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Empathy as an answer for the Tragedy Paradox in music

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Tese orientada por Prof. Doutor Hélder Coelho (FCUL), Prof. Doutor David Yates (FLUL) e Prof. Doutor António Duarte (FPUL), especialmente elaborada para a obtenção do grau de Mestre em Ciência Cognitiva.

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"Art is a human activity, consisting in this, that one man consciously, by means of certain external signs, hands on to others feelings he has lived through, and that other people are infected by these feeling and also experience them."

Leo Tolstoy, *What Is Art?* (1897)

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.

Resumo

O apelo de motivos trágicos nas artes constitui um paradoxo que remonta à Antiguidade clássica, aplicado sobretudo no âmbito das artes dramáticas, denominado Paradoxo da Tragédia. Aristóteles foi o primeiro filósofo a elaborar uma resposta para o mesmo baseada na purgação de emoções negativas do espectador pela sua experiência em contextos ficcionadas, o qual designou de *catarse.* O objectivo deste trabalho foi resolver o mesmo paradoxo no âmbito da música com motivos trágicos, ou seja, capaz de evocar emoções negativas - em especial a tristeza -, através de *explicações conversoras*, que consideram que a experiência de emoções negativas é convertida em experiências psicologicamente recompensadoras. Considerando a *catarse* uma proposta coerente com as explicações conversoras, o trabalho propôs-se a oferecer uma versão adaptável à música.

Tendo em conta a relação estabelecida na literatura entre a apreciação de música triste e disposição individual de traços de empatia, esta foi considerada como uma capacidade importante para a resolução do referido paradoxo. Contudo, como é possível que a empatia explique tal conversão? Como empatizar com a música? Para perseguir o objectivo acima descrito, estabeleceram-se duas questões de pesquisa fundamentais que dividiram o trabalho em duas partes: *Como é que uma experiência empática permite experienciar emoções negativas através da música?* e *Como é que a empatia pode explicar um processo catártico na música*?

Na primeira parte do trabalho foi elaborada uma confirmação da evocação de sentimentos negativos através da música, indispensável para defender a explicação mencionada, produzida por mecanismos de *empatia emocional* (*contágio emocional*) ou cognitiva (*imaginação*), caso a resposta tenha origem nas características acústicas da música ou no significado da letra. Além disso, foi destacado o papel dos neurónios-espelho na ponte entre a percepção de emoções na música e a sua apreciação. Na segunda parte do trabalho foi atribuída a exclusiva responsabilidade das recompensas psicológicas aos mecanismos de *empatia cognitiva*, gerando recompensas com origem no próprio processo empático e na falta de implicações reais associadas com a tristeza provocada pela música. Tais recompensas compõe o processo catártico que leva à purificação de emoções negativas do ouvinte e justifica as suas motivações para ouvir música triste .

Para o futuro, sugere-se que seja explorada a relação entre mecanismos homeostáticos de regulação de emoções e da empatia cognitiva, a fim de gerar um melhor entendimento sobre a capacidade de empatizar, bem como, sobre o papel da música como potenciador de tal capacidade, tão importante para as interações humanas a diversos níveis da sociedade.

Palavras-chave: tragédia, música, empatia emocional, empatia cognitiva, catarse

Abstract

The appeal of tragic motifs in the arts constitutes a paradox already discussed in Classical Antiquity, above all, in the field of dramatic arts, the known Tragedy Paradox. Aristotle was the first philosopher answering to it through a proposal based on the purging of the negative emotions of the spectator stemmed from the experience of such emotions in fictional contexts, a process called of *catharsis*. The aim of this work is to solve the same paradox applied to music with tragic motives, i.e. able to evoke negative emotions - especially sadness - through *conversionary explanations*, which consider that the experience of negative emotions is converted into a psychological rewarding one. Considering *catharsis* a proposal coherent with such explanations, the work proposes a cathartic process applicable to music.

Considering the relationship established in the literature between the personal trait of empathy and the appreciation of sad music, empathy was considered as the key capacity to solve the paradox. However, how to empathize with music? How would empathy explain such conversion? To pursue the objectives described above, two fundamental research questions were established to accomplish such goal: *How does an empathic experience allow us to experience negative emotions through music*? and *How does empathy explain a cathartic process in music?*

In the first part of the work, it was confirmed the evocation of negative feelings through music indispensable to defend the mentioned explanation, considered to be generated by mechanisms of *emotional empathy* (*emotional contagion*) or *cognitive empathy* (*imagination*), whether the emotional response is originated from the acoustic features of music or from the meaning of the letter. Moreover, it was highlighted the role of mirror-neuron system in the link between the perception of emotions in the music and its appreciation. In the second part of the work, it was attributed exclusive responsibility to *cognitive empathy* mechanisms for the generation psychological rewards, which generate rewards either from the empathic process itself and the lack of real-world implications associated with the sadness-evoked by the music. Such rewards comprise the cathartic process that leads to the purification of listeners' negative emotions and justifies their motivations to listen to sad music.

For the future, it is suggested to explore the relationship between homeostatic mechanisms of emotion regulation and *cognitive empathy*, in order to generate a better understanding of the ability to empathize, as well as the role of music as a potentiator of such important ability for the core human interactions within society.

Key-words: tragedy, music, emotional empathy, cognitive empathy, catharsis

Resumo Alargado

O apelo de motivos trágicos em obras de arte envolvidos na evocação de emoções negativas constitui um paradoxo que remonta ao tempo da Antiguidade Clássica, denominado Paradoxo da Tragédia, cuja atração de filósofos como Aristóteles tem motivado explicações particularmente válidas no âmbito das artes dramáticas. Este trabalho será desenvolvido a partir da mesma motivação dirigida para o caso particular da música, traduzindo-se na compreensão do apelo de músicas que evocam emoções negativas, nomeadamente a tristeza, cuja sensação é comummente evitada na vida quotidiana em pessoas mentalmente saudáveis. A resposta a este enigma será tecida a partir de *explicações transformadoras*, as quais consideram que as emoções negativas provocadas pela música são convertidas em emoções positivas no âmbito da sua apreciação. A *catarse* é uma resposta congruente com tais explicações, tendo sido proposta por Aristóteles no âmbito da Tragédia Grega para designar a purificação dos sentimentos negativos através da sua experiência em ambientes ficcionais.

De acordo com tais explicações, considera-se a reiterada relação entre elevados traços individuais de empatia e a preferência por música triste (Vuoskoski and Thompson, 2012; Vuoskoski and Eerola, 2017; Wallmark, Deblieck and Iacoboni, 2018) para a elaboração de uma resposta, com base no papel da empatia, para a apreciação de emoções negativas na música segundo o seu envolvimento num processo catártico. Faltando à música o carácter representativos das obras dramáticas e ficcionais, tornou-se necessário argumentar de que forma poderia ser possível empatizar com a mesma e qual a relação da empatia com recompensas psicológicas associadas à tristeza provocada pela música. Assim, o trabalho está dividido em duas partes através de duas perguntas de investigação: *Como é que uma experiência empática permite experienciar emoções negativas através da música?* e *Como é que a empatia pode explicar um processo catártico na música*? (Capítulo I).

Considerando a empatia uma importante competência para interagir socialmente através da qual é possível participar, partilhar e entender os sentimentos do *outro* pelo acesso aos seus estados mentais (emoções e sentimentos), será necessário conceber o modo como se pode empatizar com a música, uma vez que esta é desprovida de estados mentais. Nesse caso, convocar-se-ão processos de simulação mental virtual que designa a recorrência aos próprios recursos neurais para simular os estados mentais dos outros, no caso da música, estados *virtuais*. São distinguidos processos de simulação de alto e baixo nível, os primeiros correspondendo ao poder de imaginar a perspectiva do *outro* e os segundos ao contágio emocional inconsciente, respectivamente associados a *empatia cognitiva* e *emocional.* Por último é considerado que o acto de empatizar com a música permite que sejam capturadas as emoções que expressa através da evocação das mesmas emoções no ouvinte (Juslin, 2013) (Capítulo II).

A primeira parte do trabalho distribui-se entre os Capítulos III e IV. O Capítulo III discute o processo emocional como base de comparação com as emoções potencialmente evocadas pela música a fim de justificar a sua *real* qualidade negativa coerente com as teorias emotivistas da música. Assim, as emoções são consideradas actos de percepção para atribuição de significado a eventos internos ou externos (*Teoria dos Actos Conceptuais*) que permitem classificar, orientar e regular o comportamento do organismo num ambiente complexo de acordo com princípios homeostáticos. Alargada a homeostase ao espaço social, as emoções são consideradas importantes pelo papel desempenhado na sinalização de estados mentais que informam o comportamento dos *outro* (Barrett, 2014; Damasio, 2017).

A tristeza em específico é considerada uma reação a situações de perda que sinaliza desequilíbrios homeostáticos para o próprio e para o outro. Neste sentido, tanto o reconhecimento da emoção como a sua experiência são actos fundamentais para a atribuição de significado a um determinado evento e agir de acordo com ele. Para além disso, é de notar que as emoções geradas por eventos internos podem desencadear circuitos neurais *(as-if-body-loops)* que levem à percepção da emoção sem que ocorram alterações corporais, considerados potenciais circuitos dos processos empáticos (Damasio, 2017). São apresentados três processos chave do processo emocional: i) identificação do estímulo afetivo; ii) geração da experiência emocional e comportamento e iii) regulação da emoção e do comportamento.

O capítulo IV apresenta argumentos em favor do processamento emocional associado ao processamento musical, a fim de justificar que a música pode, de facto, gerar sentimentos negativos através de processos empáticos. Como os sentimentos empático derivam da experiência de uma emoção expressa pela música, torna-se necessária a verificação de duas formulações congruentes com os primeiros dois processos do processo emocional (i e ii): 1. a percepção das emoções na música envolve os mecanismos envolvidos no reconhecimento de emoções nas interações sociais; 2. as emoções geradas pela música constituem emoções genuínas.

A partir destas duas verificações, primeiro, é possível atribuir ao sistema de neurónios-espelho uma importante função no reconhecimento de informação emocional a partir do sinal auditivo através da representação de elementos motores hierarquicamente codificadas, os quais estão associados a mecanismos de *empatia emocional* que empregam processos de *simulação virtual de baixo-nível*; segundo, é igualmente possível atribuir uma importante função do mesmo sistema na geração de respostas emotivas dada a sua conectividade com sistemas envolvidos na resposta emotiva (ínsula e sistema límbico) (Molnar-Szakacs and Overy, 2006); terceiro, reconhece-se o envolvimento de áreas associadas com o processamento de emoções negativas bem como o relato subjectivo do sentimento de tristeza ao ouvir música (Mitterschiffthaler et al., 2007); por último, identifica-se a influência do papel das letras da música na geração de sentimentos tristes (Brattico et al., 2011). Esta última verificação permitiu considerar mecanismos de empatia cognitiva na geração de emoções na música, orientada por representações semânticas que levam à captação do sentido das letras e, portanto, à geração de emoções a partir de simulações de alto-nível como os processos imaginativos e os circuitos *as-if-body-loops.* Assim, respondendo à primeira questão, considerar-se-ão tanto os processos *empáticos emocionais* como *cognitivos* responsáveis pela geração de sentimentos de tristeza através da música, os quais levam à representação de sentimentos de *como seria vivenciar a tristeza* pela ausência de um objeto real para a sua evocação (perda, abandono, fracasso), no entanto associados a sensações genuinamente caracterizadoras da tristeza - à semelhança do que acontece com os sentimentos empáticos despoletados relativamente a outrem.

Na segunda parte, responde-se à segunda questão de investigação no Capítulo V discutindo-se os motivos de tais emoções influírem estados de recompensa psicológica que estão, por sua vez, associados aos processos de regulação emotiva (iii). Para tal, é apresentado, em primeiro lugar o papel principal dos mecanismos de empatia cognitiva na geração de tais recompensas, recorrendo ao exemplo dos músicos para corroborar tal afirmação, dada a sua elevada sensibilidade de apreciar músicas que evocam tristeza relativamente a não músicos, devido à maior capacidade de ultrapassar os mecanismos de contágio através de regulações homeostáticas que envolvem maior activação de redes neurais

envolvidas no controlo emocional (Brattico et al., 2016) também associadas a processos de empatia cognitiva. Além disso, são considerados os factores situacionais que levam as pessoas a recorrerem à música triste, nomeadamente, situações de angústia pessoal e fragilidade psicológica ou solidão, sendo atribuída à música a função de melhorar o humor por funcionar como uma ferramenta de consolo e companhia para os ouvintes (Taruffi and Koelsch, 2014).

Tendo em conta que a *catarse* se refere à purgação de emoções negativas e que isso implica que para a música triste servir processos catárticos os ouvintes necessitarão de ter presentes as suas emoções negativas, então pode-se responder à segunda pergunta relacionando a empatia cognitiva da qual é possível gerar recompensas psicológicas da tristeza sentida com as funções mormente associadas à música triste. Desse modo, sugere-se um processo catártico através da música triste, baseado em quatro etapas correspondentes a diferentes recompensas psicológicas dirigidas por processos de empatia cognitiva. As recompensas psicológicas são adaptadas das propostas de Levinson (Levinson, 1982) para justificar a compensação das emoções negativas na música, a primeira associada à ausência do contexto onde a tristeza se origina (*savoring feelings*), a segunda à atribuição da causa dos sentimentos negativos à música (*apprehending emotions*), a terceira à partilha e compreensão dos sentimentos percepcionados na música (*emotional communion*) e a última, à *catarse*.

Como conclusão (Capítulo VI), é revelada a natureza aprazível de um processo catártico através da música triste, que através de processos de empatia cognitiva e emocional leva à evocação de sentimentos de tristeza e, exclusivamente, devida à acção de mecanismos de empatia cognitiva gera recompensas psicológicas que levam à purificação de emoções negativas do ouvinte a curto prazo e justificam comportamentos intencionais de ouvir música geradora de tais sentimentos a longo prazo. Para o futuro, sugere-se que seja explorada a relação entre mecanismos homeostáticos de regulação de emoções e da empatia cognitiva, a fim de gerar um melhor entendimento sobre a capacidade de empatizar, bem como, o papel da música como potenciador de tal capacidade, tão importante para as interações humanas a diversos níveis da sociedade.

Palavras-chave: tragédia, música, empatia emocional, empatia cognitiva, catarse

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Introduction

The word Tragedy derives from the contraction of two Classical Greek words which meaning is translated by *goat song*. The origin for the word *goat* is undefined: it might be either referring to the goat as a prize for dramatists who won competitions between plays, to the dresses made out of goat skin used by the performers, as well as to the goat itself which was sacrificed in rituals where tragedy possibly arose. Aristotle was the first philosopher devoted to the origin of tragedy, attributing it to the improvisations done by leaders of choral hymns played in heroic sacrifices of Dionysiac rites (Aristotle, 2010). In fact, music is considered to be at the roots of tragedy, since it was the chorus of Greek Tragedies that represented Dionysius's manifestations, the Greek God who embody the knowledge of human suffering as a universal characteristic (Nietzsche, 1993; Aristotle, 2010). In *The Birth of Tragedy out of the Spirit of Music*, Nietzsche (1993) argues that Greek Tragedy was the highest form of art, through which the affirmation of human suffering leads the spectators to experience human condition, governed itself by two main opposite forces, chaos and order. Dionysius and Apollo were, respectively, the Gods that embodied these two motifs. The Dionysian chaotic and undifferentiated reality was substantiated in the abstract elements of the chorus music that were considered to be at the origin of tragedy and were balanced by the Apollonian structure and order represented by the dialogues. Nietzsche argues that the identification with the chorus in the first place leads the audience to experience the downfall of a tragic hero not as the fate of one single individual but rather as a condition inherent to all individuals (Nietzsche, 1993).

Tragedies penetrate osmotically the contemporaneity assuming very different nuances in multiple artistic contexts and constitute objects of appreciation (Menninghaus et al., 2017) which impregnate human artistic manifestations from ancient times. Classical dramaturgists, as Shakespeare, constitute a perfect example of how to approach human suffering and loss, exhibiting the paradoxical nature of life through plots where the hero or protagonist struggles with the unexpected consequences of his actions - a foreshadowing of the relationships between morality, reason and emotions within an unpredictable world. Examples of this sort are works like *Hamlet, Romeo and Juliet, Macbeth* or *The Tempest*; in literature realms the same motifs are also present in Goethe's *Werther* and *Fausto* and in Portuguese writers as Camilo Castelo Branco; in music the same happens with composers like Beethoven, Rachmaninoff or Brahms. Although the different expressive modes, the common essence between all this forms concern to the internal logic of life estrangement and man's ontological falling from grace (Steiner, 2004).

People moved by sad stories tend to manifest their appreciation in comments such as 'an heartbreaking story', 'any problems of my own fade against the events of this book', 'it's beautiful and vivid', 'I felt so deeply for the characters and the not so happy ending', 'the fact that it is a true story makes it even more heart-wrenching'. The case of music is not an exception, for instance, the Portuguese Fado is a highly emotional musical genre that entail a deep sense of communion among instrumentalists, vocalists and listeners when it convoques a real experience. Fado represents a complex cultural phenomenon rooted in Portuguese Culture, mostly expressing strong emotions with a sad connotation along with lyrics related with the particular feeling of saudade - a complex mixture of sadness and nostalgia that comes from the longing for the departed ones or those left behind. At the surface, these emotions

seem very related with the sense of isolation and abandonment, but in a deeper analysis they are strongly rooted in the importance that Portuguese people place to the sense of belonging (Von Scheve and Schellenberg, 2012).

Tragic art reflects the work of arts that are able to induce particular reactions in the spectator or listener that lead to the evocation of negative emotions as sadness. Sadness is defined as a complex bodily and neural state that results in feelings of low energy, social withdrawal, low self-worth and a sense of limited horizon of the future (Mee et al., 2006; Hervas and Vazquez, 2011). However, the characteristics of a work of art that contribute for the evocation of particular emotions vary across epoch and culture in the same way that the beauty patterns vary according with the context. Nonetheless, beauty is associated with works able to express harmony and integrity, whether by the form or by the content - objects and elements that are attractive, pleasantness, lovely, sublime, delicate or graceful are considered to be beautiful for a determined epoch or culture. The same might happen with the works that evoke opposite reactions associated with ugliness, which are considered to be unpleasantness, repulsive, repugnant, frightening, terrifying or deformed (Eco, 2007). Similarly as ugliness represents symptoms of degeneration or exhaustion, tragic art represent the ambiguity of human condition in the fragility of the order of life. As Eco (2007) highlights, although there are universal emotional reactions, they might be evoked by different works according with the notions of beauty and ugliness reflected by specific historico-cultural context. Thus, a work of art considered to be tragic shall be able to evoke some genuine negative emotions, even though the concept of tragic might vary across cultures.

The ability to experience emotions through art is not only considered to be the higher purpose of any artistic expression but also the fundamental reason to attend to it (Fellous and Robinson, 2010). Tragedies depict negative emotions, where sadness or pity occupy an important position (Aristotle, 2010), however, in real life the experience of sadness is avoided or, at least, not desirable, since it is linked to a perceived sense of loss, whether it is of a valued object, health, status, a relationship or a loved one. The appeal of art portraying negative emotions represents a paradox that lies in the appreciation of sadness in artistic contexts when people are not motivated to experience it in real life contexts. The presuppose that music is also able to arouse such emotions, turns the same problem to be relevant in the context of music. In fact, listeners report to feel sadness in response to sad music (Juslin et al., 2011), at the same time that they consider this experience to be highly agreeable (Eerola and Peltola, 2016; Peltola and Eerola, 2016). The Paradox occur only for the cases when listening to music triggers sadness in the listeners and, nevertheless, that does not hinder them to listen to it intentionally, i.e., when still occurs the engagement with artistic works that are *known* to produce negative emotions.

This paradox intrigued philosophers since ancient times (Peltola and Eerola, 2016), starting to be discussed by Athenian philosophers of the Pre-Christian as Aristotle, who attempted to explain the psychological reward of tragic theater through the idea of *catharsis* - the purge of negative emotions through their experience (Schaper, 1968). More recently, it has attracted contemporary attention in diverse fields such as media psychology (Schramm and Wirth, 2010), philosophy (Knobloch-Westerwick et al., 2013), psychology (Wildschut et al., 2006; Goldstein, 2009), and neuroscience (Wagner et al., 2014). In the realm of music, although the attempts to explain the reasons for appreciating sadness in music, namely by Levinson (Levinson, 1982), the mechanisms behind such explanations are still not understood.

The main motivations for people to listen to music, in general, unroll under four dimensions, namely enhancement (personal growth, well-being, achieving positive moods and feelings); coping (ameliorate loneliness, reduce tension or boredom, improve mood or overcome difficult times); social motives (improve social relationships) and conformity motives (fitting with peers or creating external impressions) (Kuntsche, Le Mével, and Berson, 2016). The common explanations at the base of sad music listening, in particular, consider music as either a "vehicle to reminisce" (Tahlier et *al*., 2013), to "think about the ideas conveyed by the lyrics" (Mori and Iwanaga, 2014) or to "derive comfort from" (Van den Tol and Edwards, 2013), whether through autobiographical memories (Vuoskoski and Eerola, 2012; Tahlier et *al.*, 2013), through mood regulation (Garrido and Schubert, 2011; Van den Tol and Edwards, 2015) or through mood sharing (Hunter et *al.*, 2011; Taruffi and Koelsch, 2014). However, the only explanations that consider the musical sadness as the reason to listen to it consists of the derivation of comfort through mood regulation or mood congruency, i.e., the possibility that sad music offers for the recovering of a personal distress or, on the other hand, for an emotional state sharing. All the other options consider sad music appealing by reasons that are not dependent on the sadness evoked by music, meaning that the paradox is not applicable to them.

The explanations might follow two types of solutions, the ones based in hedonistic motivations and the ones based in non-hedonistic motivations. The first ones concern to the anticipated pleasurable responses associated with sad music - nevertheless, this responses are not coherent with the nature of the sadness evoked by the music. In this sense, two main explanations are given in order to understand the pleasurable side of sad music: *deflationary explanations*, which argue that the sadness provoked by the music do not correspond to a genuine sadness, rather an emotion derived from an aesthetic context which might be considered pleasurable; and on the other hand, *conversionary explanations*, which rather consider that sadness provoked by artistic means can be converted into pleasant emotions. On the other side, the non-hedonistic motivations for listening to sad music might derive from the acknowledging of a different reality, from the better coping with the environment or from the understanding of an emotion itself. The different starting points from which each one of these perspectives emerge consist on the assumption that there is a difference between a pleasurable experience (hedonistic motive) and a valuable experience (non-hedonistic motive), however, is it not a valuable experience a manifestation of a rewarding experience? The answer for this question will be considered positive.

