of the study. Until further work is conducted, and new evidence obtained, it remains unclear whether listening to music can induce positive mood intensive enough to benefit creative performance, or if such mood-alteration can even be achieved in children.

Nevertheless, the confirmed benefits of music-making and listening to music are many, but music is consistently undervalued and underrepresented in children's education. It is crucial to find out which types of interventions can increase divergent thinking in early stages of development, when the cognitive skills can be stimulated in a potentially more durable way. This could have a beneficial effect both for the individuals and for society. In the time of a reported decrease in creative thinking and great investments in innovation, new ways to improve creativity are needed. Further research into this subject is necessary, as it might reveal new perspectives and ways to utilize music in non-artistic creative production. Music can be easily integrated in our routines and could facilitate creative cognition in a variety of tasks, e.g., scientific or educational tasks, so it could be considered a valuable mean of inducing divergent and convergent production. If music proves to be a reliable and efficient creativity-inducing tool in early development, it might be a very attractive mean to boost the creativity on an everyday basis. The reasons for that are plenty, like the fact that music is easily accessible and simple to implement in creativity-related tasks, and – let's not forget – so pleasurable to listen to.

The effect of mood-induced creative thinking improvement was not observed in this study, but it still contributes new information to the research on music-mood relation in children. Our

understanding of what makes children more creative is limited, and the pursuit of new strategies of divergent creativity improvement makes a valuable contribution to the research. The tendency for small effect sizes in mood-induced creative performance could suggest that other strategies for increasing creativity should be explored by researchers. However, from an epistemological perspective, the pursuit of a better understanding of mood-induced music and creativity relation should not be abandoned. There is enough variance in effects across studies on the relationship between mood-inducing music and creativity to suggest the possibility to improve the understanding of that relation. Music has been observed to be a successful mood-inducer, and the potential of music to become a creativity enhancing tool deserves to be further examined.

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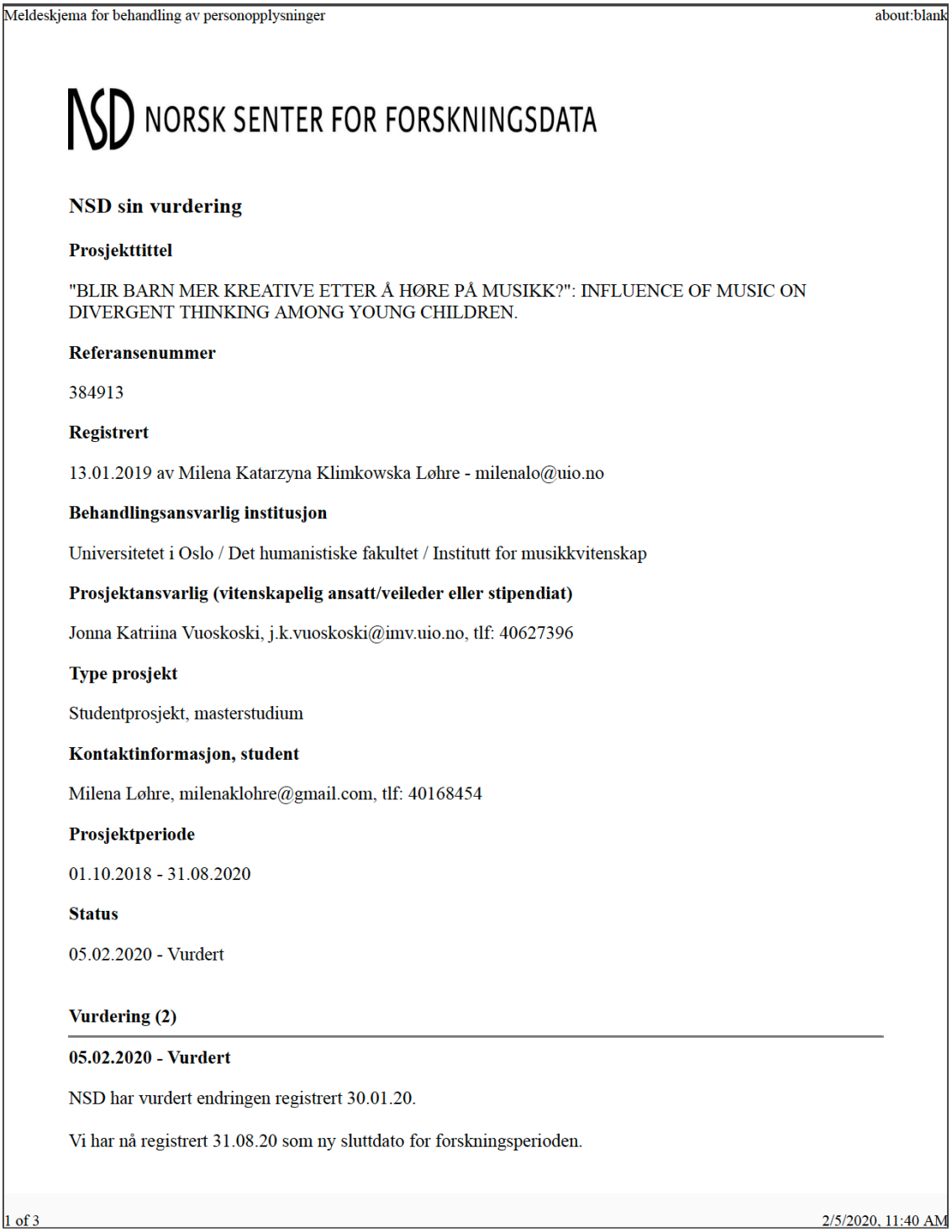
Appendices