Although a pleasurable experience constitute itself an ambiguous concept, due to the lack of an objective distinction relatively to a non-pleasurable response, the Tragedy Paradox is based on the puzzling fact that people might enjoy sadness in music. In this sense, it is only valid for the cases when the sadness evoked by music is appreciated. Considering, though, that music appreciation comprises the manifestation of an aesthetic emotion, positive by nature, whatever takes the listener to appreciate the sadness provoked by music, represent reasons guided by hedonistic motives, even though the pleasurable experience might assume diverse dimensions. In this context, this work will focus on the explanations for the rewarding side of sadness induced by music based on hedonistic motives that are able to explain the diversity of reasons that might be behind such behavior.

The Paradox here presented in the context of music corresponds to a specific case of a more general Paradox that is based in the fact that we are able to derive pleasure from artworks that trigger negative emotional reactions - as it happens when watching horror

(Walthers, 2004) or tragic (Hanich et al., 2014) movies. The pleasures associated with tragedy in cinema have been repeatedly related with the interindividual variability of the trait empathy (Hanich et al., 2014; Knobloch-Westerwick et al., 2013). In the context of music, the same might be applicable relatively to the appeal of sad music (Vuoskoski and Eerola, 2017) and particularly, unfamiliar sad music (Gabrielsson, 2012; Vuoskoski and Eerola, 2011; Vuoskoski et al., 2012), which does not remete the listener for extrinsic references, as memories, but rather for the intrinsic characteristics of the music itself. Empathic responses are pointed as the main responsible for the evocation of sadness in listener (Juslin and Västfjäll, 2008; Vuoskoski and Eerola, 2012), from one hand, but also might be responsible for the enjoyment of music-induced sadness, which implies that some listeners might be more prone to appreciate it than others, dependent on the variability of the trait between individuals (Gabrielsson, 2012; Vuoskoski and Eerola, 2011; Vuoskoski et al., 2012; Eerola, Vuoskoski and Kautiainen, 2016).

Empathy corresponds to a human capacity that, from the realm of psychology subsumes the ability to understand and share another person's feelings or experiences and, from the aesthetic realm, implies the capacity to mentally identify with any external object of appreciation (Clarke, DeNora and Vuoskoski, 2015). This faculty involves either an emotional and a cognitive component (Schubert, 2017), both representing different responsive dispositions according with different individuals (Wallmark, Deblieck and Iacoboni, 2018). The fact that when listening to music individuals might experience sadness and still appreciate the music constitute the starting point to follow the *conversionary explanations* for the Tragedy Paradox in music. In this sense, the empathic experience provided by music constitutes a plausible explanation for the emotions provided by music and its appreciation simultaneously. However, taking empathy as a way to understand controversy explanations, a question comes up in the way: how is it possible to understand an empathic experience with music?

According with these first assumptions, the work will be developed taking into account the role empathy plays in the appreciation of music, in special, sad music. Moreover, considering the explanation Aristotle gave for the appreciation of Greek Tragedy, i.e. the catharsis, and the fact that it might be considered under the scope of a conversionary explanation, these work aims to provide an interpretation of the Paradox that supports a cathartic process in music based on empathy as a plausible solution. As a mean to achieve such aim, the work will be divided into two parts that correspond to the different phases of the argument guided by two main research questions, respectively:

1. ***How does an empathic experience allow to experience negative emotions through music?***

2. ***How does empathy explain a cathartic process in music?***

The first question aims to provide evidence in favour of the real experience of sadness when listening to music - the first step to pursue a *conversionary explanation* - along with the role played by empathy in that emotional experience. On the other hand, the second question aims to understand how the empathic experience leads to the appreciation of the sadness provoked by music by offering the listeners the possibility of a controlled purification of negative emotional states. The proposal of this work constitutes a new

approach for the understanding of the rewarding side of sad music which takes into account the role of empathy in the communicative power of music.

I. Structure of the work and Methodology

In order to answer to such questions, this work provides an integrative framework for the understanding of the enjoyable nature of the sadness induced by music, supported by a literature revision from neurobiology, philosophy of mind, psychology of art and social cognition areas. Considering that the solutions for the Tragedy Paradox are driven by hedonistic motivations, i.e. the rewarding responses provided by music are the ones that guide the appreciation of sad music, then, this work will unroll itself according with the answers to the research questions which, in turn, constitute the necessary steps to argue in favor of the *converionary explanation.*

The **Chapter I** is an introduction to the Tragedy Paradox in music. It starts by the explanation of the nature of tragedy, exposing the proposal of Aristotle and how he considered *catharsis* as an element of its structure. Furthermore, it is offered a definition for tragic art that includes music, which permit to define the Tragedy Paradox under the scope of music. The divergent approaches to the Paradox are considered through two different models of emotional expression in music, the *cognitivist* and *emotivist* theories and *conversionary explanations* are considered to be congruent with the *emotivist* theory. From here, the works that already took part on the understanding of the enjoyment of sad music are discussed. First, the eight rewards of sad music proposed by Levinson and, additionally, the recent proposals that already addressed empathy as a decisive factor for the enjoyment of sad music through *moving sadness* - an intense emotional experience which involves *perceived* sadness and *feelings* of sadness, as well as feelings of *being moved* and liking. In sum, this chapter expose the Tragedy Paradox in music and introduce empathy as possible mechanism for its resolution.

Before answering the research questions, in the **Chapter II**, the concept of empathy is approached according with a philosophical, neuroscientific and psychological dimensions, since it constitutes the ground for the understanding of the contents of the following chapters. Considering empathy as a capacity that enables individuals to take others' perspective by the comprehension of their minds, Philosophy of Mind will help to understand such concept through a discussion of the modes of assessing mind - the mind reading capacities. Two main theories are embraced in this context: *Simulation Theory* - which offers an explanation based on low and high levels of simulation - and *Theory of Mind*. On the other hand, neuroscientific approaches consider neuron-mirror system and neurohormones as playing an important role in the process of empathizing and social bondings. In the end, a psychological approach will consider a perception-action coupling model to explain empathic behavior. Along the different perspectives, it is recognized the difference between the emotional and cognitive components of empathy. In the end, all the dimensions are important for a discussion about how an empathic experience might occur with music.

Having addressed empathy in a deeper way, the next two chapter will provide information for the conclusion about the real experience of emotions through music, considering the involvement of empathic mechanisms, composing the first part of the work. The **Chapter III** introduces the emotional processes in general integrating two theoretical frameworks, from one hand, the Conceptual Act Theory proposed by Barrett, on the other, the

homeostatic approach of emotions suggested by António Damasio, both functionalist theories of emotions. Such approach allows to understand the nature and function that sadness plays either in the biological and social realm. From this chapter it is possible to conclude that emotions constitute diverse levels of responses - subjective, physiological, expressive, behavioural and regulatory - that result from the interaction of the individual with the environment. The emotional process exhibited three distinct phases: the identification of emotional information, the generation of emotional experience and behavior and, lastly, the regulation of the emotion experience. This three phases will serve as a term of comparison for the responses provoked by music in order to take conclusions relatively to its capacity to generate real emotions. The understanding of emotional processes constitutes the base for the assumption that music evokes real emotions, but also for the further explanation of their rewarding nature.

The **Chapter IV** constitute the conclusion for the first research question. First of all, music is presented as an emotional stimuli based on an evolutive approach - it will be defended evolutionary reasons for music to constitute a mean of emotional communication. Second of all, it will be presented neurobiological evidences for the involvement of the same brain areas involved in emotional processing when listening to music. From here, a question arises: how is it possible to attribute emotional content to a stimulus deprived from mental states? In this sense, it is considered that the auditory signal is decodified into emotive information through empathic processes which happens by means of two separated phases: i) the perception of emotional information in music and ii) the activation of mechanisms responsible for the induction of corresponding emotions. These two phases correspond, respectively, to the distinction between *emotional perception* and *emotional induction* in music and their association with different empathetic processes, which are equivalent with the two first phases of the emotional processes described in the Chapter III. Therefore, the conclusion that music induces sadness is done at the cost of the verification of the two phases necessary for the decodification of emotional information in music, highlighting the role of neuron-mirror system and emotional contagion processes, respectively. Moreover, the fact that the auditory stimuli of music do not only provokes emotions but also manifest emotions, according with the intrinsic properties of the auditory signal, constitutes a reason to attribute human characteristics to the music. In the end, it will be concluded that through music it might be experienced sadness in the absence of a real loss, which will permit the defeat of *deflationary explanations* and the prosecution of *conversionary explanations*, finalizing, then, the first part of the work.

The second part of the work begins with the **Chapter V**, where the second research question is addressed in order to understand how sadness provoked by music becomes rewarding for the listener. In this sense, the high-empathy listeners either report more intense emotional responses as they are more prone to derive greater rewarding responses, which are mostly derived from cognitive empathy mechanisms. Moreover, considering the main reasons that take people to listen to sad music as moments of personal distress, music is conceived as a virtual person that provides comfort to the listener by means of mood-sharing, an explanation that is associated with the last phase of emotional processing - the regulatory processing. In this sense, considering the possibility to feel either sadness and enjoyment when listening to sad music by means of empathy; along with the fact that positive feelings govern such behavior, it is proposed a cathartic process in music listening based on empathic capacities, which consider rewards already proposed by Levinson, such emotional communion, expressive

potency and emotional regulation. In this sense, it will be offered a possible conversionary explanation for the Tragedy Paradox in music.

Chapter I

The Tragedy Paradox in Music

1. From Aristotle to Tragic Art

In Poetics, Aristotle defends that moral ambiguity constitutes the essence of the tragedy, which is expressed in the paradoxical situations experienced by an heroe, a character whose misfortune is brought about his own errors [*harmatia*] and vulnerability, rather than a result of a guilty act. In this sense, tragic acts provide a sense of moral failure congruent with Greek ethic where failure is the manifestation of a certain level of ignorance of a virtuous man, attained through the nature of any man. In Aristotle words, Tragedy is "an imitation [*mimēsis*] of an action that is serious, complete and of a certain magnitude… through pity and fear affecting the proper purgation [*catharsis*] of these emotions." (Aristotle, 2010) In his view, a perfect tragedy evokes pity and fear, emotions that arise, respectively, from unmerited misfortune and from the misfortune of a Man like the spectator. The main purpose of a perfect tragedy is to convey the purification of such emotions by their evocation (*catharsis*), through the acknowledging of a reality otherwise inaccessible - the main source of tragic pleasures (Aristotle, 2010).

In this sense, tragedies were a mean of exploring emotional resources. However, Aristotle emphasized the composition of the narrative above the spectacle itself as the source of emotions - the emotive effect of the poetry was represented by the Dionysian element - since tragedies were considered to be composed by six elements, namely, the myth, the character, the elocution, the thought, spectacle and melopeia. The plot is equivalent with the myth, composed by three elements essential for the emotional effects, namely, the recognition scenes (*anagnōrisis*), the change of intention or situation (*peripeteia*) and the catastrophe, where a painful and pernicious action takes place. The initial stage defined by stability, familiarity and recognition, the second stage defined by the surprise, ambiguity and tension and, finally, the third stage representing resolution, integration and synthesis, associated with *catharsis* (Figure 1). In his point of view, the set of actions which, by obeying to principles of verisimilitude and necessity, lead to the transition from happiness to unhappiness of the hero, through their acts rather than their fate, constitute the tragic action. Therefore, tragedy, more than the *mimēsis* of an action is the *mimēsis* of cases where actions trigger tragic emotion (Aristotle, 2010).

Therefore, Aristotle theorized tragedy as a drama developed through a language heightened by means of lyric poems and songs and, mainly, able to trigger emotional responses with beneficial effects. The drama goes beyond the trivial description of bad situations, rather revealing the subtleties of human condition - where Man is seated in front of others in the world. This confront requires decisions and actions that carry a complexity of consequences, most of the time not expected, that bring contradictory feelings and, ultimately, a necessary pain. In this sense, tragedy represented a primary medium of self-knowledge, whereby the individuals recognized their place in the society and in the universe, through a reconciliation between ethical and artistic demands.

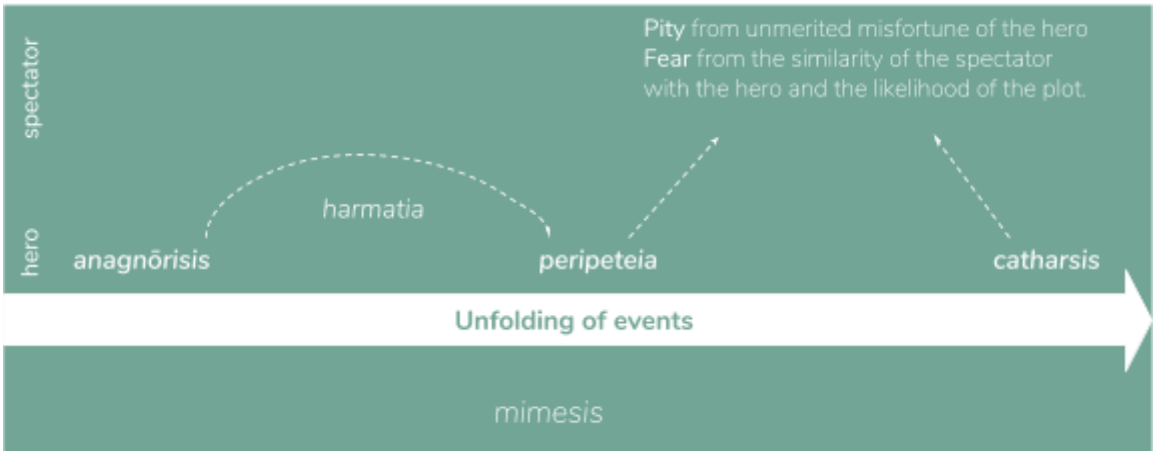

Fig. 1 | Diagram of Aristotle's Tragedy Structure according with *Poetics*. Made by the author.

1.1 From fictional tragedies to music

Aristotelian categories to consider tragedy as a sense of life was increasingly extended from drama to literature, philosophy or cinema, assuming different nuances in multiple artistic contexts, but still being able to evoque psychological discomfort, unease and beneficial negative emotions, defined by Aristotle as necessary for a tragic myth. Dramaturgist such Shakespeare depicts the tragic features in dramas like *Hamlet* or *King Lear* and in literature the same happens with Goethe's *Fausto* or with Tolstoy's *Ana Karenina*. Watching or reading such narratives, who represent human characters and situations that we all recognize as real, might provoke distressing responses, however, some studies reveal that such distress is associated with a greater enjoyment of the tragedies (De Wied, Zillmann and Ordman, 1995). A good number of explanations have been provided for this paradox, for instance, the enjoyment of tragic films has been associated with the evocation of beauty and the portrayal of human perseverance that arise from insights about human existence (Oliver, 1993; Oliver, Hartmann and Woolley, 2012; Wirth, Hofer and Schramm, 2012), as well as the reconsideration of one's experience from different perspectives, often called meta-appraisals (Schramm and Wirth, 2010; Pelowski et al., 2017). Susan Feagin was also proponent of the pleasurable meta-responses directed to the negative emotions evoked, considering that the pity or the sadness felt for a character such Anna Karenina feels good through the employment of subjective evaluations of the emotion itself (meta-appraisal) that result in the realization that one cares about right things (Feagin, 1983). Investigating aesthetic responses in films, a positive relationship between felt sadness and felt enjoyment mediated by feelings of *being moved*, was described as an effect not found between felt joy and enjoyment (Wassiliwizky et al., 2015). Particular empathy-related words, such as "sympathetic" or"compassionate", were used to depict the reactions to the sadly moving scenarios suggesting the value of social bonds and prosocial behaviors in such scenarios. Along with the feelings of *being moved*, feelings of sadness also predict positively the likelihood of aesthetic chills, contrarily to felt happiness.

However, music, as an artistic expression absent of human characters - except in operas - lacks the same Aristotelian tragic elements, such that the same effects turns most of

the answers given for fictional expressions inadequate. In order to attend the tragic in the realm of music, where it is rather the sound what is being psychologically represented by the listener (Zimmermann, Leliveld and Schehka, 2013), it will be considered its emotional significance as the main definer of the tragic elements. In fact, the emotional significance of music has been a topic of scholarships from centuries. Aristotle and Plato for example thought that happy music tends to make people happy and sad music turns to make people sad, moreover one of the strongest reasons for music listening is attributed to its influence on people's feelings, due to its expressive nature that is able to influence emotional states (Juslin and Laukka, 2004; Lonsdale and North, 2011). Oliver Sacks offers a compelling example of a personal experience of strong emotional experience when listening to music in a concert ceasing the a period of anhedonia (inability to feel pleasure) resultant from the loss of a close relative:

> "the whole concert bored me—until the last piece was played. It was a piece I had never heard before, by a composer I had never heard of. Suddenly, as I listened, I found my eyes wet with tears"
>
> (Sacks, 2007, p. 296–297).

Thus, similarly with the definition of Aristotelian tragedies, the tragic character of music comes from its potential to induce equivalent emotions to pity and fear, considered to belong to sadness feelings. Sad-sounding music is objectively defined based on its acoustical properties, particularly associated with lower overall pitch, narrow pitch range, slower tempo, use of the minor mode[1], solemn timbres, low energetic levels and *legato* articulation (Juslin and Laukka, 2004). Bi-directional model of emotions distribute them through different levels of *arousal* - activation-deactivation continuum - and *valence* - a pleasure-displeasure continuum. According with this view, sad music is usually associated with low valence and arousal (Trost et al., 2012). However, sad-sounding music may also be defined subjectively, based on a listener's interpretation of the perceived or induced emotion (Vuoskoski and Eerola, 2017), which is usually determined by asking the participants about the emotions they believe music is expressing or otherwise what are the emotions felt through the music (Guhn et al., 2007). Moreover, the lyrics of popular songs as well as the poetry of classical pieces might trigger memories associated with sadness (Van den Tol and Edwards, 2013; Mori and Iwanaga, 2013).

2. The Tragedy Paradox in music

The appealing of tragic fictional artworks have been already explained by different authors and, specially, by Aristotle who proposes *catharsis* as the component of tragedies that explains itself why people appreciated them. However, the enjoyment of tragic emotions in fictional artworks seem to do not be appropriate to music since the emotions it evokes are deprived of a narrative. In everyday life situations, sadness is related with a perceived loss (either material or immaterial), resulting in feelings of low energy, low sense of personal value and social withdrawal (Hervas and Vazquez, 2011). The appealing of sadness provoked by

[1] Mode is a type of organization of a sequence of pitches of characteristic melodic behaviors. The word "mode" derive from the Latin word *modus*, which means "measure, size, limit of quantity". Source: *WordNet 3.0, Farlex clipart collection.* (2003-2008). from https://www.thefreedictionary.com/Mode+(music)

music becomes puzzling (Garrido and Schubert. 2011; Kawakami et al., 2013; Kreutz et al., 2008; Vuoskoski and Eerola, 2012; Zentner et al., 2008) when negative emotions are not desirable in real world contexts and when proposals as *catharsis* seem to do not explain tragic pleasures in music, due to the absence of a plot that depicts human actions and failures comparable to the ones experienced in the real world, through which they might identify themselves. Moreover, listeners tend to experience positive emotions in music more frequently than negative emotions (Gabrielsson, 2001; Juslin and Laukka, 2004; Juslin et al., 2008), generally preferring the positive ones - a preference that is widespread even among individuals who experienced damage to the emotion-processing centers of the brain, like the amygdala (Gosselin et al., 2005), which demonstrates how important positive emotions are in the appeal of music. In this sense, the "Tragedy Paradox" comes out from the puzzling appealing of tragic emotions in artistic contexts when, on the other hand, human beings work to minimize sadness in their lives. It is defined by the trueness of the following three premises:

i) people have negative emotional experiences in response to tragic art;
ii) people tend to avoid negative emotional experiences;
iii) people pursue engagement with tragic art (Smuts, 2009).

The explanations for this puzzle will consider pleasure-centered solutions, where the motivation to listen to sad music takes into account the value or the appreciation of such experience (Smuts, 2009) - as *catharsis* represent the beneficial acknowledging of negative emotions. Such solutions assume that the sadness provoked by the music is appreciated or represents a costful path for a psychological advantage, which, even though it does not represent a fully positive experience, does not result into a painful behavior or into an overall negative response. The two main arguments congruent with such solutions recur either to the assumption that music do not convey genuine negative emotions, which corresponds to *deflationary explanations* or to the defense of a transformation of the negative emotional responses into positive ones, which rather corresponds to *conversionary explanations*. Two different schools of thought for the attribution of emotional responses to music reflect these different explanations: the cognitivist and the emotivist view.

From a *cognitivist* view, music do not provoke real emotions, i.e. emotions felt through music correspond to specific emotions not transposable to real life contexts. One of the defensors of this theory was Kivy, who considered "music-sadness" not comparable to "life-sadness" (Kivy, 1991) due to the fact that the conditions necessary for the arising of the emotion - namely a real loss - were not present (Hospers, 1969). Thus, the emotional value of a musical piece is attributed to its expressive properties, considering music as an external object of appreciation that lead to aesthetic emotions, positive by nature ("awe, enjoyment, wonder, enthusiasm") (Konečni, 2008). According with this position, music expresses emotions that are recognized by listener but not felt, as it would in an everyday situation (Meyer, 1956), which is congruent with *deflationary explanations*. This explanations either might support that feelings provoked by music are not negative or unpleasant at the first place or that music is not able to provoke feelings at all.

On the other hand, from the *emotivist* view, the music is taken as a mean to provoke real emotional states, meaning that listeners do not only recognize the emotions expressed, but also go through physiological changes similar to the ones experienced in real life contexts (Gabrielsson, 2002; Juslin and Västjfäll, 2008). Recent evidences show that music can lead to

changes in the major reaction components of emotion, including subjective feeling, physiological arousal (autonomic and endocrine changes), emotional expression (facial expressions) and action tendencies (Koelsch, 2015), highlight the changing of activity in the core regions of the brain that underlie emotions (Koelsch, 2014). In this sense, music itself may constitute a medium for expressing human-like emotions, leading to intense emotional experiences and even mixed musical emotions (Vuoskoski et al., 2012; Kawakami et al., 2013; Taruffi and Koelsch, 2014). Pleasurable sadness might be seen as a "mixed" emotion, in which positive and negative affects are experienced simultaneously (Juslin, 2013). The position that advocates that music provokes genuine emotions permit to defend *conversionary explanations*, which demands the understanding of the mechanisms by which music may provoke such emotions along with the mechanisms responsible for the enjoyment of negative emotions like sadness. In this context, it might be either considered mechanisms of compensation, through which the unpleasant emotion is compensated by a posterior positive emotion - which is congruent with the mixed emotions proposal - or mechanisms through which negative emotions are transformed into positive ones.

This work will defend the *emotivist* theory offering an explanation for the Tragedy Paradox in music inspired in the proposal made by Aristotle. In order to do that, it will be provided relevant evidence for the fact that, in the first place, negative emotions are felt when listening to music and, afterwards, that they might lead tragic pleasures. Such assumption result in the refusal of *deflationary explanations* and in the defense of *conversionary explanation*, which shall offer a clear proposal of the mechanisms responsible for the purgation of negative emotions that lead to an overall positive experience. In sum, the central question of the paradox is reduced to the explanation of the rewarding side of negative emotions when triggered by music, and how that rewarding side constitutes a motivation to listen to sad music. Nevertheless, the same explanations are not extended to extreme negative emotions such as grief or anger, since they are not considered to be able to evoke positive responses in aesthetic contexts, an exclusive effect attributed to sadness (Sachs, Damasio and Habibi, 2015). The paradox is better comprehensible if the psychological, neuroscientific and philosophical perspectives are reunited for answering to the question of what turns sadness an appealing emotion in music.

2.1 A revision of the mechanisms already proposed for sad music enjoyment

Empirical evidence stemming from the domains of psychology (Goldstein, 2009, Wildschut et al., 2006), philosophy and neuroscience have started to expose the ways people derive enjoyment from sad music (Eerola and Peltola, 2016). Philosophers as Jerrold Levinson also follow the emotivist theory, considering that sad music is able to induce 'genuine' sad affective states in listeners and arguing that this response might be inherently rewarding (Levinson, 1982) by means of eight different mechanisms (Figure 2). The *understanding feelings, emotional assurance*, *savoring feelings, emotional communion* and *emotional resolution* proposed by Levinson are considered to involve the most frequent rewards of sad music (Taruffi and Koelsch, 2014). Additionally, listeners consider that sad music is able to trigger specific memories, having an impact on the distraction from current problems (Van den Tol and Edwards, 2013) and an influence in the engagement of imaginative processes (Taruffi and Koelsch, 2014), which also lead to rewarding responses.

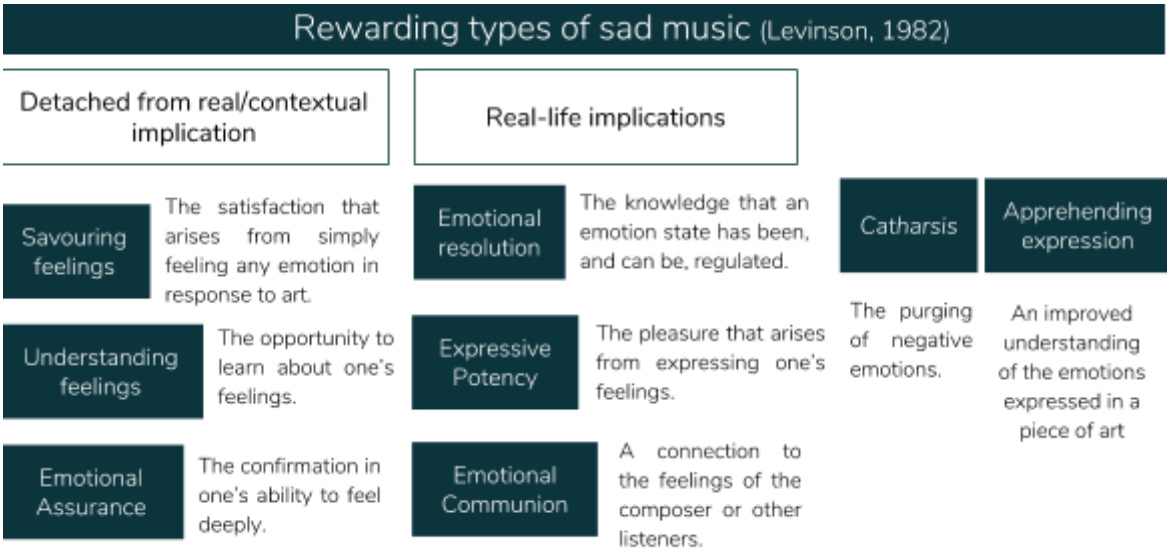

Fig. 2 | The eight rewarding mechanisms for negative emotions in music proposed by Levinson (1982, pp. 327-346). Made by the author.

In fact, *conversionary explanations* have been already suggested by the literature (Vuoskoski et al., 2011), where sad music is reported to be able to trigger pleasurable emotions (Gabrielsson, 2001), being inclusively involved in biological reward (Blood and Zatorre, 2001). Perceived sadness in music is considered to be more correlated with beauty than happy music (Bigand et al. 2005; Kreutz et al., 2008; Eerola and Vuoskoski, 2011), but also associated with the most intense aesthetic experiences (Eerola and Peltola, 2016). Aesthetic experiences in music are considered to be positive by nature (Konečni, 2008) considered to comprise different components:

i) *the aesthetic emotions*, which according with the Aesthetic Trinity Theory proposed by Konečni (2008) considers three separate aesthetic responses: 1. aesthetic awe, defined as an intense, rare and highly memorable peak experience; 2. state of being moved, a more frequent and less intense experience; 3. chills, a physiological response which represents the more commonly occurring one.

ii) *the aesthetic judgement* which involve appraisal of beauty;

iii) *the conscious liking*, which regards to the decisional processes based in personal evaluations.

Based on preliminary empirical work suggests that the beauty and the conscious liking of sad music are highly correlated dimensions (Eerola and Vuoskoski, 2011). Beauty is considered to be a different way of describing a pleasant stimuli (Juslin, 2013), so, how to explain the beauty of sadness provoked by music? The relationship between perceived sadness and beauty was explored by Vuoskoski and Eerola (2017), assessing how the enjoyment of a sad-sounding music might be mediated by the judgment of beauty. The results supported the role of *movingness* in the aesthetic appreciation of sad music, which establish a correlation between sadness and beauty and, therefore, *movingness* connects sadness and conscious liking (Vuoskoski and Eerola, 2017) (Figure 3). In terms of chronological succession, the perception of the basic emotions in music precede motivational and evaluative processes, meaning that the

aesthetic responses - the aesthetic emotions or the beauty judgement - might precede conscious liking (Brattico et al., 2013), an effect attributed to the independent occurence of each other (Brattico et al., 2016).

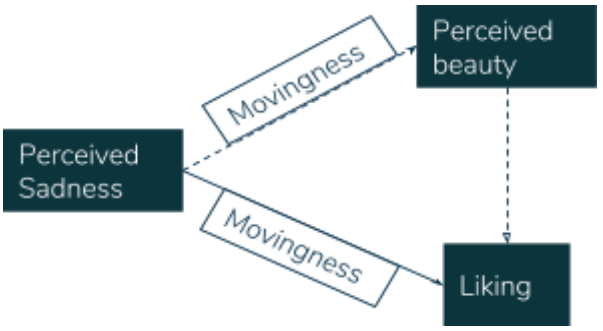

Fig. 3 | The relationship between perceived sadness and liking modulated by movingness feelings Created by the author based on data from Vuoskoski and Eerola, (2017).

These studies suggest that the pleasures of sad music are due to the co-occurence of an aesthetic judgment of beauty and the perceived sadness in music, however, other studies show that *felt sadness* contribute for such perception of beauty and conscious liking by the intensification of being moved feelings (Vuoskoski and Eerola, 2017), which is evidenced through the positive relation between *being moved* feelings and felt sadness when listening to music. The construct of *being moved* tends to favor the appreciation of sad music due to the positive correlation with stronger aesthetic responses (Brattico et al., 2016), being inclusively one of the best predictors of the likelihood to experiencing aesthetic chills (Wassiliwizky et al., 2015) as well as pleasurable bodily sensations like shivers (Panksepp, 1995). Another recent study conducted by Eerola and colleagues explored the feeling of *being moved* in the context of music and evidenced how it plays a central role in the enjoyment of music-induced sadness. In this sense, although sad music might be considered pleasant for its aesthetic qualities, the *felt sadness* through music also plays an important role for its own appreciation (Eerola et al., 2016).

Being moved feelings are considered responsible for the attribution of value to social bonds activating prosocial behaviour and, in turn, being activated through prosocial behavior (Menninghaus et al., 2015; Kuehnast et al., 2014). The influence of this construct in music indicates a relation between social emotions and emotions provoked by music. In fact, individuals especially responsive to social traits, as empathy, are particularly prone to experience feelings of *being moved* (Menninghaus et al., 2015). Empathy traits, usually measured according with the Interpersonal Reactivity Index (IRI) - *fantasy, perspective taking, empathic concern* and *personal distress* - are repetitively associated with a greater enjoyment of sad music and with higher levels of felt sadness (Garrido and Schubert, 2011; Vuoskoski and Eerola, 2012; Eerola, Vuoskoski and Kautiainen, 2016). According with these studies, on one hand, feelings of *being moved* are related with a greater enjoyment of the felt sadness, and from the other, empathy tends to favour feelings of *being moved*, which, in the end result in a overall positive influence of empathy in the enjoyment of sadness (Figure 4).

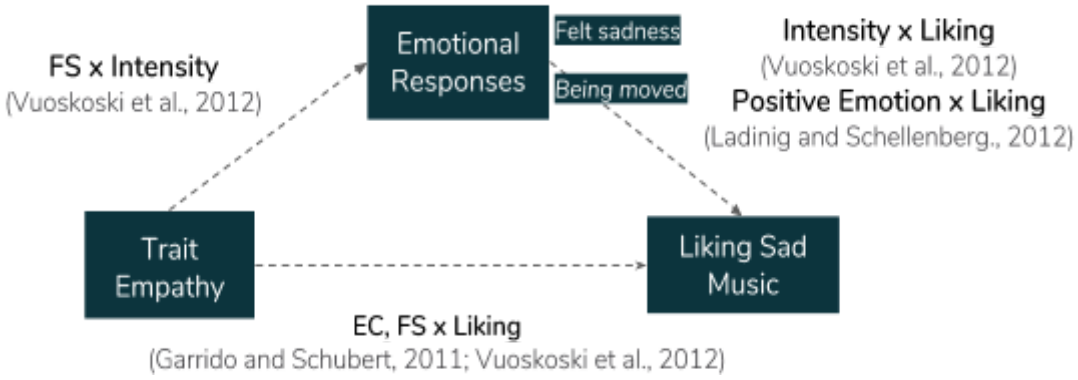

Fig. 4 | The personal trait empathy have a positive influence in the "moving sadness" emotion, influencing positively the enjoyment of sad music. Empathic traits modulates the enjoyment of sad music directly or indirectly through its influence on the intensity of the emotional response which itself leads to conscious liking. EC - Empathic concern; FS - Fantasy. Adapted from Kawakami and Katahira, (2015, p.3).

The *felt sadness*, the *being moved* feelings and conscious liking dimensions were considered by Eerola and colleagues as constituintes of the same latent emotion: "moving sadness". Interestingly, empathy dimensions such as *fantasy* and *empathic concern* along with the emotional contagion mechanism were reported to induce "moving sadness". These results entail that those who show an higher tendency to be moved towards the others also tend to experience the same tendency towards music (Eerola, Vuoskoski and Kautiainen, 2016). The statement that the "pleasurable sadness" could be explained by the aesthetic appreciation of sad music (Juslin, 2013) proposed by Juslin, is refuted through this proposal, since *felt sadness* contribute to the "enjoyment of sadness-inducing music by directly intensifying feelings of being moved" (Vuoskoski and Eerola, 2017). Furthermore, trait empathy contributes directly to the intensity of felt sadness and movingness. Similarly to what happens in sad films, the association found between empathic dimensions and feelings of being moved provide further support for previous findings that have linked empathy with the enjoyment of sad music, highly predicting the feelings of "moving sadness" (Garrido and Schubert, 2011; Vuoskoski et al., 2012; Taruffi and Koelsch, 2014; Eerola, Vuoskoski, and Kautiainen, 2016). Nevertheless, the importance of empathy when listening to music raises a question: what are the listeners empathizing with when they listen to sad music? In this sense, considering these results and the rewarding mechanisms proposed by Levinson, this work will offer an original proposal for the appreciation of the sadness provoked by music proposing *cognitive empathy* mechanisms to assume the main responsibility of such enjoyment and considering *catharsis* as the leading reward resultant from the action of these mechanisms.

3. The social cognition in music

The aesthetic response of *being moved* is considered socially significant (Menninghaus et al., 2015), which corroborates the fact of empathic traits having an influence on such response. In this sense, *being moved* in the context of music entails that music might be considered a social stimulus. Indeed, music is defined as "structured sounds produced as a mean of social interaction, expression, diversion or evocation of emotion" (Koelsch, 2014). The involvement of areas of the brain associated with social attachment-related emotions (love, compassion or empathy), like the hippocampus - more precisely its ventral striatum neural projections - during emotional responses provoked by the music like tenderness, joy or sadness (Mitterschiffthaler et al., 2007) is consistent with social functions attributed to music, becoming itself into a candidate for the maintenance and strengthening of social attachments. Several musical activities, from singing, clapping, playing instruments and dancing correspond to social activities since they are dependent on communication, cooperation and social cohesion, inviting individuals to share intentions and to joint attention, action and emotionality. This means that music-making establishes a link with social cognition (Philip-Silver and Keller, 2012; Moran, 2014), which might not only influence musical production, but also its perception when listening to music (Aucouturier and Canonne, 2017).

In this sense, the use of acoustic features for the understanding of underlying social intention in music, turns it into a mean to communicate social intentions between real and/or virtual agents, serving "as an aesthetic surrogate for social interaction" (Elvers, 2016). Besides that, Levinson proposes that music might be perceived and experienced as the narrative of a virtual person 'inhabiting' the musical environment (Levinson, 2006). The particular subscales of the trait empathy related with the feelings of *being moved* - *fantasy* and *empathic concern* - correspond to traits involved in the tendencies to imaginatively transpose oneself to the feelings of fictional characters (Vuoskoski and Eerola, 2017) and engage in behavior oriented toward the others (Davis, 1983; Eisenberg and Fabes, 1990), which means that it might occur that the same mechanisms used to respond empathetically towards a person might be employed in music as well.

Thus, the displeasure associated with sad music might be transformed or mitigated into positive emotions through empathy. In fact, the power to overcome the cognitive dissonance associated with negative emotions might constitute one potential evolutionary benefits conferred by music (Perlovsky, 2017) akin to *catharsis* proposed by Aristotle . So, in order to understand the reasons behind sad-music listening according with *conversionary explanations*, it is necessary to direct the work into a deep approach on how emotions are evoked through musical stimulus and how the process of empathizing through music constitutes a psychological benefit for the listener.

Briefing

This introduction defined the object of study of the work, through the adaptation of the Tragedy Paradox, relevant in fictional works as theatre, literature and cinema, to the realm of music. This Paradox became treatable in music through the consideration that, as fictional works, music also provokes negative emotions as it unrolls in time. Aristotle suggested that Greek Tragedies provide a mean to purge negative emotions by the evocation of such emotions, due to the nature of the plot where human actions are depicted with a certain level of similarity with reality, a process that he called *catharsis*. The same explanations are difficult to transpose to the cases where people listen to music that make them feel sad, when sadness state are avoided in real life. In this case, *deflationary* and *conversionary* types of explanations are exhibited, which hold on the arguments that music do not provoke real emotions or, on the other hand, that the negative emotions provoked by music are just transformed into positive emotions, respectively congruent with the musical emotions theories that refuse real emotions (*cognitivist theory*) and defend genuine everyday emotions provoked by music (*emotivist theory*). The work will defend the emotivist theory congruent with *conversionary explanations*, by which the process of *catharsis* might be applied to music.

In order to defend such positions it is first presented the mechanisms already proposed by the literature to appreciate sad music, where empathy traits directly contribute to the sadness felt and to the positive feelings of *being moved*, indirectly favouring the enjoyment of the sadness felt. This results show that the appreciation of sad music do not only involves aesthetic positive feelings but also negative stimuli as sadness, leading to the hypothesis that the enjoyment of sadness evoked by music is related with an empathetic response. Considering empathy a capacity particularly relevant in the social level, how to attribute the same social importance to the music? In order to answer to such question, the next chapters will consider, first, the capacity of empathize in diverse levels of understanding and then how empathy might be at the base of the emotions provoked by the music and of their rewarding side.

Chapter II

The realm of empathy

The natural sociability of human beings is dependent on an ensemble of developments necessary for their interactions, including the ability to understand other's mind. Unlike behavior, the content of other's mind is not directly observable, relying on the mind reading capacities, i.e. the representation of others' mental states. Mind reading capacities possess a crucial importance for our social life, allowing us to coordinate between each other through the prediction of behavior in a wide range of circumstances; to attribute mental states to others and, through that, to explain their behavior (Heider, 1958; Stich and Nichols 1992). Empathy translates this capacity in a particular way.

The word empathy has origin in the Greek *empatheia*, translated by *em* - 'in' + *pathos* - 'feeling', meaning physical affection or passion, which was used to translate the German word *Einfühlung* that means "feeling into" being originally used by in a book of visual aesthetics by Hermann Lotze and Robert Vischer (1873). Lately, Theodor Lipps (1903) apply its idea in a more general concept that explains the human capacity to "take part of, and sharing the feelings of, another person" (Clarke, DeNora and Vuoskoski, 2015). Nowadays, the definition of the word empathy by the Oxford English Dictionary is the following:

> "a. Psychol. and Aesthetics. The quality or power of projecting one's personality into or mentally identifying oneself with an object of contemplation, and so fully understanding or appreciating it.
> b. orig. Psychol. The ability to understand and appreciate another person's feelings, experience, etc."

The capacity to feel and transpose to the circumstances of another, subsumes the notion of "fellow feelings" designed by Adam Smith (1759) in "The Theory of Moral Sentiments", constituting the base for understanding between each other and the sense of a moral life. This notion, was placed in terms of *imaginative reason* rather than involuntary affect. But how is it possible to experience the mental states of the others?

In a work developed by Edith Stein in 1917 titled "On the Problem of Empathy" the author defends that empathy is dependent on the similarity with the other. Besides that, Stein adds an important notion of subjectivity necessary to maintain the self-other awareness (Stein, 1917). Based on such approach Laurence affirms (Laurance, 2008) that maintaining our first hand experience, we are able to imaginatively enter into the inner states of others, reaching their experience of the world and feelings, but understanding the differences between both experiences as empathic observers. This claim is very important to differentiate the so called low-level empathic processes - as mimicry and contagion - and higher-level empathic processes. Coplan also supports the fact that empathy rather involves high-level processes through complex imaginative processings "in which an observer simulates another person's situated psychological states while maintaining clear self-other differentiation" (Clarke, DeNora and Vuoskoski, 2015). For Coplan, empathy comprise

situations where low level sensory-motor processes transport people to a powerful intersubjective experience, but entails necessarily the engagement of high-levels imaginative processes, that allow the access to other's state of mind that it is not only accessed by perceptual states - only facilitated by them (Coplan, 2011).

Empathy is divided into two main branches, the processes that possess an involuntary character, which lead to the loss of the self into the other, and the ones that involve a deliberative capacity, rather dependent on imaginative projection into the others (Clarke, DeNora and Vuoskoski, 2015). These two forms of understanding empathy are distinguished in different concepts: *emotional* and *cognitive empathy*. *Emotional empathy* comprises the set of processes that lead someone to automatically and involuntary capture the emotion of other through bottom-up processes, whereas the *cognitive empathy* systems are rather involved in the processing of contextual data, memory and background information that shapes the affective responses through top-down processes, required for the self-others separation (Schubert, 2017).

The understanding of empathy in terms of individual dispositions reflects the individual tendencies to present traits of behavior directed toward *emotional* or *cognitive empathy* and within each component, whereas they were more directed toward the self or the other. In the end, four dispositions are proposed: *Empathic Concern; Personal Distress; Perspective Taking* and *Fantasy* (Davis, 1980; Wallmark, Deblieck and Iacoboni, 2018), the first two belonging to emotional empathy and the remaining other to cognitive empathy. Empathic Concern refers to the experience of compassion and concern directed to the others, whereas Personal Distress refers to the individual's emotional response caused by the negative experiences of others, directed towards the self. Perspective taking is considered a capability to understand situations from the perspective of other person, shifting the own perspective, while Fantasy corresponds to the tendency to identify with fictional characters, whether in books or in films (Clarke, DeNora and Vuoskoski, 2015).

Copler defends that *cognitive empathy* is what truly defines an empathic experience (Copler, 2011), by allowing the individuals to make a distinction between the self and the other as a mean to have the capacity to put in other's shoes. In contrast with e*motional empathy*, the tendency to deliberately engage in top-down imaginative positions is associated with brain areas linked to theory of mind (Saxe and Kanwisher, 2003; Goldman, 2006), executive control (Christov-Moore and Iacoboni, 2016), and contextual appraisal (de Vignemont and Singer, 2006). The cognitive *perspective taking* may exert some control over the emotional empathy circuits, modifying the emotional reactivity in light of contextual and more complex social appraisals (Christov-Moore and Iacoboni, 2016; Christov-Moore et *al*., 2017), such that both dimensions - emotional and cognitive - may operate intertwined. The fact that someone, by means of imagination is able to comprehend others' mind, implicates that empathy involves *mind reading capacities*.

However, these accounts struggle with the explanation of empathy in music, once music do not possess mental states. Although mental states are unobservable constructs, they possess unique features that characterize them, namely, the fact that they are *events that occur in the mind, constituting the subjective experience of each one of us* (Malle, 2012). In this sense, mind reading capacities face an apparent difficulty, such that, it sounds impossible to empathize with music unless music possess real mental states. Shall the non-resemblance between human beings and music hinder the possibility of empathizing with music? Or there might be universal cues of different perceptual nature that permit to "feel into"

different natures of stimuli? The emotional component of empathy considers the perceptual engagement with an object through low-level interactions. These questions depend utterly on how people represent others' mental states, in order to establish a relation between empathic experiences and mind reading capacities and, from there, build an understanding of how music may provide a mean to empathize with. Such answer will be addressed from three different perspectives: a philosophical, a neurobiological and a psychological one.

1. The philosophy of mind approach

Mind reading capacities refer to the capacity to infer the mental states of the others (Clarke, DeNora and Vuoskoski, 2015). As perceivers, we expect others' mental states to roughly resemble ours, despite of their ultimate intangibility. The own experience is a good source of information for the attribution of mental states, for instance, I will better understand and predict the behavior of someone in love if I already had fall in love. In that sense, reasoning about others' mental states is compatible with the idea of using our own minds to simulate others'. However, what if someone had never been in love? What if people do not experience the same concepts of love? The fact that we all possess different experiences justifies that we might use a conceptual framework about human behavior to help us perceiving others as agents who can act intentionally and who have feelings, desires, and beliefs that guide their actions and are different from ours. These different approaches to access mental states introduce the main theories for the explanation of mind reading capacities in the philosophical approach: the Simulation Theory and the Theory of Mind (ToM). Simulation theory suggest that we use our own cognitive states to simulate others, whereas Theory of Mind proposes that we deploy conceptual knowledge about behavior in order to predict and explain others' behavior and attribute them mental states.