Appendix 1. The formal approval to conduct the study from the Norwegian Centre for Research Data (NSD)



Meldeskjema for behandling av personopplysninger about:blank

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

"BLIR BARN MER KREATIVE ETTER Å HØRE PÅ MUSIKK?": INFLUENCE OF MUSIC ON DIVERGENT THINKING AMONG YOUNG CHILDREN.

Referansenummer

384913

Registrert

13.01.2019 av Milena Katarzyna Klimkowska Løhre - milenalo@uio.no

Behandlingsansvarlig institusjon

Universitetet i Oslo / Det humanistiske fakultet / Institutt for musikkvitenskap

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Jonna Katriina Vuoskoski, j.k.vuoskoski@imv.uio.no, tlf: 40627396

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Milena Løhre, milenaklohre@gmail.com, tlf: 40168454

Prosjektperiode

01.10.2018 - 31.08.2020

Status

05.02.2020 - Vurdert

Vurdering (2)

05.02.2020 - Vurdert

NSD har vurdert endringen registrert 30.01.20.

Vi har nå registrert 31.08.20 som ny sluttdato for forskningsperioden.

1 of 3 2/5/2020, 11:40 AM

Vi gjør oppmerksom på at ytterligere forlengelse ikke kan påregnes uten at utvalget informeres om forlengelsen.

NSD vil følge opp ved ny planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.
Lykke til videre med prosjektet!

Kontaktperson hos NSD: Silje Fjelberg Opsvik
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

02.04.2019 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet den 02.04.19 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 31.08.19

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke behandles til nye, uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og/eller rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Silje Fjelberg Opsvik
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix 2. Information about the study and consent form given to the parents.

Vil du at barnet ditt deltar i forskningsprosjektet ”BLIR BARN MER KREATIVE ETTER Å HØRE PÅ MUSIKK”?

Dette er et spørsmål til deg om å inkludere barnet ditt i et forskningsprosjekt hvor formålet er å undersøke om musikk kan gjøre barn mer kreative. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Tidligere forskning viser at musikk kan ha mange positive effekter for både barn og voksne. Denne studien vil undersøke om det finnes en relasjon mellom musikk og kreativitet hos små barn. Musikken kan bli et viktig og enkelt verktøy som gjør barn flinkere til å finne løsninger på ulike problemstillinger.

Denne studien er et masterprosjekt. Det er mulig at anonymiserte resultatene av denne studien publiseres og brukes i undervisningen. Institutt for musikkvitenskap- Det humanistiske fakultet ved Universitet i Oslo er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

Studien fokuserer seg på barn i alderen 3-4 år. Alle barn fra din barnehage i denne aldersgruppen får mulighet til å delta i studien. Din barnehage har godkjent og delt ut denne informasjonen.

Hva innebærer det for ditt barn å delta?

Etter at du filler ut spørreskjema, ditt barn skal bli med på en studie hvor vi vil observere barnets kreativitet under lek.

- Hvis du velger å delta i prosjektet, innebærer det at du fyller ut et spørreskjema. Det vil ta deg ca. 5 minutter. Skjemaet inneholder spørsmål om barnets og din erfaring med musikk. Dine svar fra spørreskjemaet blir anonymisert og registrert elektronisk.
- Barnet vil bli med på en kreativ lek som blir tatt opp av kamera, og anonymisert ummidelbart (les mer om dette under «Ditt personvern»).

- Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger.

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- Bare prosjektansvarlig og prosjektveileder skal ha tilgang til opplysningene om deg og opptakket av ditt barn.
- Personopplysningene skal få en kode som lagres på egen navneliste adskilt fra øvrige data. Opptak av ditt barn får samme kode, og skal bli lagret på en internettfri sikker datamaskin tilhørende UiO.