1.1 Simulation Theory

Simulation Theory suggests that the access to other's mind is done by a recreation of people's mental states employing the resources of our own brain in a "mental simulation". But what does it mean to run a mental simulation of one's mind? How are mental simulation events dependent on mind reading capacities? The relationship between mental simulation and *mind reading capacities* will be drawn through the illustration of David Marr (1982) classical idea of tri-level hypothesis applied to cognitive science (Figure 5). According with this hypothesis, the first level describes the functions of the capacity and the problems it solves, corresponding to the more abstract level. In this case, *mind reading capacities* represent the first level of the hypothesis, defining the capacity to understand others as mental beings and predictor their behavior through the attribution of mental states (beliefs, desires, intentions or emotions). The second level corresponds to the *cognitive processes* that describe how the task is accomplished in a functional way, representing the cognitive capacity abstracted from its physical implementation. Thus, the same type of *cognitive processes* may be employed by different physical structures performing the same specific function, as it happens with the processes of visualizing through imagination or through vision. In the end, the physical implementation of the capacity constitutes the third level of analysis, represented by a *cognitive mechanism*. A cognitive mechanism corresponds to the

implementation of a cognitive process in virtue of the particular interactions carried out by specific types of physical structures, as a brain activity pattern.

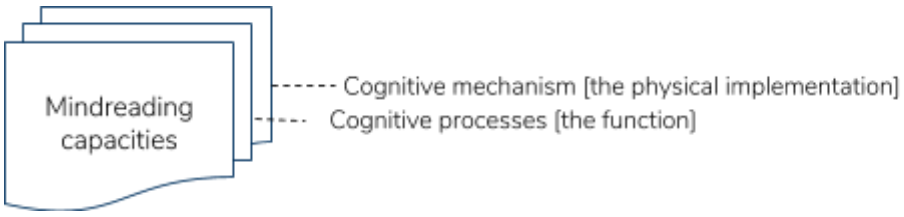

Fig. 5 | Illustration of David Marr (1982) classical idea of *tri-level hypothesis* applied to cognitive science. Made by the author.

The expression *mental simulation* of is a reference to a dyadic relation applied, for instance, when saying that M* is a *mental simulation* of M. On the other hand, the expression *simulated mental state* refers to the property of being simulated and, in that case, may be used to say that M represents a simulated mental state. *Mental simulation* refers to a phenomenon that always involve two or more agents, where one uses their own mental resources to represent the other's mind. Taking into account that music does not possess mind or mental states, a *mental simulation* of a music naturally will not resemble a *mental simulation* of a person, rather being considered to be a ***virtual mental simulation***.

Simulation Theory proposes that both cognitive processes and mental states can be simulated, such that, applying the definition to the case of music, they will be defined in terms of *virtual mental simulations,* considering virtual mental states (M*) and virtual cognitive processes (P*) that can be generated by the music. A cognitive process is a mental simulation if and only if, i) a cognitive process (P*) generates a token mental state (M*); ii) M* resembles another token mental state (M) in some significant aspects; iii) M and M* are both mental states; iv) M is generated by another cognitive process (P); v) P and P * are both cognitive processes; vi) P is implemented by a cognitive mechanism of type C and vii) P* by the reuse of the same token cognitive mechanism of type C. On the other hand, a token mental state M* is a simulation of M if and only if, i) M and M* are both mental states; ii) M* resembles M significantly; iii) M is generated by token cognitive processes P and iv) M* by token cognitive processes P*; v) the former is implemented by the use of cognitive mechanisms of type C and vi) the latter by the re-use of the same mechanisms (Barlassina, Luca, Gordon and Robert, 2017). Figure 6 summarizes schematically what has has been described.

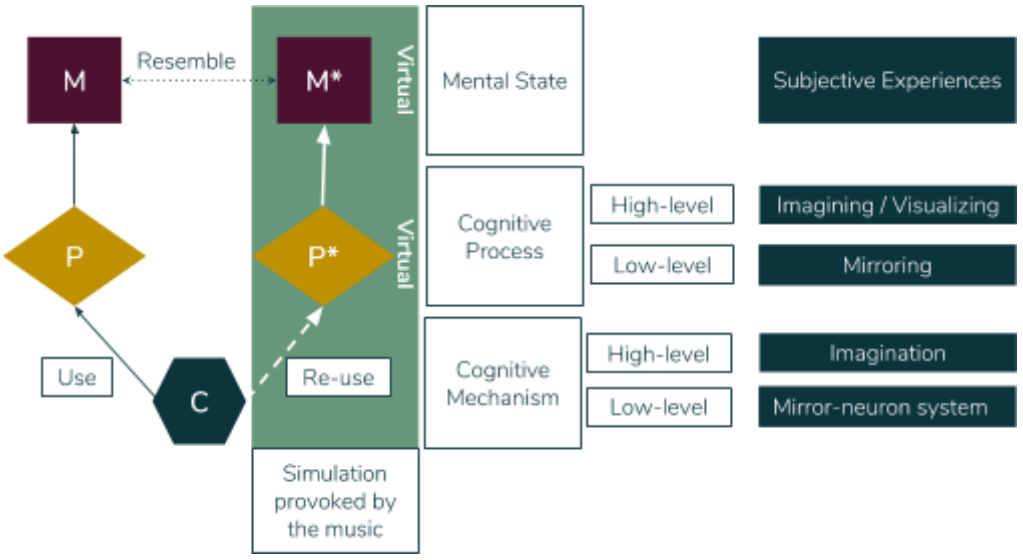

Fig. 6 | A Simulation Theory diagram. The hexagon C depicts a cognitive mechanism C; when C is re-used it implements a cognitive process P* generating a mental state M*, which, in turn, resembles M. M* is a mental simulation of M; M* a simulated mental state and P* is a simulated process. Adapted from Barlassina, Luca and Gordon, Robert M. (2017).

Mental simulations cover high and low-level processes, the former with a voluntary and stimulus-independent character and the latter rather with an automatic and stimulus-driven character (Barlassina, Luca, Gordon and Robert, 2017). For instance, recurring to the neural substrates that allow to imagine other's sadness, in order to consider an actual simulation of sadness requires that the simulated/ imagined state resembles a real mental state. This means that imagining sadness shall reuse the circuits involved in the experience of sadness. The same applies to a *virtual mental simulation.*

Evidence from neuroscientific data shows that a specific area of the brain called "default mode network" is involved in imagination-based perspectival shifts, which include perspective taking (Goldman and Jordan, 2013). According with this authors, the fact that one brain network is responsible for this common activities supports the idea that one cognitive mechanism involved in imagination may control all *high-level mental simulation* that involve visualizing, the cognitive process of generating visual images. Examples of such processes include motor imagination - the cognitive process of generating bodily movements and actions; imagining deciding - the cognitive process of generating decision-like imaginings; imagining-believing - the cognitive process of generating desire-like imaginings. According to these statements, imagination-derived processes constitute the core of high-level simulations processes, involving outputs in terms of imaginings, images, imagery, that constitute mental states and are controllable independently of the external stimuli (Barlassina, Luca, Gordon and Robert, 2017). Moreover, a study conducted by Singer and colleagues relatively to the feelings towards other's pain suggests that it is not necessary to undergo a detailed sensory discrimination of a noxious stimulus in order to understand others' feelings (Singer et al., 2004). A subjective feeling of how might be to feel pain, in other words, an *high-level mental simulation* - due to the involvement of an *high-level* processes - might lead to the comprehension of such emotional experience.

Low-level processes are mostly confined to mirrorring mechanisms supported by mirror- neurons system, which fire when an endogenous mental event takes place due to the perception of an external sign of the same type (Barlassina, Luca, Gordon and Robert, 2017). Having music involved, the *low-level mental simulations* might rather involve the endogenous mental state provoked by the musical external event. The most robust evidence for the central role played by mirroring processes in mind reading comes from the emotional processing (Goldman, 2006; Goldman and Jordan, 2013), where it is verified that the attribution of emotions to someone else depends on the own simulation of such emotions. A phenomenon known as emotional contagion constitutes an example of a mirroring process and, consequently, of a low-level simulation process, which corresponds to the activation of the regions associated with a particular emotion by the observation of the facial expression of the same emotion (Hoffman, 2008). The employment of the same neural basis for both perceptual and endogenously modes confirms the reuse of the same cognitive mechanism for emotional responses resulting from perceptions.The automatic mimicking of another's emotions response is a purely automatic emulation, not implying a real understanding of the other's situation (Hatfield, Cacioppo and Rapson, 1994). However, when the ability to undergo the emotion is gone, the mind reading capacity is also gone (Barlassina, 2013) which is coherent with the proposal of Coplan, who proposes that understanding others' situations only is possible when the process is voluntary and conscious, but susceptible of being sustained by low-level processes, such that, the key ingredient in this interaction comes to be the ability to be aware of their occurrence (Damasio, 2010). In this sense, *low-level* processes might contribute (either constitutively or causally) for mind reading.

1.2 Theory of Mind

In a now-classic experiment, Heider and Simmel, (1944) conclude from showing a film with 2D triangles and squares moving differently in space, that viewers tended to attribute human qualities to them based on their appearances and on the way they move. For instance, the larger triangle was preferentially described as the most active and aggressive trying to chase and fight the smaller one, which was trying to escape. Thereby, through this experiment, they highlight our capacity of conceptualize simple perceptual systems, whether they have human or non-human characteristics. In this case, however, it is difficult to take Simulation Theory as a plausible source of explanation for this mentalizing, since there is any human object to be simulated. To perform a discrimination between a lifeless object and a person they suggested that human mind relies on a conceptual framework, early developed in childhood, that classifies certain configurations of behavior into basic social categories in a faster and more efficient way. The fact that, as social beings, humans possess a theory for human behavior constitute the base of Theory of Mind proposal, entailing that our *mind reading capacities* constitute an exercise of theoretical reasoning. The ability to reason about mental states through a theory requires inference models for the attribution of mental states and behavior prediction that shares some features with scientific theories: it postulates unobservables, predicts them from observables and uses them to explain other observables (Malle, 2012).

These capacities have been noticed to develop early in childhood, usually referred to appear around the age of four, according with a set of experiments. One of the most famous experiment is called the "false belief test" guided by Heinz Wimmer and Joseph Perner

(1983). In the original test, it is showed a puppet to the participants called Maxi. Maxi shows his piece chocolate, which he then hides in a cardboard box. He leaves the scene to play outside and a second puppet is introduced as Maxi's Mom. When, Mom finds the chocolate inside the cupboard, she moves it into a second box, called "refrigerator". Mom leaves and Maxi returns, saying that he is looking forward for his chocolate. The action stops some control questions are asked in order to check if the participants are accompanying what is happening. Then, it is formulated a question about where do they think Maxi will look for his chocolate: the cupboard or the refrigerator? Children until the age of four answer that Maxi will look at the refrigerator, while children older than five answer correctly about the Maxi's false belief (Barlassina, Luca, Gordon and Robert, 2017). This set of experiments show that the concept of belief about others is developed over time, requiring a maturation of cognitive capacities (Ravenscroft and Ian, 2016).

Folk Psychology, on the other hand, constitutes the representation used as substrates for the reasoning about others. In this sense, a theoretical model to represent others' mental states implies that certain perceptual inputs are interpreted as intentional action or beliefs directing a further processing of its meaning to the inference of the agent's motives. Having a theory to explain mind is an approach that takes folk psychology as a model to built hypothetical structures from a set of beliefs, desires, actions, emotions and so forth. This model may, indeed, serve either as a predictive device and as an explanatory device (Maibom, 2003; Godfrey-Smith, 2005). In the case of music, the musical features like the tempo, rhythm, harmony and melody would constitute the principles through which it would be possible to explain the "behavior" of music or to attribute it mental states. In order to take a position relatively to the duality of the philosophical proposal, it will be next considered a neuroscientific approach that through evidences will help to understand the principles behind the empathizing with music.

2. Neuroscientific approach

2.1 Mirror-neurons system

From a neuroscientific perspective, accessing mental states involves the coupling between the perceptual and the motor functions of the central nervous system, which means that the experience of the own actions resembles itself to the experience stemmed in the perception of the other's actions. The discovery of mirror neurons were first made in the macaque brain, when it was find that they fired any time a monkey perform an action or observe another monkey performing the action (Gallese et al., 1996; Fogassi et al., 2005). This system have been specially pointed as responsible for coding action in the motor areas of the brain regardless of their source: visual, auditory or performative (Kohler et al., 2002). In the human brain, a similar fronto-parietal network - the inferior frontal gyrus (Brodmann Area 44), adjacent ventral premotor cortex and the inferior parietal lobule (Brodmann Area 40) - seems to play related functions, being engaged in the representation of motor action, imitation or of the observation of others' actions (Johnson-Frey et al., 2003; Aziz-Zadeh et al., 2006; Molnar-Szakacs et al., 2006), but more importantly in the understanding of intentions behind such actions (Iacoboni et al., 2005). The discovery of such system provide a powerful mechanism of explaining intersubjective phenomena as empathy.

According with Freedberg and Gallese, embodied neural mechanisms underlie the aesthetic responses, implying the general involvement of simulation of actions, emotions and corporal sensations (Freedberg and Gallese, 2007). Moreover, it is also argued that intense aesthetic experiences activate the default mode network (Vessel, Starr and Rubin, 2012), previously referred to be involved in the imagination processes, which suggests that aesthetic responses might be related with high- level processes involved in empathic experiences. This mechanisms were firstly described relatively to visual observation, however, subsequent research has been revealed their operation in auditory systems, which represents a change in the understanding of how music is processed. Without reducing human experience to neuroscientific evidence, a proposal made by Gallese, (2003) known as the "shared manifold" aims to defend intersubjectivity, which includes empathy phenomena, according with a three-level model: i) the phenomenological level, which allow us to share a sense of similarity with our conspecifics - achieved through empathy; ii) a functional level that governs self-other interactions and iii) a sub-personal level that represents the activity of mirror neuron system. Moreover, Gallese highlight that simulating the others through mirror-neurons is not equivalent to first-hand experiences, emphasizing the necessity to preserve the alterity character of others in any empathic response, i.e. a self-other differentiation.

An hypothesis for the differential involvement of areas of the brain involved in *emotional* and *cognitive empathy*, considers that the former privileges the involvement of the mirror neuron system and the later rather involves areas of the brain associated with ToM, mentalizing and autobiographical memory (Goldman, 2013; Shamay-Tsoory, 2011). However, empirical works support the activity of mirror-neurons in both *cognitive* and *emotional empathy* (Iacoboni, 2012; Preston and De Waal, 2002), which supports the consideration that low-level processes of simulation might be at the base of higher-level processes that enable us to distinguish our first-hand experience from the others. In this sense, one initial hypothesis regarding the participation of mirror neuron system in empathic processes might be that mirror neuron system underlie music appreciation, considering that empathy is responsible for music appreciation.

2.2 Neurohormones

The role of neurohormones is also considering as important for empathy, mainly the ones who belong to the group of the Endogenous Opioid System (EOS). Such hormones are pointed to play a significant role in social bonding functions, for instance, between infants and their caregivers (Clarke, DeNora and Vuoskoski, 2015). EOS were also demonstrated to play an important mediator role in the synchronization of movements in dance movements (Tarr, 2017). Kreutz (2014) show the impact of choral singing not only in the increased subjective measures of wellbeing, but also in the higher levels of oxytocin in saliva samples compared with an equivalent period of social conversation (Kreutz, 2014), providing evidence for a neurohormonal response even without a high level of physical arousal, being inclusively associated to the success of a mind-reading task through an image of a person's eyes (Domes et al., 2007). Such mechanisms of social coordination are suggested to play a role in intersubjective experiences as *empathy*.

3. Psychological approach - Perception-Action coupling Model

The behavioral level of empathy understanding privileges *mimicry* and *emotional contagion* as the main mediators of intersubjectivity, which were previously proposed as low-level processes of simulation. These processes are rooted in perception-action coupling models (PAM), congruent with the suggestion of Frans de Waal (de Waal, 2007) that the nervous system connects perception and action systems which represent states, situation or objects of conspecific automatically leading to behavior otherwise inhibited that is responsible for the navigation into the social environment (Preston and De Waal, 2002).

Mimicry relates to the behavior of inaccurate and spontaneous copying of external sources, constituting a form of imitation already present when newborns imitate adults. *Emotional contagion* refers to the embodiment of the emotions manifested in perceived actions - facial expressions or crying. These forms are considered to be precursors of *emotional empathy*. The interesting fact about these models regards the sharing of mental processes for the perception of an action and for the expression of the same action, congruent with the proposal of the common coding theories, of which PAM is an example and the neural circuitry involved is denominated of contagious circuits. In this sense, the emotion that is perceived might be internally simulated as an emotion felt (Schubert, 2017). Simultaneously, these circuits might be shaped by cultural norms and social interactions, where modulatory processes take place (Valdesolo and DeSteno, 2011).

The *cognitive empathy* precursors consider that the person employ mechanisms to overcome the contagious experiences through inhibitory processes that allow the understanding of the difference between the self and the other. The shifting of the locus of the emotion from the internal to external side leads to prosocial behavior. This process of differentiation are at the base of the perspective taking manipulating the bottom-up stream of affective information through top-down mechanisms that integrate contextual information (Schubert, 2017). In line with these proposals, both *cognitive* and *emotional empathy* work together, even though they show a reasonable functional independence (Shamay-Tsoory, 2011) (Figure 7). The interaction between these two different dimensions of an empathic experience occurs, for example, when the perceptions of someone's pain is modulated by the evaluation of their life and their social behavior, resulting in the construction of a perception of fairness or unfairness relatively to the pain, which, in turn, influences the behavior towards the person.

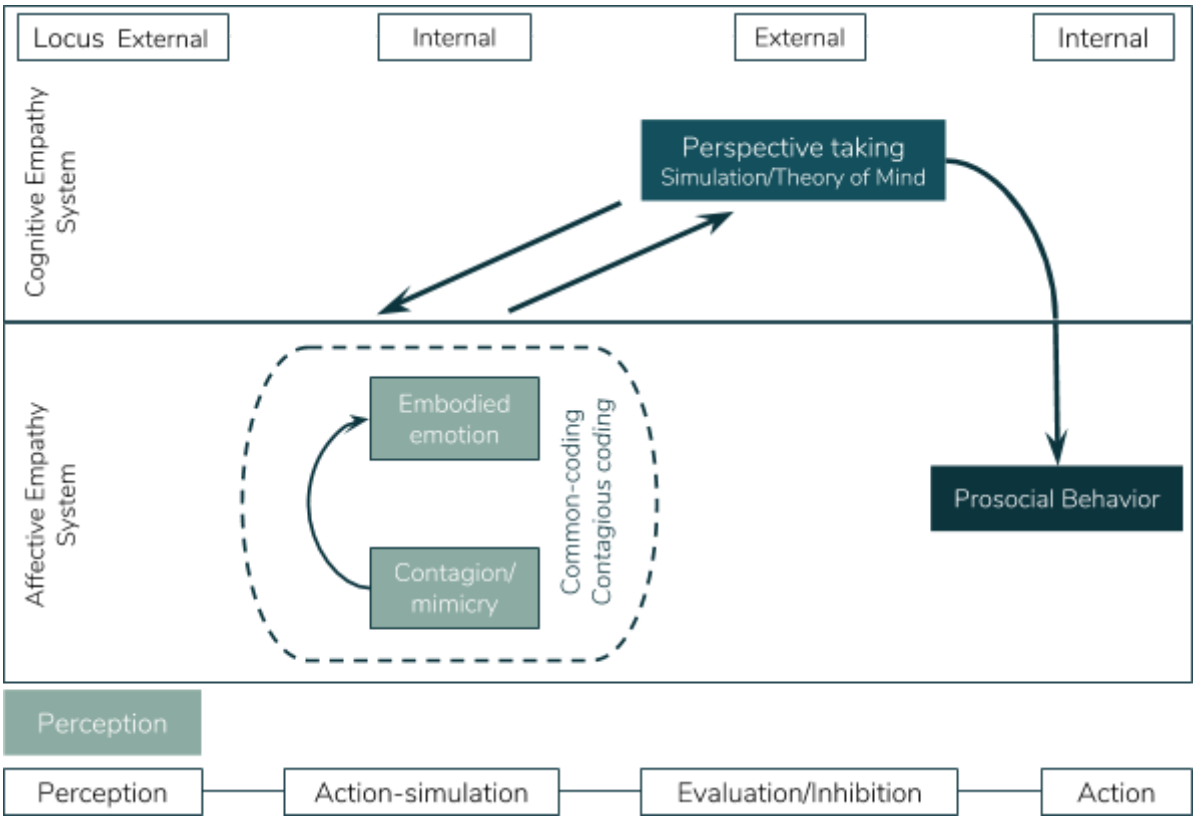

Fig. 7 | The lighter boxes denote bottom-up processes, whereas the darker one denote top-down processes. The common coding represented in the dotted space lead to emotional activation. The cognitive empathy systems evaluate the affective output which result in top-down processing that ends up in prosocial actions.This proposal is based on the Common Coding Model of Prosocial Behavior Processing proposed by Schubert (2017).

4. Music and empathy

After the previous introduction to empathy, it might be considered that it represents a capacity through which human beings are able to feed relations of attachment and concern. Such sense of empathy tend to be greater with a close relative, as a friend or a family member. However, empathy might also be extended to non-human forms, for instance, companion animals (Paul, 2000). In sum, empathy and empathic feelings are strictly related with feelings of oneness that one individual feels with another (Schubert, 2017). In this regard, Naomi Cumming weaves the following commentary, relatively to the solo violin introduction of the aria 'Erbarme Dich' from Bach's St. Matthew Passion:

> "The pathos of Bach's introduction, and its elevated style, are quite unmistakable, and recognition promotes empathy. [...] The music forms the listener's experience, and in its unique negotiation of the tension between striving and grief, it creates a knowledge of something that has been formerly unknown, something that asks to be integrated in the mind of the hearer" (Cumming, 1997)

However, music do not correspond to a sentient being, as a non-human animal, equipped with intentional capacities. How is it explained that someone empathize with the musical signal? And what kind of intersubjective experience music provide? A conceptual framework proposed by Clarke and colleagues, the empathic experience in music takes place through reciprocal relationships between the listener and the context, reflected in the influence of different contextual sets in the empathic dispositions of each listener, i.e. their "contagious susceptibilities" relatively to a specific music (Clarke, DeNora and Vuoskoski, 2015). The principal means of empathic engagement are distinguished under five different channels.

1) Perceptual-motor resonance, which might range from the act of dancing, singing or just listening with or to the musical material.
2) Synchronization or entrainment, which derives from a directed attention that involves the engagement with the rhythm of music (Clarke, DeNora and Vuoskoski, 2015).