Hverken deg eller ditt barn vil kunne gjenkjennes i publikasjon etter at resultatene av denne studien publiseres.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet skal etter planen avsluttes i august 2020. Alle personopplysninger skal anonymiseres og opptakket slettes ved prosjektavslutning.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra Institutt for musikkvitenskap, Det humanistiske fakultet ved Universitet i Oslo har NSD - Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Prosjektansvarlig Milena Løhre ved Institutt for musikkvitenskap, Det humanistiske fakultet ved Universitet i Oslo på epost (milenaklohre@gmail.com).

- Prosjektveileder Jonna Vuoskoski ved Institutt for musikkvitenskap, Det humanistiske fakultet ved Universitet i Oslo på epost: (j.j.vuoskoski@imv.uio.no)
- Personvernombudet ved UiO Maren Magnus Voll (personvernombud@uio.no)
- NSD - Norsk senter for forskningsdata AS, på epost (personvernombudet@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Milena Løhre	Jonna Vuoskoski
Prosjektansvarlig	Prosjektveilder

Samtykkeerklæring

Vi, foreldre/foresatte til _____ har mottatt og forstått informasjon om prosjektet BLIR BARN MER KREATIVE ETTER Å HØRE PÅ MUSIKK?, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☐ å fylle ut spørreskjema

☐ å la barnet mitt delta i studien

Foresatt 1

Jeg _____ samtykker til at mine og mitt barns opplysninger behandles frem til prosjektet er avsluttet, ca. august 2020

(Signert av prosjektdeltaker, dato)

Foresatt 2

Jeg _____ samtykker til at mine og mitt barns opplysninger behandles frem til prosjektet er avsluttet, ca. august 2020

(Signert av prosjektdeltaker, dato)

Appendix 3. Questionnaire about the musicality and exposure to music of the child delivered to the parents.

SPØRRESKJEMA til prosjektet
«BLIR BARN MER KREATIVE ETTER Å HØRE PÅ MUSIKK?»:

1. Barnets fornavn:

2. Barnets alder:

3. Barnets kjønn: Gutt ☐ Jente ☐ Vil ikke oppgi ☐

4. Pleier barnet å synge spontant?

aldri ☐ sjeldent ☐ noen ganger ☐ ofte ☐

5. Pleier barnet å bli med å synge sammen med andre?

aldri ☐ sjeldent ☐ noen ganger ☐ ofte ☐

6. Pleier barnet å bevege seg/danse til musikken?

aldri ☐ sjeldent ☐ noen ganger ☐ ofte ☐

7. Er barnet ditt musikalsk? Beskriv hva du mener. Ja ☐ Nei ☐

8. Hvordan får barnet ditt oppleve musikk hjemme (sett ring rundt riktig svar):

a. Barnet blir sunget til:

Hver dag / Noen dager i uka / En dag i uka / En gang i måneden / Aldri

b. Barnet går på konsert:

Hver uke / Hver måned / Noen få ganger i året / Aldri

c. Barnet hører på plate, Spotify, etc.:

Hver dag / Noen dager i uka / En gang i uka / En gang i måneden / Aldri

d. Barnet hører på radio:

Hver dag / Noen ganger i uka / En gang i uka / En gang i måneden / Aldri

e. Barnet spiller et/flere instrumenter:

Hver dag / Noen ganger i uka / En gang i uka / En gang i måneden / Aldri

f. Barnet hører på noen andre spille et instrument:

Hver dag / Noen ganger i uka / En gang i uka / En gang i måneden / Noen få ganger i året / Aldri

9. Har barnet blitt med på musikkundervisning? (babysang, musikkbarnehage, etc.)

Ja ☐ Nei ☐

9. Hva slags utdannelse har foreldre/foresatte til barnet:

	Foresatt 1	Foresatt 2
9-årig skole eller kortere	☐	☐
Grunnskole	☐	☐
Videregående/gymnas/yrkesskole (3 årig)	☐	☐
Høyskole- eller universitetsutdanning på 3 år eller mindre	☐	☐
Høyskole- eller universitetsutdanning på mer enn 3 år	☐	☐
Annet ☐	☐	☐

10. Hva slags musikkutdannelse har foreldre/foresatte til barnet:

	Foresatt 1	Foresatt 2
Ingen utdannelse innen musikk	☐	☐
1-3 år musikkutdannelse (musikklinje, instrument, sang)	☐	☐
4-8 år musikkutdannelse	☐	☐
Profesjonell musiker	☐	☐

Den signerte SAMTYKKEERKLÆRINGEN og dette SPØRRESKJEMAET skal leveres i barnehagen i konvolutten. Tusen takk for hjelpen!