Relatively to these two different channels for empathizing with music, a study where listeners were ordered to rock chairs according with the tempo of the music, reported greater closeness feelings relatively to the partners when they were synchronized in the same music (Demos et al., 2012). Furthermore, other studies demonstrated children previously involved in activities where they were rhythmically synchronized with music presented more cooperative and empathic behaviors comparatively with other children (Kirschner and Tomasello, 2010; Rabinowitch, Cross and Burnard, 2013). The intersubjectivity verified in the interaction with music range from the individual subjectivity to the group intersubjectivity, where emotions, cognitive processes and intentions are highly coordinated among the subjects (Rabinowitch, Cross and Burnard, 2012), as facilitators of task execution. Moreover, people tend to better synchronize with a musical pattern when they believe that the sound is intentionally originated by a human than when its source is mechanical or unknown (Kirschner and Tomasello, 2009). In musical interaction, such intersubjectivity contributes not only for the understanding of others, but also to the facilitation of the musical activity itself. These acknowledgments permit to conclude that an empathic experience with music might occur by motor resonances with the particular auditory features of the music, possibly related with human expressivity. The remaining three mechanisms proposed to describe an empathic experience are the following:

3) Perceptual-cognitive resonance, which represent the type of competence demonstrated by the listener relatively to the familiar or unfamiliar type of musical events (Clarke, DeNora and Vuoskoski, 2015).
4) Mimetic resonance, which correspond to the proclivity to hear music through an animated or humanized way (Stern, 2010) according with either the musical qualities or other perception-action coupling (Clarke, DeNora and Vuoskoski, 2015).
5) Affective resonance, which arise from an interaction between the (10) and (8), through the recognition of important properties (style and gesture) for the expression of musical properties. In this sense, the listener's affective competence and sensitivity relatively to such properties is manifested in the listener experience (the preference

or enjoyment of the music might be seen through such resonance, but not reduced to it) (Clarke, DeNora and Vuoskoski, 2015) (Figure 8).

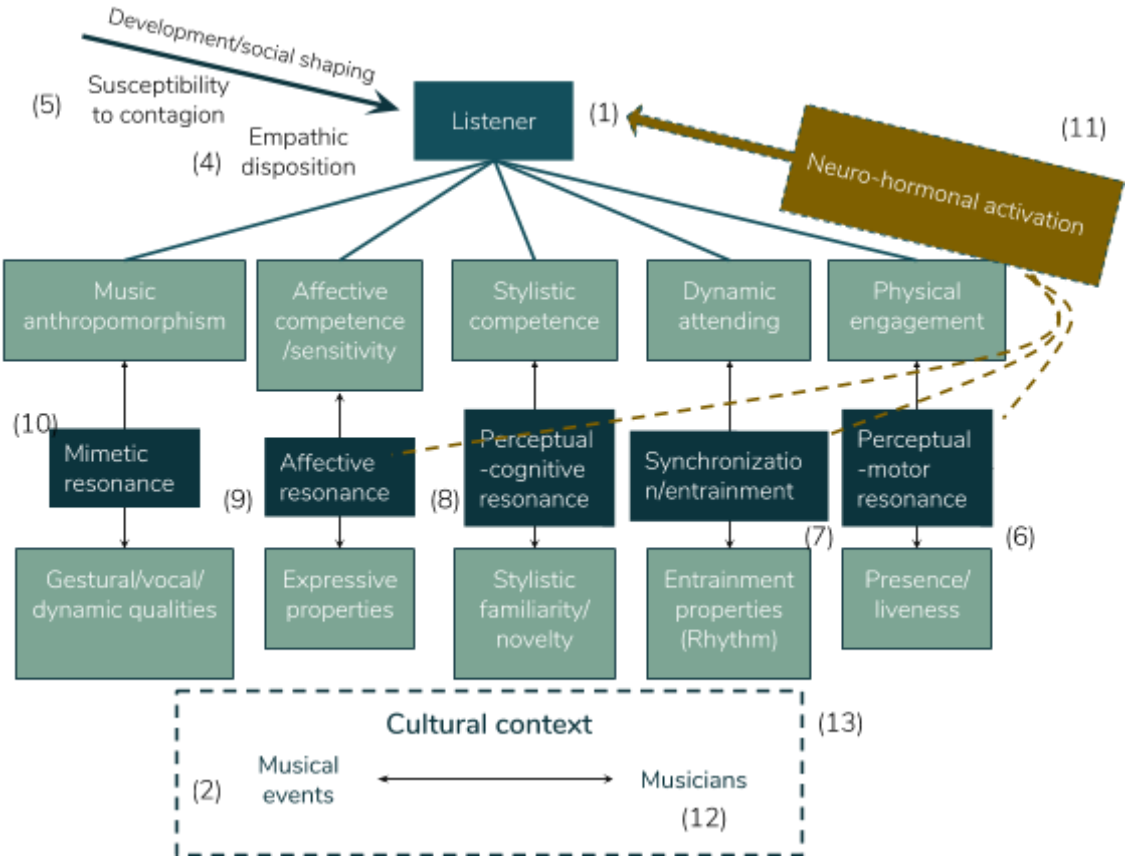

Fig. 8 | Diagram representing the empathic experience of the listener. Adapted from Clarke et *al.* (2015, p.50).

An experience described as "merged subjectivity" (Rabinowitch, Cross and Burnard, 2012) occurs in music-making as a consequence of coherence, integration and synchronization of the individual behavior into a unified auditory scene (Bregman, 1990). However, the passive listening of music, also provide similar experiences, through which some listeners report to feel 'one with the music' (Gabrielsson, 2012), which favour the fact that not only the direct participation in music-making, but also the act of listening to music might be related with activities of intersubjectivity, with the only difference that listening to music do not correspond to an engagement with a real human subject but rather with an auditory signal. Regardless of the source for empathy, whether it is a sentient or non-sentient being, the sense of oneness constitutes the most important aspect of such capacity (Schubert, 2017), defining the meaningful interaction between two different sources.

For the purposes of this work, the mental representation of emotions and their respective experience, constitute the main empathic event provided by music that is important for the explanation of the Tragedy Paradox. The facility to resonate the affective state of others is a characteristic of an high social empathizer and also a result of *emotional empathy* systems (Wöllner, 2012; Schubert, 2017): an high social empathizer denotes a greater functionality of contagious circuits (not vice-versa), i.e. "the activation of contagious circuitry is necessary and sufficient for empathy" (Schubert, 2017). The higher the state of empathy

provoked by a particular situation due to the functionality of the *contagious circuitry*, the more accurate is the matching between the emotions expressed by the source and the emotions felt by the receiver (Egermann and McAdams, 2013).

One interesting experiment was based in the acknowledging of the emotions expressed in opera performances under two different conditions: listeners with explicit instructions to employ an empathic perspective over the performance and listeners directed to the employment of an objective perspective over the performance, mainly focused in the musical characteristics of the songs. These conditions correspond, respectively, to a high and low empathy conditions. After the psychophysiological responses, the high empathy condition corresponded to an higher relation with the emotional content of the performance, even taking into consideration the semantic content provided by the opera songs (Miu and Baltes, 2012). Therefore, higher dispositional empathy corresponds not only to a fixed rigid trait, but rather to a more readily tendency to empathize in different situations (Clarke, DeNora and Vuoskoski, 2015). This means that the dispositional empathy is not a deterministic trait of the person, rather a consequence of the type of interactions that are established with the context in a certain situation.. The role of empathy in listening to music has been investigated relatively to the influence of the dispositional traits of empathy in the induction of emotions by the music (Vuoskoski and Eerola, 2011; Vuoskoski et al., 2012) revealing that people with higher disposition to empathize report more intense sadness, wonder or transcendence when listening to music (Miu and Baltes, 2012). In sum, the emotional response to music and the person's susceptibility to empathize are closely related.

In this sense, it is considered that the greater proclivity to empathize with music is also dependent on the susceptibility to activate contagion circuitry through music, involving involuntary responses derived from bottom-up automatic motor resonances (Molnar- Szakacs and Overy, 2006; Goldman, 2013; Schubert, 2017). Cox's mimetic theory states that music is processed by motor reenactments of the internally imitation of the physical gestures associated sound (Cox, 2016). This proposal reflects the mimetic resonance of the framework earlier proposed for the relation between music and the listener. On the other hand, the encoding of affective gestures into the musical signal by composers and performers and their decoding by listeners through contagious processes whereby affective bodily motions are internally reenacted in the listening process (Molnar-Szakacs, 2009), rather reflect affective resonance. The *emotional contagion* in music might occur through an explicit mechanism of matching between the emotional expression in music and the emotion felt, by which the emotion musically expressed is captured by the listener (Evans and Schubert, 2008; Juslin and Vastfjäll, 2008; Juslin and Lindström, 2010; Juslin, 2013). In the case of music, "mirroring" mechanisms (Goldman, 2011) are at the base of the perceptual-action couple that leads to *emotional contagion* by the music (Davies, 2013; Juslin and Västfjäll, 2008). In this sense, the *emotional contagion* experience can occur through a wide range of stimulus, either human and non-human, from which music is an example. Moreover, lower empathizers, as Autism Spectrum Disorder (ASD) people, show a unimpaired ability to understand the emotions transmitted by music, which seems to be justified by their functional levels of *emotional empathy* (even though with complexes variations), rather showing more evidence for the deficit in *cognitive empathy* (Schubert, 2017). Thus, ASD people might escape from the complexities of the social world when listening to music (Molnar-Szakacs et al., 2009), which provides an ideal set to recognize emotions. In conclusion, the activation of *emotional*

contagion mechanisms constitutes the initial phase of an empathic experience with the music favoured by *emotional empathy*.

On the other hand, the emotional responses provoked by music might be also a result of reconstructive processes (Goldman, 2013), in this case, associated with *cognitive empathy* where the emotional response evoked by music might be provoked by imaginative perspective-taking or fantasy components of *cognitive empathy*, which let the listener to understand what took the composers to write certain music (Scherer and Zentner 2001) or to interpret music as a *virtual person* (Levinson, 2006; Vuoskoski and Eerola, 2015). In the end, the only processing of *cognitive empathy* rely on the understanding of music as the cause of the emotional contagious mechanisms, which involve much less burden than processing complex social interaction with cognitive empathy (Schubert, 2017).

4.1 Simulation Theory or Theory of Mind?

The contagion mechanisms here exploited have been also related with the low simulation processes proposed from the realm of philosophy of mind, such that Simulation Theory serves as a philosophical model for the low-level processes employed in emotional empathy through music. However, when it comes to explain processes of *cognitive empathy* in music by Simulation or Theory of Mind the distinction is not so straightforward. Discerning human intentions according with a theory of human behavior might provide a good base for an empathic experience based on logical reasons, which explain, for instance, that someone attributes feelings of trust to a friend that is trying to help us in the resolution of a difficult problem. However, when a human being is replaced by a music, accessing its emotional content through Theory of Mind approaches would lead the listener to recur, in the final analysis, to the musical characteristics (as tempo or mode), as the theoretical background that would concur to the attributions of sadness or happiness to the music. Such approach based in theoretical and objective terms, would rather give a distant way to understand the musical piece, do not attending to the emotional experience provided by the music. The experiment carried out by Miu and Baltes corroborates this argument, since it is demonstrated that taking an objective perspective over a musical piece leads to the inhibition of the feelings of its emotional content (Miu and Baltes, 2012).

In this sense, adopting the Simulation Theory for the explanation of such phenomena rather leads to the question of how is possible to simulate mental states through auditory signals? Taking into account that the simulations here proposed correspond to *virtual mental simulations,* implies that simulating an auditory signal leads to the activation of networks involved in the representation of emotional content, the same way a scream indicates angry, fear or surprise states. As previously referred, the main high-level process of empathy that take place when listening to music refers to the matching of the emotion locus in the music perceived (Schubert, 2017), contributing for the self-other differentiation by which is attributed an emotional content to the music. The explanation of the emotional content of the music is done at the cost of previous low-level simulations not by the theoretical attribution of reasons by which a certain music provides a certain emotional content, which would happen with human being interactions but not with the music-human interaction. In this sense, simulation mechanisms constitute the base for both *low* and *high-level simulation processes* of imagination (Figure 9). Simulating non-human entities employing human

resources constitutes an argument in favour of the susceptibility to egocentric errors of any simulation, i.e. to the attribution of human characteristics to the music.

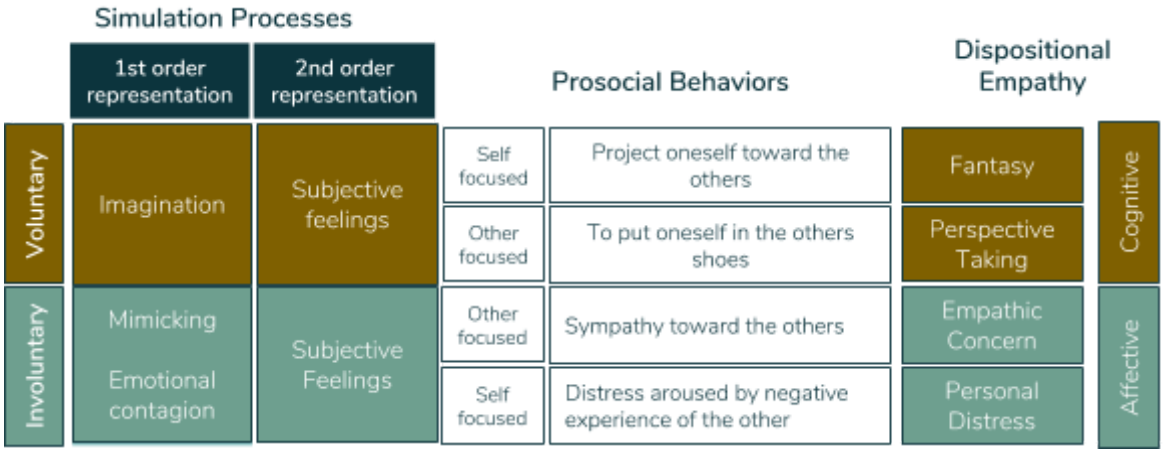

Fig. 9 | The different possible empathic experiences emerging from processes of simulation. Made by the author.

In this sense, the experience of emotions through music in order to be derived from the capacity to empathically respond toward the others is at the first level connected with the involuntary processes a person uses to integrate perceptual information. The same way that the act of responding towards the pain of the others by internally running circuits involved in the subjective experience of pain allow us to feel pain for the others, to respond to music by internally simulating the emotional content of the auditory signal also constitutes an example of a simulation through which emotional experience might take place.

The different responsiveness to sad music among people, according with the different tendencies to respond empathetically in different situations support the possibility of, at least, not all people feel negative emotions in response to sad music. Thus, the puzzling fact of listening to sad music might not constitute a puzzling fact for everyone in consonance with *deflationary explanations*, however, the fact that some people feel sadness in response to music means that the Tragedy Paradox stands for some cases, which are the interesting cases to be explored. Thus, in order to pursuit *conversionary explanations*, the next chapter will provide evidences that consolidate the cases where people feel real emotions through music. In that regard, the functional role of emotions will be discussed in the first place, to further argue in favour of the genuine emotional experience through music under scientific evidences.

Briefing

After the proposal of the first Chapter that empathy is involved in the appreciation of sadness in music, the pursuit of conversionary explanations for the Paradox demanded the previous understanding of empathy. In that sense, this chapter provide an overlook into the main perspectives to understand empathy. As a general definition, empathy consists of the understanding and sharing of others' feelings, requiring a capacity to understand their circumstances. From the perspective of Philosophy of mind, such ability is related with mind reading capacities, raising the discussion about the way of access others' mind. Two main philosophical approaches are then exposed, the Simulation Theory, which suggests that we recur to simulations of others' minds employing the own resources or the Theory of Mind, which rather proposes that we recur to a theory that explains their minds and behavior. For the case of music, a non-human entity, both approaches might bring problems at the first sight. Relatively to the simulation, what is there to be simulated if music does not have mental states? On the other hand, the closest a theory might be from providing a empathic experience would be through the employment of objective approaches to musical components, however such objective approach would exclude genuine feelings in music that would necessarily lead to the denial of *conversionary explanations*, incongruent with the main purposes of the work. Thus, following the simulation theory it was assumed that with music might occur virtual mental simulations, being proposed that the auditory signal lead to the simulation of emotional content by the listener. Thus, although music does not have mental states itself, it might be able to provoke mental states in the listener.

From a neurobiological approach evidences are presented for the involvement of mirror-neuron system in the representation of perceptual signals, including auditory signals that explain different intersubjective phenomena. Thus, it is considered that mirror neurons underlie *low-level mental simulation* that support *high-level mental simulations*. The psychological approach adds that mirroring mechanism constitute contagious circuits that lead to emotional experiences, being at the base of emotional empathy. Additionally, it is proposed that the emotional experience is intertwined with cognitive empathy mechanism that allow to differentiate the self from the other. In that sense, empathic experiences with music are suggested to involve virtual simulation mechanisms through which mimetic, affective or perceptual-cognitive levels of resonances occur. After this first hypothesis, the first part of the challenge to pursue *conversionary explanations* lays in the confirmation that music triggers real emotional experience, through which it will be possible to answer to the first research question.

Part I.

The defeat of deflationary explanations

The experience of emotions through music

Chapter III

Emotions in mind

The understanding of the mind within the Western philosophical and scientific tradition diverges throughout times. From one side, the understanding of mind as being composed of building blocks known as faculties, in turn reflecting a particular process based in distinct and innate physical correlates - neurons, modular brain circuitry or a pattern of bodily correlates (Barrett, 2006). On the other hand, under more recent theoretical approach known as constructionism, oppose the idea of faculties in mind, rather being setted upon two main hypotheses:

1. Faculties are not independent capacities, but rather folk constructs based in highly variable factors;
2. The building blocks of mind are constructed under more basic, domain-general processes (Barrett, 2013).

Emotional science is a perfect example of such division of paradigms, where emotional faculties found proponents in the works of Herbert Spencer or Charles Darwin, and later in the 'basic emotions' theory (Ekman, 1992; Izard, 1977). In the middle of twenty century, this idea was rejected in the name of a constructionist view, however, without empirical support. Nowadays, appraisal theories propose "emotions as acts of meaning", a definition understood both under a classical view or a constitutive appraisal model (Barrett et *al.*, 2007; Gross and Barrett, 2011) (Figure 10). However, a growing number of empirical evidences (Gendron et *al.*, 2014; Kober et *al.* 2008) disconfirmed the validity of classical view in the approaching basic emotions.

From the philosophical realm, two opposite approaches of emotion the *feelings-based* or *sensation-based* approach, which consider that at the core of an emotions is a specific sensation, and the *thought-based* or *cognition-based approach,* which considers that at the core of the emotions is a specific idea or judgment. The *feeling-based* views consider that any sort of cognitive representation, like beliefs or desires, might be characteristic of a determined type of emotion but not essential to such emotion, since the emotional core belongs rather to physiological sensations or feelings of comfort and discomfort, considers that intentionality of the emotion is preserved by characteristic focus of concern that the subject considers significant. On the other hand, through *cognition-based approach* it is also considered emotions as bodily responses with distinctive physiological, phenomenological and expressive profile, that serves the function of directing attention and action in a certain direction and involve varying degrees of cognition involvement, where thoughts and beliefs about a specific object shape the responses towards it. However, it might be reasonable to consider a spectre of emotional states ranging from the minimal involvement of cognition to the middle involvement, reflected in emotions such hunger, surprise, lust, fear, anger, joy or sorrow, to complex involvement of cognition as it happens in feelings of embarrassment, pride, shame, jealousy, remorse or enjoyment (Levinson, 2007). The involvement of cognition

might occur through cognitive appraisals, that constitute the subjective evaluation of a specific object relatively to the individual's values, needs or goals (Juslin and Västfjäll, 2008).

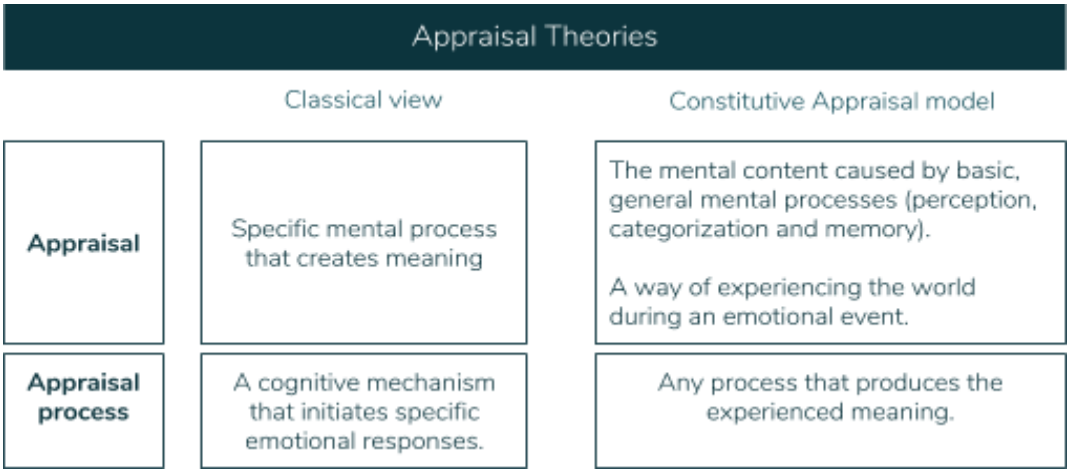

Fig. 10 | Difference between Classical View and Constitutive Model of Appraisal Theories. Made by the author.

Regardless of the perspective employed, emotions constitute mechanisms of adaptive adjustments of the body responsible for life regulatory phenomena which depend on simple perceptual apparatus that allow the detection of emotionally competent stimulus and mechanisms responsible for its generation (Damasio, 2006). Juslin proposes six sub-components for an emotional process, namely, the *subjective feeling*, the *physiological arousal*, an *expressive medium, actions tendencies* and *mechanisms for regulation*. The sub-components of an emotion are synchronized, which means that sadness might evoke specific types of reactions at those different levels and those reactions are related between each other. On the contrary of moods, which are diffuse affective states that lack a clear origin and might last hour or days, emotions are provoked by a specific object, showing higher intensity and shorter duration. Affect is the concept that involves all the evaluative and valenced states, i.e. moods, emotions or preferences (Juslin and Västfjäll, 2008).

According with a constructionist theory of emotions, emotional categories are seen as interactions of systems that are not specific to emotions (Barrett and Satpute, 2013; Lindquist et al., 2012; Barrett, 2009) which means that an emotion might be "construed" through different neural representations and give rise to the same functional outcome. This means that, the bunch of thoughts, sensations, physiological changes, desires, shifts of attention that an emotion comprises, requires an organization with causal relations between all the elements of the structure in order to be understood (Levinson, 2007). In this sense, this chapter aims to provide insights about the functional role of emotions through neuroscientific evidences, discussing in the end the particular function of sadness.

1. The Conceptual Act Theory

The previous approach is consistent with the Conceptual Act Theory (CAT) proposed by Barrett, which considers that an emotional event involves the interaction between external sensory stimuli from the world and sensations from the body categorized according

with contextual information. Similarly to appraisal theories, CAT entails that an emotion constitutes an act of meaning making. In this sense, a brain circuit associated with the act of crying is not necessarily interpreted as sadness, it might also means happiness according with a contextual appraisal. The dependence of emotions on acts of categorization is crucial for the understanding of the interactions between the subject and the world (Barrett, 2014). In this sense, the emotion do not comprise only the physical responses that occur in the body, but the processes of meaning making that connect such alteration with the context. This flow of information is necessary for the categorization of an emotion, since it constitutes always an interaction between the individual and the environment. The physical reactions together with the external events that commonly accompany sadness, such as the loss of a beloved one, a personal failure or lack of achievement, lead to the categorization of sadness. This means that, in order to understand how sadness is felt through music, is primarily necessary to understand sadness itself.

The *first* assumption of this theory concerns to the evolutionary advantage of the emergence of emotions from domain-general processes in the functional architecture of the brain (interoception, exteroception, conceptualization, attention, executive control), due to their efficiency and flexibility comparatively to domain-specific mechanisms (Laland and Brown, 2002). A *second* approach of such theory entails that, although emotional episodes comprise general-species actions, like freezing, fleeing or fighting, (Barrett, 2012) human emotional processes are beyond those general processes, being also dependent on abstract conceptualization and language. The *third* assumption of CAT regards the hypothesis of emotions constitute acts of meaning-making through the continuous interpretation of sensory inputs from the internal and the external world, consistent with the constitutive appraisal theory. The *fourth* hypothesis has to do with the functional account of emotions, which means that an emotion is a response to a particular event having a specific function. Embodied conceptual knowledge is used for the perception of a physiological change associated with the emotional state which, although it possesses a physical function by itself, it is dependent on situated interpretations in order to shape behaviors. In this regard, the last and *fifth* conjecture acknowledges the importance of past experiences shaped by the cultural contexts where the social interaction take place. For this reason, what makes an American sad does not work the same way for a Japanese, which concur for the notion that emotions constitute culturally sensitive phenomena. This do not mean that culture cause emotion, instead that emotions are cultural performances that depend on the conceptual knowledge that is enacted and transmitted in socialization and acculturation and is responsible for regulating the interaction in the cultural arena (Barrett, 2014), amplifying or reducing the expression of certain emotions comparatively to others.

1.1 A commentary about culture and emotions

Although some part of the emotional experience is biologically determined, such that, regardless of cultural changes emotions are experienced similarly, cultures also constrain the way emotions are felt and expressed (Lim, 2016), which corroborates the CAT. Specific situations tend to lead people to experience negative rather than positive emotions, and vice-versa, in an universal way. Ekman affirms that facial expressions of basic emotions are interpreted the same way across different cultures (Ekman, 1987. How does culture plays a role congruent with the CAT proposals?

Culture provides the standards for perceiving and communicating between people that share a "language, a historic period, and a geographic location" (Triandis, 1996). In this sense, biological reactions are shaped by cultures, such that, the way people should feel in certain situations and how they should express their emotions varies according with different cultures. Culture do not only influence the situations whether the emotions might be expressed or not, but also the "labeling" or categorization that people attribute to them. Again picking the example of Americans and Japaneses, which represent two opposite societies in terms of cultural framework, it might be considered that the first represents the model of an individualistic culture and the later the model of a collectivist culture (Lim, 2016).

Individualistic cultures, which are mainly represented by Westerns, tend to favour an independent self-construal, which means that the group have the function to promote individual well-being (Oyserman and Lee, 2008). In this sense, individual's uniqueness is valued and the members of this cultures are encouraged to express their inner states and feelings and to play an influence on the others (Tsai, et al., 2007). By contrast, collective cultures like the Easterners tend to build interdependent self-construals, where the core unit of the society rests in the group (Oyserman and Lee, 2008). This cultural sets favour the adaptation of a member to fit in a group and do not influence the others to fit in the groups they belong (Tsai, et al., 2007). Cultural forces push the members more strongly towards one self-construal over the other, such that people are motivated to behave congruently with such cultural constructs. They turn to be reflected in the affective states preferences of the different members (Tsai, et al., 2007), for instance, Americans compared with East-Asians tend to prefer excitement or enthusiasm over the solemnity and peaceness reported as more desirable among Japanese and Chinese (Lu and Gilmour, 2004; Uchida and Kitayama, 2009).

2. Plutchik's wheel of emotions

The proposal of the CAT shows plenty of similarities with the psychoevolutionary theory of emotion proposed by Robert Plutchik. According with Plutchik, it might be distinguished eight primary emotions: anger, fear, sadness, surprise, anticipation, trust and joy, which correspond to different biological reactions with evolutive survival value. In this sense, he defended that emotions favoured the interaction with environment, being transversal to all organisms in similar prototypes forms, although they are triggered by different stimuli and expressed under different forms. The basic emotions represent such prototypes in a form of idealized states, which means that their characteristic and properties are prone to variations, and all the other emotions constitute derivations of the basic ones.

The concept of basic emotion refers to the notion of a constrained number of emotional responses more fundamental than others. Such responses derive from goal relevant situations during the evolutive process (Oatley, 1992) as cooperation, conflict, separation, danger, reproduction, and caring. This idea is coherent with the phylogenetic continuity of basic emotion proposed by Plutchik (1980), i.e. the fact that basic emotions of show distinct patterns of brain activation (Ekman et al., 1983; Murphy et al., 2003) earlier developed and associated with a cross-cultural facial expression (Elfenbein and Ambady, 2002).

According with the proposal of Plutchik, all emotions show positive and negative properties (Plutchik, 2005), which is usually represented by their *valence*, but also different

degrees of activation in an activation-deactivation or interest-disinterest line, which represents their *arousal* (Russell, 2009). Although, the categorical and the dimensional approaches of emotions might be considered complementar of each other (Damasio, 1994), they both show quite fundamental differences, since categorical approach interpret emotions varying in a discontinuity space - a discreteness - whereas the later considers emotions varying in a continuum (Juslin, 2013). The approach employed here will rather follow the understanding of emotions in terms of categories or boundaries, which are more complete in a functional way. This means that, when taking an emotion as a driver of behavior, its valence is not particularly informative - how much negative should be an emotion in order to motivate a behavior? - meaning that, as forms of communication and decision-making emotions rather require sharper categorizations - a category - to better inform behavior (Markman and Rein, 2013). However, the consideration of categories of emotions do not exclude the different qualitative degrees they might present, likely associated with different subjective experiences. In that sense, the dimensional aspects of emotions might be also incorporated into the various emotional categories proposed.

In that sense, Robert Plutchik created a colorfour wheel to represent all the different degrees of emotions, where each color represent a shared valence and the gradient of the colours represents the degree of arousal of the emotions (Figure 11). The degree of arousal raises as the emotions move towards the center, moreover the emotions that are represented in the opposite direction represent opposite emotions in terms of valence. Lastly, the emotions between the petals represent the fusion of the emotions of each side, such that, love represents the joining of trust and joy according with this model.

The reduction of specific emotions to compartments inside the brain or individualized networks do not reflect the complexity and function of an emotional process rather dependent on the interaction of different networks reflected in high-dimensional brain states (Barrett and Satpute, 2013). According with this perspective, a particular pattern in the brain get some features *sufficient* to instantiate an emotion - sadness, for instance -, but none of them are *necessary* to correspond to such category, such that another episode of sadness may involve another non-overlapping set of "voxels"[2], although none of them co-occur for another emotional category. Consequently, the set of the different patterns of interactions represent the subset of activations of each category, although each category might be represented only by a specific subset sufficient for its activation for being closer to a specific category than to another.

[2] Each of an array of elements that composes the representation of a three-dimensional object, in this case belonging to an emotional pattern (Barrett, 2012).

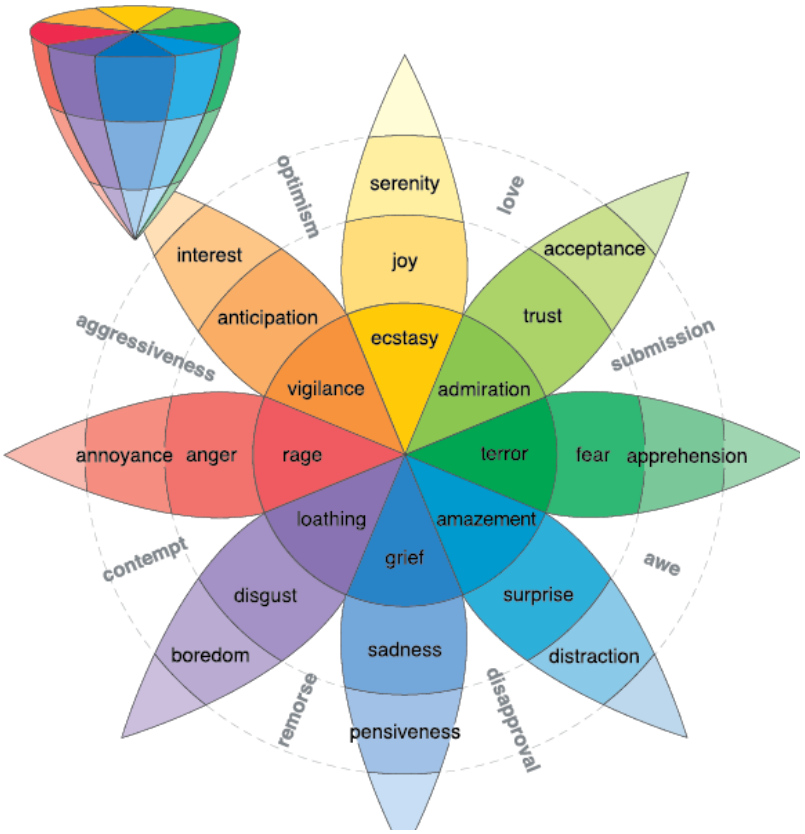

Fig. 11 | Model of emotions proposed by Robert Plutchik. Source: (Plutchik, 2005).

In order to understand the emotional brain is important to rely on the assumption that the emotions are not triggered specifically by a stimulus, instead, the further neurobiological approach is based on the assumption that the brain is actively building and testing generative models of the world rather anticipating incoming sensory input (Van de Cruys, 2017). In this sense, emotional experiences depend on domain-general networks integrated in the architecture of the human brain, which include, for instance the motor network or the central executive network, pointing to the notion that the emotional brain must not be considered separately from the social or cognitive brain (Barrett and Satpute, 2013). All the networks work together to the arising of mental events, whose emotions are an example.

It is difficult to imagine any artistic behavior outside of an affective context, therefore, in order to understand the pleasurable side of a sad experiences in artistic contexts, is first of all necessary to discuss the nature of affects states. The affective states are considered to comprise emotions, mood and feelings (Lim, 2016), however, for the purpose of this work only emotions and feelings are going to be carefully discussed. If all the information that came to our brains were not qualifiable, any image, sound, touch, smell or flavour would ever be passable of being classified as beautiful or ugly, happy or sad.

3. Emotions from Damasio's perspective

As Émile Durkheim, Charles Darwin, Sigmund Freud or William James already had noted in the 19th century, our biology plays an essential role on cultural events. Nowadays,

Antonio Damasio proposes that our emotive responses as complex biological organisms stem from basic social behavior already present in unicellular organisms. These organisms already presented mechanisms as competition, cooperation, simple emotivity or collective defense tools. Damasio defends that our mind evolved through the same primitive phenomena of interaction with the outer world and, along with the role of cultural evolution, reached the cultural achievements that we have access. In that process, Damasio considers that feelings were the main moderators, constituting the main driving forces to move the organism towards desirable states. In this sense, complex minds delivered the principles of homeostatic life regulation to instruments of culture based on principles of thriving, which, in the first instance, were ruled by emotions and feelings (Damasio, 2017).

The models employed here for the understanding of emotions derive from Damasio's proposal for the regulatory function of feelings under the conceptual logic of the CAT, which provide a base for the explanation of emotions in general. The constructionist view of emotions proposed by Barrett in the CAT results in four different outcomes. The first one concerns to the consideration of the predictive nature of the brain, where past experiences are organized according with embodied concepts. The second outcome consists on the shared nature of an emotional experience and an emotion perception, due to the fact that they both depend on the enactment of conceptual knowledge for the emotional categorization. Additionally, it is considered that the act of categorization initiates the further regulatory behavioral processes, suggesting a very blurred distinction between emotion generation and emotion regulation. The final proposal of a constructionist view corresponds to the assumption that emotional episodes are all construed as perceptions, whether referring to an emotional experience or to a perceived emotion (Barrett, 2012).

According with Damasio, emotions and feelings expand the homeostatic processes of human beings beyond their automatic regulation of physiological parameters (Damasio and Damasio, 2016). The traditional concept of homeostasis derives from an idea introduced by the French physiologist Claude Bernard, in the late nineteenth century, who noted that living systems, in order to maintain life, needed to keep numerous variables of their internal milieu within fairly narrow ranges, since deviations from the requisite levels might end in disease states or even death. Walter Cannon, an American physiologist, later coined the term, calling attention to the fact that life regulation operates according to ranges of values rather than set points. Nowadays *homeostasis* refers to the tendency of an organism to maintain an intrinsic stability within a constantly changing environment. However, besides automatic and unconscious control, human beings are under supplementary mechanism of control that involve conscious thinking and feelings (Berridge and Kringelbach, 2015; Damasio, 2000; Damasio, 2010; Damasio, 2017; Damasio and Carvalho, 2013).

Feelings, according with this proposal lead the organisms to consciously look forward for states that lead to the maintenance of the body and to the continuity of life. Furthermore, Damasio proposes that their mechanisms were the driving forces for the first cultural manifestations, being responsible for the monitorization of the success or failure of human actions, such that the interactions that serve the continuity of life are favoured in detriment of the ones that lead to its unbalance. Considering the homeostatic regulation enriched by a conscious feelings interface, the adaptability of the organisms increases at the cost of their basic efficiency, which means that higher degrees of uncertainty are introduced in their systems (more degrees of freedom) as the possibilities of responses are broadened, which

make them more prone to mistakes and at the same time more adaptable (Damasio and Damasio, 2016).

In order for the organisms to be able to intervene in their own regulation, their *mental* experience might possess a qualitative information, i.e. it must be *valenced*, informing the organism about the *appetitive* or *aversive* quality of the experience and guiding its behavior through the reflection of mental categories of actions 'there is a need to do something about this issue urgently', 'don't need to do anything about it" or "do more of what you have been doing" (Damasio and Damasio, 2016). In virtue of this first condition, the qualitative maps we have access through *valence*, reflect whether or not homeostatic processes are within suitable limits - the states of life congruent with the progress and proper functioning of the bodily processes are connotated with a positive valence, whereas the ones resulting from a dysfunctional working of the body are connotated with a negative valence. In sum, *valence* refers to the judgment of the present efficacy of the processes of the body and *feelings* inform about the results to the proprietary of the body.

In this sense, spontaneous or homeostatic feelings are the first gate in order to have a report of the state of life, letting our minds be tuned with the functioning of our inner state through a natural background noise (Damasio, 2006). In this sense, a general well-being signalizes the optimal physiological coordination and running of the operations of life, as well as a greater ease in the ability to act, whereas discomfort, on the other hand, might signalize a dysfunctional coordination of life functions through states of functional disequilibrium. Thus, the emotional processes are related with the spontaneous processes of life management routines responsible to inform the mind about the homeostatic state of the body, such that the main difference between feelings and the other mental experiences concerns to its content, which refer specifically to the body where they arise, offering an image of the state of the body and their internal operations.

The interaction with an external world involve the representation of objects that are able to trigger modifications in the body, (emotional competent object) along with the representation of such altered states of the body - the emotional responses - through which is possible to have direct access to the bodily processes in sequence of a particular event - the provoked feelings - are connotated with a qualitative *valence*. The alteration of the body state - the physiological changes - are transmitted to the brain through a corporal arc, being transformed into maps in the brain, concurring for a intertwining of the neuronal and non-neuronal experiences in a mental experience through body-loop interactions. On the other hand, the emotional experience do not necessarily require bodily changes, meaning that sensory body maps might be activated as if the body have really been changed, constituting the denominated as-if-body-loops. Damasio refers these paths as simulations of the affective narratives already experienced in the past, allowing the reference to a feeling without its real experience or just through the experience of a pale version of it, saving unnecessary energy. It is hypothesized that these systems evolved to represent the other's bodily states, being, for instance, the base of the functioning of mirror neurons and empathy bringin obvious social advantages in the interaction with the others (Damasio, 2017) (Figure 12). Gallese, (2003) consider these *as-if-body-loops*, the fundamental building blocks of the 'shared manifold' attributing them the capacity to identify with another's action.

The bodily changes are essential to make the event emotional but not sufficient to define a specific emotion. The necessary categorization of a prelinguistic experience is only

achieved by a conscious experience. If *valence* and *arousal* explain the underlying affect space physiologically driven (Eerola and Vuoskoski, 2011), discrete emotion terminology - category - is rather used to label the emotional experiences when these core affects are consciously interpreted. In order to report sadness, it is necessary to recognize the emotional responses as belonging to a set of features associated with past experiences. Regardless of their different patterns of activation - different degrees of activation or different set of responses - the categories of emotions correspond to recognizable templates (Damasio, 2017; Eerola and Vuoskoski, 2011). Sadness, for instance, is characterized for the low physical arousal, the reflective and critical type of information processing, a condition known as depressive realism, the slow cognitive processing style and the behavioural withdrawal associated with anhedonia states (Sachs, Damasio and Habibi, 2015).

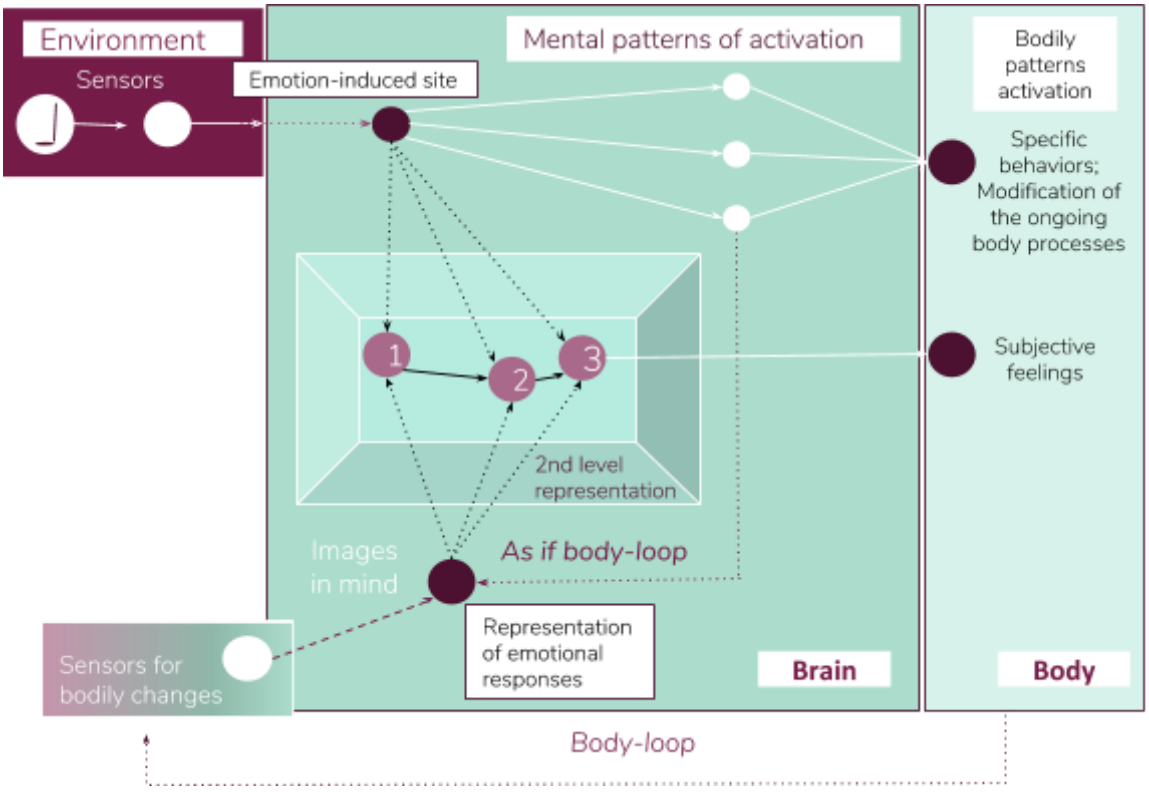

Fig. 12 | Schema for the arousal of a feeling from the emotional responses (*body-loop*) or by the reuse of the patterns associated with the emotional responses in higher levels (as if body-loop). Made by the author integrating information from Bosse, Jonker and Treur, (2008) and Damasio, (2017).

In sum, this means that *emotions* do not correspond to isolated moments, but rather to *processes* of bodily changes in response to internal or external stimuli, functioning according with principles of life maintenance. The *feelings*, on the other hand, represent for definition conscious experiences that allow us to have direct access to such state of our life (Damasio, 2017), keeping their work on the monitoring of the interactions made between the individual and its environment. These conscious experiences are also linked to the *appraisals,* introduced in the beginning, which correspond to the conscious access of events considered as relevant.

The primary appraisal of an events indicates the qualitative "label" that oscillates between the positive or negative valences attributed to it, either through more automatic

processes - as primary affective responses to an injury through a painful experience - or rather through less automatic processes - as the anticipation of repercussions of the event based in previous experience or interpretive processes. A secondary appraisal refers to the assessment of further aspects of the event that are relevant to the type of action readiness - approach or withdrawal forms of behavior. In this sense, different codings of an event might lead to different emotions, however, only a conscious experience of such changes leads to their experience. In this sense, it is possible to understand why an emotional experience (feeling) might be compared with a process of perception, since it involves a conscious assessing to what is "happening" to the body. Moreover, the feeling itself represents a function associated with a particular behavior, which might be associated with behaviors responsible for the mitigation of the feeling itself. A study conducted by Lamm and Singer (2010) suggests an unifying model for the multimodal integration of global emotional states that guide adaptive decision making and homeostatic regulation related to self and to other's affective states (Figure 13). In this sense, the emotional processes depends on (**a**) the *identification* of emotionally salient information in the environment; (**b**) *generation* of emotional experiences and behavior in response to (a) and, finally, (**c**) the *regulation* of emotional experience and behavior in order to produce contextually appropriate responses (Phillips, 2003).

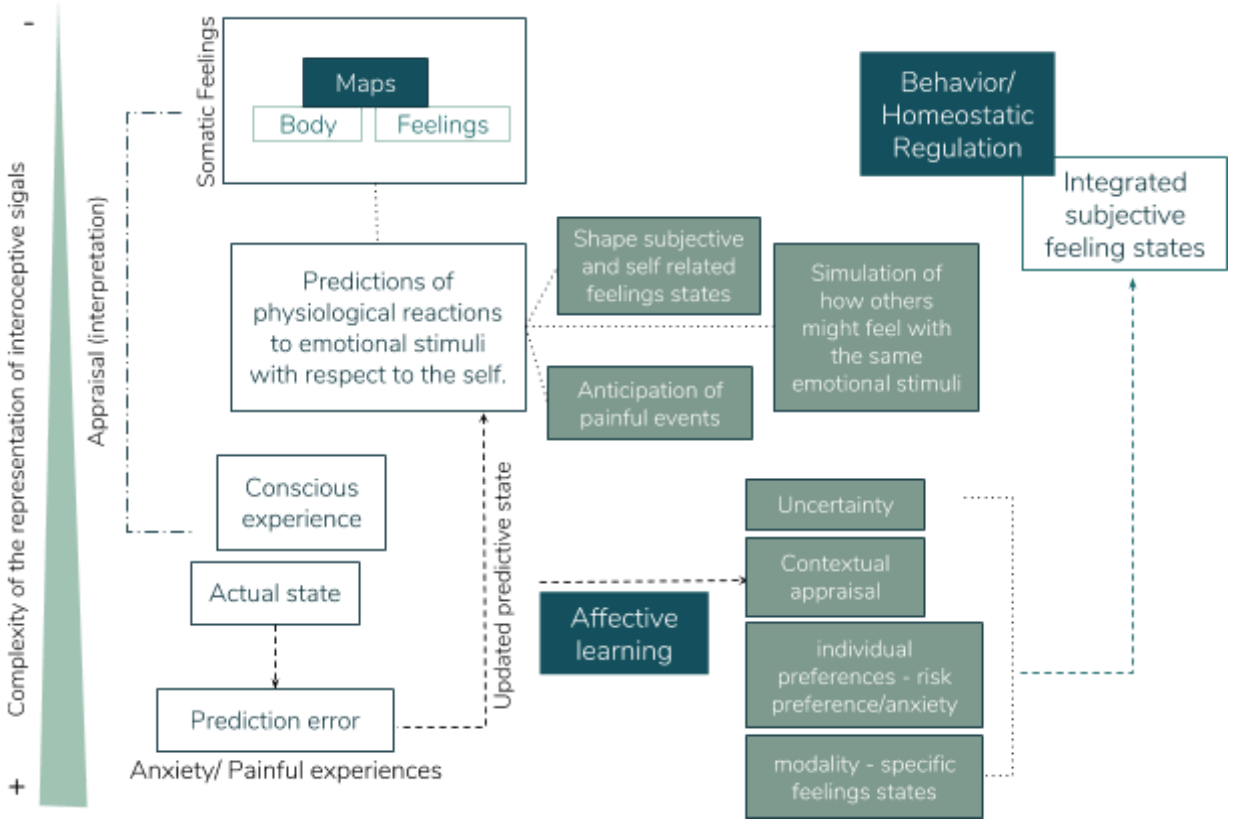

Fig. 13 | The representation of the interoceptive signals over time increase their complexity over time. The capacity to interpret physiological reaction increases over time at the cost of prediction errors that lead to affective learning. Affective learning and regulation of body homeostasis guide decisions making in complex and uncertain environments. Made by the author, based in information from Lamm and Singer, (2010).

3.1 The identification of the affective stimuli

The initial identification and appraisal of an affective stimulus is the first process comprising the emotional response (Whittle, Yücel and Allen, 2009). The detection of emotionally significant information is determined by the competition between exogenous bottom-up attention mechanisms - stimulus driven - and endogenous top-down attention mechanisms - goal-directed (which include internal rules, plans, moods and motivational states) (Brattico, 2015). An affective stimulus may possess inherent affective properties - an emotionally expressive face or sound - or may be rather a neutral stimulus conditioned to elicit an affective response. Different kinds of perturbations or sensory signals detected by the organism induce adaptive adjustments of the body that leads to changes in brain mapping of the body states (Damasio, 2010). In this sense, the signals detected result from an integrative activity of the *affect generating systems* and the *emotional effector system* - which include peripheral physiological arousal system and motor systems responsible for actions, action tendencies or motoric expression of emotion. The sensory information stemmed from the activity of effector systems, which possesses an interoceptive, proprioceptive or cutaneous exteroceptive networks, plus the information of the affective systems generates an emotion percept that results in a pre-verbal subjective feeling. This initial percept is then represented in the insular cortex, cingulate and secondary somatosensory cortex for being posteriorly reconfigured into a symbolic code like language (Koelsch, 2014). The amygdala and insula are the two main structures implicated in emotion perception.

i) The role of amygdala

The amygdala presents an high network centrality within emotion networks, where both the superficial and laterobasal nuclei groups show the most pervasive function (Koelsch, 2014). It is involved in the modulation of vigilance to emotionally salient stimuli, as well as in the initial subconscious attribution of affective significance to the sensory events (LeDoux, 1993). Cluster of activity show the maxim expression in left superficial amygdala (SF), medial nucleus (MeA), right laterobasal amygdala (LB) and central nuclei of amygdala (CeA). Both two first are involved in sensitive socio-affective information and modulate behaviors of avoidance or affordance in response to such information. On the other hand, LB has been implicated in the evaluation and learning of both positive and negative stimuli, furthermore it is involved in the regulation of goal-directed behavior through the generation of anticipated reinforcers, modulating the neural inputs that get hippocampal formation; lastly, CeA is involved in the endocrine, autonomic and behavioural responses and expression (Koelsch, 2014).

ii) The role of insula in emotion perception

Insula is mainly involved in the autonomic regulation and sensory interoceptive representation of bodily reactions concomitant to emotions (Koelsch, 2014). Anterior insula is considered as one of the most important areas of the brain associated with the awareness and representation of current global emotional states (Singer, Critchley and Preuschoff, 2009). Multiple fMRI studies have reported its implication in the recognition and processing of disgusting stimuli, due to its activation when perceiving facial expressions of disgust and

unpleasant stimuli (Calder et *al.*, 2000). There is also a significant connection between its activity and emotion processing, mainly fear stimuli, pain perception and facial emotional judgments (Gorno-Tempini et *al.*, 2001). Importantly, it is referred that impairments of insula are related with deficits in the awareness and understanding of self-related emotional states that result in deficits related to the prediction of how others will feel in certain situations as well as in the capacity to share affective states (Lamm and Singer, 2010).

3.2 The generation of emotional experience and behavior

i) The medial orbitofrontal cortex (OFC)

This particular region of the brain have been described as responsible for the production of reward-related emotional states and behaviors through the representation of the reward value of a stimulus and the guidance of goal-directed or normal social behavior (Drevets, 2000). Furthermore, emotional expression is associated with a higher activation of this regions, which happens, for instance, when smiling or laughter during exposure to visual comics (Whittle, Yücel and Allen, 2009). Lastly, OFC is considered to be involved in automatic appraisals - transmitting the value of the stimuli in a particular context - as well as particularly sensitive to violations of expectations, such that, it represents a significant area involved in the control of emotional behaviour. In this sense, OFC is considered to belong to the affect-generating brain systems (Koelsch, 2014).

ii) The anterior cingulate cortex (ACC)

Either the amygdala and insula have been highlighted as important in the generation of responses to particular salient fearful stimuli (Calder et al., 2001). The dorsal ACC (dACC) is involved in a range of cognitive processes that include attention, error monitoring and inhibitory control (Bush et al., 2002). It has been manifested its importance in the context of social affective functions, due to its activation during reported feelings of social exclusion (Somerville et al., 2006), maternal distress triggered by the crying sounds of their infants (Lorberbaum et al., 2002). A significant number of functional imaging studies account for the important activity of ACC in the induction of diverse emotions, being inclusively verified an increasing of its activity for the induction of sadness (Liotti et al., 2000), along with an higher resting activity in individuals with higher self-reported negative affectivity traits (Koelsch, 2014).

iii) The particular case of pain

An experiment intentionally designed to trigger admiration or compassion from narratives presenting virtuous acts (e.g. generous attitudes) or virtuosity (e.g. athletic feat) or from physical pain (someone hurted) and mental problems, showed that the regions of the brain activated by these specific emotions shared the networks associated with basic emotions, mostly involving the insular and the anterior cingulate cortex (ACC).

The areas of the brain responsive to pain experienced in oneself, the so called pain matrix, (Apkarian et al. 2005; Peyron et al. 2000), can be subdivided into areas coding for the

sensory-discriminative component of the pain experience - which involve predominantly the primary and secondary somatosensory cortices and dorsal posterior insula - and areas coding for the motivational-affective, i.e.the subjective experience components of pain. - rather involving anterior insula (AI) and and dorsal anterior cingulate cortex (dACC) (Lamm and Singer, 2010). These areas (AI and dACC) are both particularly associated with general purpose mechanisms of affective experiences (Ostrowsky, 2002). Nociceptive information, i.e. the one that comes from the direct stimulation of nerve cells, is processed in the posterior insula and re-mapped in the AI to form integrated affective feeling states (Craig, 2010).

However, interesting findings reveal that when we do not *feel* pain in the first person, which happens when observing others' pain, activates part of the same affective-motivational neural networks also activated when we experience pain. For instance, Singer and colleagues showed that the neural brain activations associated with the reception of a direct electric stimulation, overlap with the ones activated when observing a partner receiving the same stimuli (Singer et *al.*, 2004). This study suggests that the representations of the participants' own negative affect were activated when looking at their suffering partners - which might be considered a form of empathizing (Singer and Lamm, 2009; Lamm, Batson and Decety, 2007; Saarela et *al.*, 2007). The networks that overlap in this case corresponded to the affective component of pain, which involved the AI and the dACC. The sensory-discriminative component, on the other hand, were predominantly activated for the first hand experience of pain. However, it also evidenced in another study that the activity of *imagining* pain from a first-hand perspective recruits this pain matrix's component more extensively than the task of observing (Jackson et *al.*, 2006; Lamm et *al.*, 2007; Ogino et *al.*, 2007), leading to the conclusion that self-related pain imagery rely in vicarious and direct experience.

Moreover, in the study lead by Singer and colleagues it was found that compassion for physical pain involved a more immediate response than for mental suffering, suggesting that physical attributes are represented in a more immediate way than the imagination of an experience that it is not directly accessible (Singer, et *al.*, 2004). In this sense, through such evidences (Lamm, Meltzoff and Decety, 2010), the hypothesis that sharing others' emotions relies upon the neural structure involved in the direct experience of those emotions constitute an argument of the continuum between emotional perception and emotional experience (Lamm and Singer, 2010).

iv) The Nucleus Accumbens (NA)

The ventral striatum is a core region of the brain reward system associated with dopaminergic pathways of the reward systems and includes mainly the nucleus accumbens. This particular area of the brain is engaged in the encoding of motivational salience of stimuli, from the attribution of its hedonic value, but also initiates and encourages behaviors anticipated as rewarding, i.e. appetitive (Berridge and Robinson, 2003). Thus, the NA is sensitive to dopamine releases associated with primary rewards (such as food, drink or sex) and secondary rewards (like money or power) (Koelsch, 2014), but also to positive auditory stimuli (Blood and Zatorre, 2001; Hamann and Mao, 2002). In sum, this area plays a main role in anticipation and experience of reward (Koelsch, 2014).

v) Hippocampus

Hippocampus is a region of the brain usually associated with learning, memory and spatial orientation, however, it has been reported to be notedly associated with positive and negative emotion-related activity through the involvement of hippocampal formation in the regulation of the hypothalamus–pituitary–adrenal (HPA) axis-mediated stress response (Koelsch, 2014). Damage in this structure is highly correlated with chronic emotional stressors that lead to feelings of despair observed in depression or post traumatic disorders (Warner-Schmidt and Duman, 2006; Videbech and Ravnkilde, 2004).

Hippocampal formation has been also involved in studies that investigated the neural correlates of attachment-related emotions, such as love, compassion and empathy (Koelsch, Skouras and Jentschke, 2013) such that, individuals that present a reduced hippocampal volume also report a reduced tendency to experience such emotions. From animal studies it is also described a role of the hippocampus in attachment-related behaviours like grooming and nursing the offspring. These functions have been particularly involved in the regulation of oxytocin release, suggesting that hippocampus might be also involved in the formation and maintenance of social attachments. The emotions related with attachment and the ones that arise from social attachment experiences are connotated with a positive valence in healthy individuals whereas the loss of social attachments are mainly linked to sadness (Koelsch, 2014).

3.3 Regulation of emotional experiences and behavior

The regulatory processes of emotions are divided into unconscious or automatic and conscious or cognitive effortful control processes. The cognitive strategies for emotional-regulation are linked to two main strategies: reappraisal and suppression. The first concerns to the cognitive transformation of the emotional experience - for instance, reconsidering a negative event into a positive or less negative one - whereas the second one concerns to the inhibition of reactions provoked by emotional stimulus through the changing of the own affective state, for instance, the act of thinking positively about the future in order to suppress an aversive mood (Ochsner et al., 2012). The main areas involved in such regulation are the hippocampus, lateral OFC, dorsolateral prefrontal cortex (DLPFC) and dACC (Figure 14).

i) Hippocampus

The hippocampus is divided into two main subregions: the dorsal region involved in spatial learning and memory and the ventral region engaged in the regulation of anxiety-related behaviors (Bannerman et *al.*, 2004). The regulation of the behavior is made through the increase of the importance of negative valenced information (Whittle, Yücel and Allen, 2009).

ii) Lateral OFC

The main function associated with the lateral OFC is related with signalizing punishment, contributing for adaptive behavior. Lesions in this area are associated with

aggressive and other socially inappropriate behaviors and emotions, like hostility and a general sense of irritability (Berlin et *al.*, 2004). These studies suggest that the activation of the lateral OFC represents an attempt to inhibit reactions to, or feelings of anger, being also reported as regulating emotional responses through suppression or reappraisal strategies (Lévesque et *al.*, 2003; Ochsner et *al.*, 2004), being inclusively associated with the suppression of the influence of negative stimuli in subsequent behavior (Beer et *al.*, 2006).

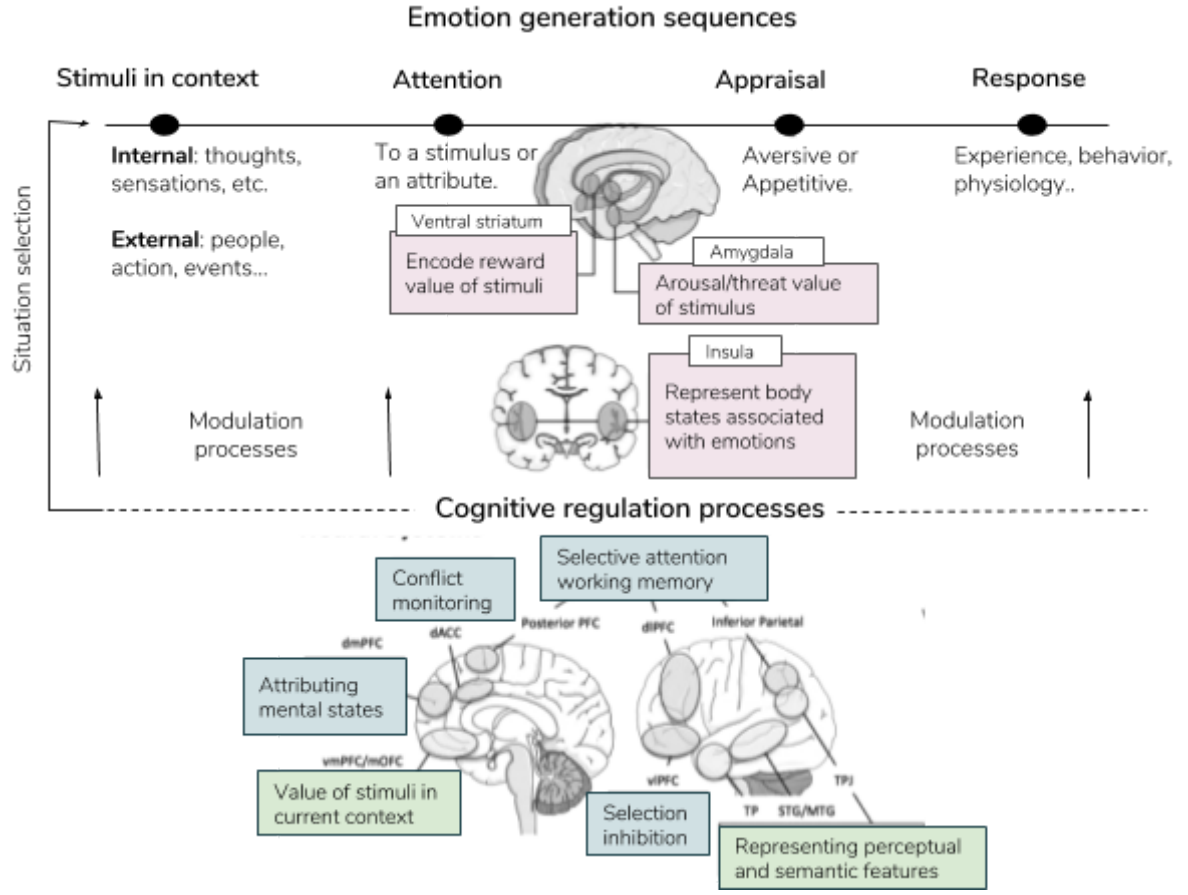

Fig. 14 | The emotional experience is dependent on neural systems involved in cognitive regulatory processes, which are prone to intervene in each stage of the emotion generation sequence (blue boxes) along with intermediary systems (green boxes), but also on neural systems involved in the generating emotional responses (pink boxes). Adapted from (Ochsner et al., 2012, p.31).

iii) The DLPFC and dACC

The dACC is mainly involved in cognitive and executive processes, establishing important connections with the prefrontal cortex, and especially, the DLPFC for the integration of higher cognitive processes and for their posterior translation into actions. So, while dACC is engaged evaluative processes that assess when control need to be engaged, the DLPFC carries out the implementation of the control strategies coherent with goals or task-oriented behavior (Botvinick et *al.*, 2001). The control functions related with affective behavior have been corroborated in a plenty of studies (Ochsner et *al.*, 2004; Ohira et *al.*, 2006).

4. What about sadness?

Basic emotions are considered innate responses with distinctive signatures in the brain, which are considered to concur for more universal set of responses (Oatley, 1992) being usually subdivided into *happiness, sadness*, *anger*, *fear, surprise, trust, disgust* and anticipation (Johnson-Laird and Oatley, 2010; Plutchik, 2005). Each basic emotion may be defined functionally as an answer for goal-relevant situations that have occurred frequently during evolution (Oatley, 1992), including cooperation, conflict, separation, danger, reproduction and caring (Juslin, 2013), being also especially important to guide decisions about future behavior. In this sense, emotional categories become crucial to better predict another's behavior and, then, facilitate the interaction between each other. Basic emotions are considered to be the more prone to effective communication, representing the optimal compromise between the access to the most information possible in the most discriminative way (Ross and Spalding, 1994): they are less ambiguous in their meaning due to the fact of being expressed in universal situations of life such as danger (fear), loss (sadness), social cooperation (happiness) or caregiving (tenderness) (Juslin, 2001).

The neural dispositions and observable behaviors that correspond specifically to sadness and, in that regard, to the characteristic changes that occur in ongoing processing of body states, including the cognitive processing, consists in the behavioural withdrawal and anhedonia states, low physical arousal, slow and critical type of information processing along with a slow production of auditory or visual images, with a sharp focus (Bosse, Jonker and Treur, 2008; Sachs, Damasio and Habibi, 2015). In this sense, emotional experiences convey information that aid inferences, communication and decision making (Markman and Rein, 2013).

The key adaptive function of sadness is to cope with loss of a person or an object of importance to the self. The psychological changes involved in this response involve the promotion of reflection (Lazarus, 1991), which contributes for the revision and ponderation of goals and plans (Bonanno and Keltner, 1997) and the turning of attention inward to improve the capacity to accept (Izard, 1997; Lazarus, 1991). An extensive body of experimental data also associates sadness with more detail-oriented information processing and less overall reliance on heuristics and stereotyping for decision making (Bodenhausen, Gabriel and Lineberger, 2000), which is coherent with the proposal that sadness tend to be accompanied by a decrease of confidence in the first impressions, compensated by a more extensive deliberation during decision making (Schwarz, 1990), such that, sad emotional state brings more accuracy to memories (Storbeck and Clore, 2008). The decreased arousal associated with the physiological changes that take place proportionate the time for cognitive structures to restore and accommodate lost objects (Welling, 2003) and facilitate problem solving through the deployment of more time consuming analytic strategies (Overskeid, 2000).

According with a social-functional perspective, nonverbal expression of sadness, as facial expressions, serves an important interpersonal function related to the creation, organization and maintenance of social relationships and interindividual interactions (Bonanno, Goorin and Coifman, 2008). The facial expressions of sadness evoke and shapes other responses, reinforcing prosocial behaviors (Keltner and Kring, 1998): helping responses towards the others (Izard, 1977; Lazarus, 1991; Keltner and Kring, 1998), assuring that individuals will receive attention and care from the others. This reaction involve an increased

amygdala activation in observers (Wang et *al.*, 2005) and physiological responses predictive of altruistic behaviors, such concerned gaze and reduced heart rate (Keltner and Kring, 1998). Therefore, emotional experience is a short-cut to assess to others' mental information, once specific kinds of mental processing are directly associated with specific feelings, which are in turn passable of being expressed in observable setting, available to others. Emotional reactions constitute windows to the other's mind.

4.1 Human sociability impact in the function of sadness

The potential of the affects' machinery to increase the survival value of an organism derives from the social nature of human beings. The need to survive in social environments - *social survival* - brought the necessity to broaden the action field of affects to cope with social problems, favouring social interaction (Fischer and Manstead, 2010). The vital problems to cope with associated with social mammals such as human beings, involve those created in their internal environment (pain, fatigue and disease), in their physical environment (the need for shelter) and in their social environment (desire for mate and offspring, loss of power, social exclusion) (Johnson-Laird and Oatley, 2010). In this sense, emotions play a central role in a) forming and maintaining social relationships and b) establishing or maintaining social positions relative to others at interpersonal and group levels (Fischer and Manstead, 2010).

The complexity of *social survival* derives from the relation between cooperation and competition. In this sense, *social survival* might be either related with *affiliation* and *social distancing* function. The first one regards the cooperative and harmonious relationships we need to maintain with other in order to work together or to endure love relationships; the second one is associated with the ability to differentiate from an individual or a group and compete for social status or power (Fischer and Manstead, 2010). As it was already described, sadness is an emotion that serve *affiliation* functions, favouring the behavior of help-seeking and support from the others. Considering that, social isolation leads to poorer health and well-being and to the inhibition of the development of social, emotional and cognitive skills (Williams, 2001), social bonds represent an essential demand for thriving. In this sense, if from one hand sadness represent an individual problem related with a personal loss, in the social realm, it signalizes a need for help that contributes for the mitigation of the initial problem.

The sociocultural behavior that demand affective engagement comprise social cooperation; in-group vs out-group status of an organism; individual and group cultural identity as a result of past experiences, historical and geographic factors and the variety of social emotions, such compassion, altruism, gratitude and indignation (Damasio et *al.*, 2000; Immordino-Yang et *al.*, 2009; Singer, 2015; Fox et *al.*, 2015). In this sense, our natural sociability rely on the capacity to process emotional information, due to its impact on the coping and interaction with others. The mechanisms that allow us to regulate the personal emotional experiences towards desirable states extend to the social realm, working together to favour desirable interaction between individuals in "healthy" conditions (Damasio, 2017).

Moreover, cultural practices are also considered potential mechanisms to generate rewarding states responsible for restoring desirable homeostatic states, such that feelings itself are cataly of human cultural practices. A real or an anticipated homeostatic decline configured by lost, pain, suffer, need or threat require the capitalization of reason tools in order to mitigate such undesirable states. In other words, the identification of *needs* - events

or situations that demand corrections - and the intervention from higher levels - *intellectual capacity* - for the creation of solutions (Damasio, 2017) (Figure 15), which might involve practices like the music. Fado constitutes an example of such practice, which is considered a collective musical phenomenon of expression of people's sadness for the bitterness of their lives, where by musical expression and participation, people would be able to cultivate a greater sense of hope, due to the cooperation, communication, social cohesion and social attachment (Baumeister and Leary, 1995) favoured by such practice.

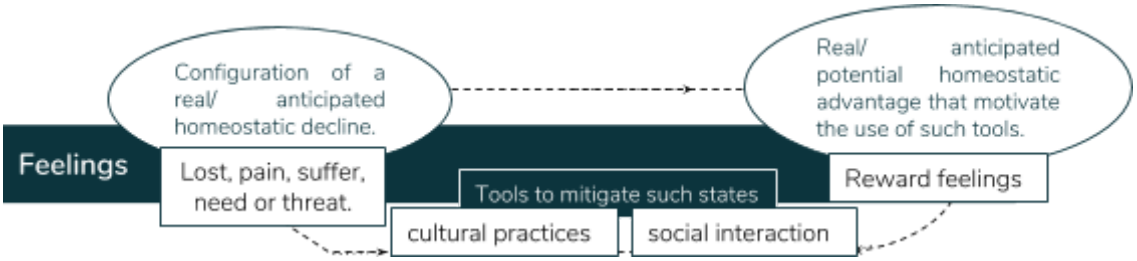

Fig. 15 | General approach for the life regulatory function of feelings, with social and cultural mechanisms playing an important role in such regulation. Figure made by the author.

Briefing

The characteristics of the emotional processes were discussed under the conceptual framework proposed by Barrett, known as the Conceptual Act Theory and the neurobiological perspective proposed by Antonio Damasio. According with both perspectives, an *emotion* do not constitute a momentary and static state, but rather a constant process of interaction between elements of the interior and the exterior of the body, which generate mental content caused by general processes - perception and memory. The access to the interaction that occur in the body are, then, experienced through a conscious awareness of the state, which constitute the emotional experience - the feeling - which constitute a specific way of experience the world during a determined emotional event. The feeling is never neutral, but rather possess a valence that brings quality to the experience and informs what to do about it, such that the emotional generation is not sharply separated of its regulation. Moreover, that experience, in order to become a specific feeling comprises a categorization process based in previous experiences or contextual knowledge. In this sense, all emotional experiences are construed as perceptions, once they depend on the way the brain creates meaning.

Taking all the notions about sadness discussed until this point, it becomes intriguing to understand the reasons behind its summoning through music, once loss situations do not occur when listening to a particular music. However, the fact that sadness also plays an important function of signaling homeostatic imbalances that deserve intervention implies that it is also necessary to be able to recognize it in the others in order to consummate its function. In this sense, the next chapter will provide information for the reasons why music is considered an emotionally competent stimulus and how the evocation of sadness by music might be dependent on the mechanisms responsible for its perception in the others.

Chapter IV

Emotions and music

Music is an human being talking with another human being.
David Attenborough in "When Björk Met Attenborough"

Music has been discussed for centuries as the 'doctrine of affections'. Musicologist Deryck Cooke claimed that music is a language of emotions (Cooke, 1959) and philosopher Susanne Langer argued that 'music can reveal the nature of feelings with a detail and truth that language cannot approach'(Langer, 1957). The importance of emotion in music for both musicians and listeners gets the point of being one of the most important feature for the appreciation of music itself (Juslin, 2013). However, when it comes to understand the emotional experience in music, the first problem that appears relates to the verification of genuine emotions in response to such strings of sounds. The emotional expression in music is a question that already lead to some investigation, either in the realm of neurobiology or philosophy (Juslin, 2013).

Pythagoras, who considered music as mathematical object based on the ratios of tones in its intervals, was the first known to consider music as a decontextualized object - a mere formal entity. This view constituted the Traditional philosophical approach and was also followed by Plato (Goguen, 2004). On the other hand, Leonard Meyer (1957) approach changed the understanding of music through the emphasis on the musical experience, where emotions play an important part. In his approach, the context turned to be crucial for the musical interpretation, considering each performance unique due to its particular embodiment manifested in the variation of the processes of interpretation in function of the auditory capabilities, the mood, the social set, the musical skills, the musical experiences, social beliefs or the physical space. Thus, studying music as an isolated phenomenon eliminates important information that comes from its subjective interactions (Kraehenbuehl and Meyer, 2006).

Strong emotional experiences through music are designated by Gabrielsson (2012) as "Strong Experiences with Music (SEM)", describing either the vivid, physical and powerful emotions and the transcendental feelings provoked by music. These experiences are named as *frissons*, a term that covers either universal and personal strong emotional experiences with every kind of music. *It* is considered a musically induced affect comparable with musical surprise, also associated with a "pleasant tingling feeling" and gooseflesh. It evokes descriptions such as "glow of excitement" or "shivers of delight", which due to the fact that they are present cross-culturally suggest its universality (Tee and Choy, 2018). In this sense, *frisson* integrates the higher emotional response to music with physical sensations not specifically localized in any region of the body (Harrison and Loui, 2014). The Oxford English Dictionary defines it as "an emotional thrill". Hence, it will be presented literature that supports the fact that music provokes emotions, the known musical emotions (Juslin and Västfjäll, 2008). In order to do that, it will be established an important relationship with the

structure of the previous chapter where the emotional process was divided into three main steps: the *identification* of the emotional stimulus; the *generative* emotional process with the respective behavioral response and the *regulatory* responses to the emotion generated. Based on the information supplied in the previous chapter, either the identification of a stimulus and the the generative processes might occur without awareness, meaning that they might result from automatic emotional processing. On the other hand, regulatory processes of emotion will rather be more dependent on the conscious subjective experience of the emotion - *subjective feeling* - conscious processes of categorization and homeostatic behavior of regulation. In this sense, *identification* mechanisms might be related with areas of the brain involved in the perception of the musical signal - as the primary auditory cortex (Juslin and Västfjäll, 2008); the *generative* processing, on the other hand might activate areas involved in the conscious experience, apart from the emotion's cause as the rostral anterior cingulate and the medial prefrontal cortex and areas dependent on the mechanism of the emotion induced that involve emotional information-processing, meaning that different emotions might activate different types of circuits (Juslin and Västfjäll, 2008). In a primary approach, this means that the first two phases might be more correlated with *emotional empathy* whereas the last one might be rather more associated with *cognitive empathy*.

In this sense, the first aim relatively to musical emotions concerns the confirmation of music as an emotional competent stimulus, through which the listener is able to identify affective information. This possibility reflects the involvement of perceptual mechanisms for the attribution of emotional expressivity to the auditory signal. This primordial phase reflects the ***emotional perception*** on music, which corresponds to the instances when the emotions are recognized in the piece by a listener, but do not necessarily imply its feeling. The next aim rather consists in the identification of the mechanisms through which emotions are felt from the musical signal, reflecting the ***emotional induction*** by music, i.e. all the instances where the music evokes an emotion, regardless of the process behind such evocation (Juslin and Västfjäll, 2008). The areas of the brain proposed earlier for the emotional processing will constitute the starting point to argue in favour of the generation of real emotions in music, considering the involvement of empathic processes in the emotional decodification and regulation. In that sense, in the first place it will be discussed the neural substrates involved in musical processing and compare them with the emotional processing in order to establish a relation between musical and emotional processing; afterwards, it will be considered the specific cases in which music is either perceived as sad and evokes sadness and the mechanisms involved in the emotional perception and induction, respectively.

A study conducted by Salimpoor et *al.*, (2011) is a good starting point for the discussion, since it shows that music can provoke feelings of craving and euphoria due to the involvement of dopaminergic system in its processing. Through fMRI, it was found an endogenous dopamine release in the *striatum*[3], a part of the brain responsible for the anticipation of reward - which is called an *emotional arousal peak* - during music listening. The increased blood oxygen flow in this area indicate the higher amount of dopamine releasing during music listening distributed differentially, such that the caudate, which

[3] The striatum is a term referred as the set of small group of subcortical structures below the cerebral cortex: the caudate, putamen, and nucleus accumbens. The caudate and putamen are usually conceptualized as belonging to the dorsal striatum whereas the nucleus accumbens constitutes the known ventral striatum contains (Yager, Garcia, Wunsch and Ferguson, 2015).

constitute part of the dorsal striatum, was mainly involved in the anticipation of the musical reward whereas the nucleus accumbens, the constituent of ventral striatum, was mainly activated during the experience of the peak emotional responses. This pathway may be different from the usual reward pleasure pathway, however, it indicates the valuable emotional stimulus that music represents. The network of both emotional processing and reward along with the activity of auditory regions defines the experience of *frissons* (Salimpoor et *al.*, 2013). It might be advocated that the experience of frisson is a slightly addictive one due to the dopaminergic anticipation verified. Moreover, a positive correlation between the reported intensity of the *frissons* and the brain activity registered in the paralimbic areas (bilateral insula, right orbitofrontal cortex), regions involved in the arousal of the autonomic nervous system (thalamus, anterior cingulate) and the motor areas (cerebellum, supplementary motor area), may explain the physical reactions - relaxation or tension - and the pleasurable responses (Blood and Zatorre, 2001).

In this sense, addressing emotions evoked in musical experiences, and specially, the musical frisson, implies the consideration of interactions between first and third hand perspectives (Goguen, 2004). The third hand approach corresponds to an objective perspective of addressing emotions in music, regarding the neurobiological evidences for the emotional processing of the musical stimuli and the evolutive explanations for the affective communication provided by music; the first hand perspective rather focus on the subjective experiences of a listener which are measured through self-report usually reflecting the main emotional components. Thus, musical experience involves objective and subjective components, respectively dependent on psychophysiological correlates and personal and environmental factors (Panksepp, 1995; Blood and Zatorre, 2001; Juslin and Västfjäll, 2008; Lundqvist et al., 2009; Salimpoor et al., 2009; Juslin, 2013).

1. Neurobiological approach to musical processing

Evidenced from neuroimaging studies show that the recognition of music expressing joy, sadness, anger or fear is impaired in patients with frontotemporal lobar degenerations, which describes non-Alzheimer dementias that are characterized by behavioural and semantic disintegration, often involving a strikingly impaired understanding of emotional and social signs. The degree of impairments of these patients is correlated with the degree of volume loss in the **amygdala**, **OFC, cingulate cortex** and **retro-insular cortex**, which represent a remarkable overlap with the regions involved in emotional processing previously presented. (Omar et *al.*, 2011). Similarly, semantic dementia is associated with the same impairment in the recognition of happy, peaceful, sad or scary emotions in music (Hsieh, Hornberger, Piguet and Hodges, 2012). The same occurs in patients with lesions in **amygdala** and in the **hippocampal formation** (Gosselin et *al.*, 2005; Gosselin et *al.*, 2007; Gosselin et *al.* 2011). Additionally, the loss of musical frissons is also reported for patients with lesions in the left **insula** and left **amygdala** (Griffiths, Warren, Dean and Howard, 2004). All these findings indicate that the regions involved in the perception and experience of emotions are atrophied in patients with disability in recognizing emotions in music, which raises the hypothesis that the activation of those areas is associated with the perception and experience of emotions through music. Starting with the premise of a causal correlation between the activation of such areas and the experience of emotions in music, this section will present

the main areas involved in the processing of music that are overlapped with the areas involved in the emotional processing.

Plenty of studies have been realized with the purpose of understanding the emotional response to music, using diverse experimental approaches for such aim, from the music-evoked experiences of intense pleasure (Salimpoor et al., 2011; Blood and Zatorre, 2001), emotional responses to melodious or dissonant music (Koelsch et al., 2006; Mueller et al., 2011), happy or sad music (Khalfa et al., 2005; Mitterschiffthaler et al., 2007; Caria, Venuti and de Falco, 2011; Brattico et al, 2011), joy- or fear-evoking music (Eldar et al., 2007; Koelsch et al., 2013), musical expectancy violations (Koelsch, Fritz and Schlaug, 2008) to the music-evoked tension (Lehne, Rohrmeier and Koelsch, 2013). Despite the differences in the methodological approaches, a meta-analysis made over these studies (Koelsch, 2014) shows the consistent report of the activity of the core areas of emotional processing in response to music, namely, the superficial and laterobasal nuclei groups of the amygdala, the hippocampal formation, the right ventral striatum - including the nucleus accumbens -, the head of the left caudate nucleus, the auditory cortex, the pre-supplementary motor area (SMA), the cingulate cortex and the orbitofrontal cortex (Koelsch, 2014). Such results are expressed in the Figure 16.

The auditory cortex plays a crucial role in musical signal processing due to its computational hub in an affective–attentional network, establishing connections with limbic, paralimbic and neocortical areas. The auditory cortex, as previously referred, is responsible for the appraisal of the musical stimulus, i.e. its perception. It is also noted the activation of the rostral cingulate zone, involved in the generation of undifferentiated emotional response. *Anterior insula* is also highlighted as being important for the autonomic regulation and representation of the relevant interoceptive sensory information that accompanies the emotions evoked by music (Blood and Zatorre, 2001; Baumgartner, Lutz, Schmidt and Jäncke, 2006; Koelsch et al., 2006), which might play an important role in the regulatory function of emotions. However, it will be only emphasized the three main neural correlates involved in emotional responses provoked by music, i.e. the *amygdala*, the *nucleus accumbens* and the *hippocampus*, leaving the regulatory mechanisms of the emotional process for the next chapter (Figure 17).

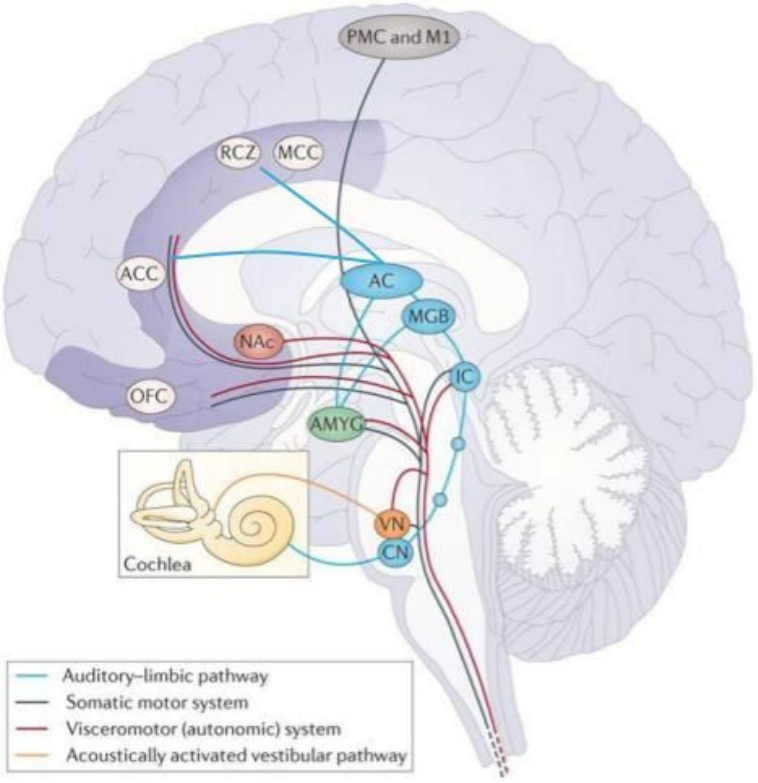

Fig. 16 | The main pathways of response to music. Importantly, the auditory cortex (AC) have projections to the orbitofrontal cortex (OFC), the anterior cingulate cortex (ACC) and to the amygdala (AMYG). CN, cochlear nuclei; IC, inferior colliculus; M1, primary motor cortex; MCC, middle cingulate cortex; MGB, medial geniculate body; NAc, nucleus accumbens; PMC, premotor cortex; RCZ, rostral cingulate zone; VN, vestibular nuclei. Source: Koelsch (2014, p. 172).

1.1 The amygdala

Acknowledging the functional role of amygdala in music-evoked emotions, it might be considered its high centrality within emotion network for being connected with several other zones involved in emotional processing, which is notable in Figure 16 (Koelsch, 2014). Therefore, the amygdala constitutes a very important area to modulate and to tune emotion networks, working in the integration of cognitive and emotional information (Goldin, McRae, Ramel and Gross, 2008) either in the initiating, sustaining as in the ending of emotional processes (Koelsch, 2014).

When processing emotional information of musical stimulus, it is verified clusters of activity in both superficial and laterobasal zones of amygdala, but also its central nuclei of (highlighted in the Figure 17a.), suggesting the differential involvement of different parts of amygdala. The superficial amygdala (SF) and the medial nucleus of the amygdala (MeA) are regions sensitive to socio-affective information, modulating approach-withdrawal behaviour in response to such information. Studies reveal that this zone is particularly sensitive to music particularly perceived as pleasant or joyful (Blood and Zatorre, 2001; Koelsch et al., 2013; Mueller et al., 2011), indicating the likelihood of the social significance of the musical signal, either associated with its communicative properties (Cross and Morley, 2008) and its

resemblance with affective prosody. This zone conveys the basic socio-affective information that might contribute for the recognition of basic emotions in music (Juslin and Laukka, 2003).

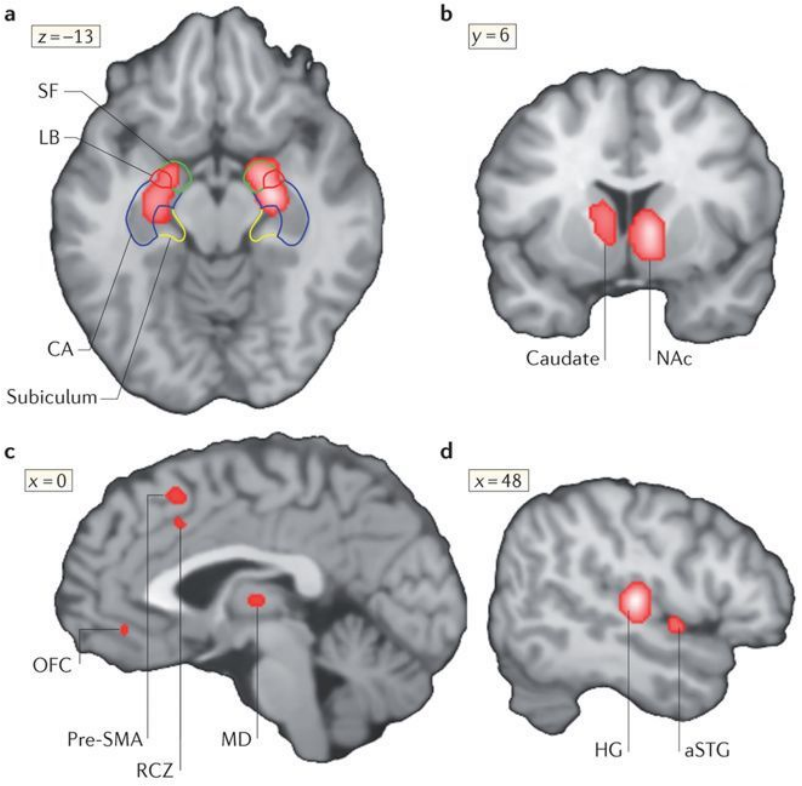

Fig. 17 | Neural correlates of Music-evoked emotions. Panel a: The clusters of activity changes reveal the involvement of superficial amygdala, laterobasal amygdala (LB) and hippocampal formation (HF); Panel b: the nucleus accumbens (NAc); Panel c: the pre-supplementary motor area (SMA), rostral cingulate zone (RCZ), orbitofrontal cortex (OFC) and mediodorsal thalamus (MD) and Panel d: Heschl's gyrus (HG) and anterior superior temporal gyrus (aSTG), which correspond both to auditory regions. Source: Koelsch (2014, p. 173).

On the other hand, laterobasal amygdala (LB) codes the reward value of music as positive or negative (Koelsch, 2014). The LB also regulates the neural inputs into the hippocampal formation (HF), being involved in the formation of expectancies that orientate goal-directed behaviour in response to the specific stimuli. This zone is activated either in response to joyful (Koelsch et al., 2013; Mueller et al., 2011) and sad music (Koelsch et al., 2006; Mitterschiffthaler et al., 2007). The LB receives projections from the auditory cortex (Figure 16) which are considered to be responsible for the modulation of LB activity facing complex sounds with emotional valence (Kumar, von Kriegstein, Friston and Griffiths, 2012). Lastly, the central nuclei of the amygdala (CeA) is mainly involved in both autonomic, endocrine and behavioural responses regarding to musical stimuli, also including the activation during the expression of emotions.

1.2 The nucleus accumbens

The nucleus accumbens, has been also indicated as other important area in the processing of emotional information of music, which is particularly highlighted in the Figure

17b abreast with the activation in the caudate nucleus (CN). The main role of CN concerns to the initiation and patterning of the somatomotor behavior along with the anticipation of frissons. The somatomotor behavior involves the SMA, which engages complex cognitive motor programming and preparation of voluntary action plans , similarly to what happens in dance. On the other hand, NAc is mainly involved in the signaling of rewards but also in the encouraging and initiating of behaviors to accomplish such rewards (Koelsch, 2014).

In response to music, several studies reveal the activation of NAc in response to pleasant music, being inclusively involved in the higher pleasurable feelings and rewards in response to music, the so called musical *frissons* (Blood and Zatorre, 2001; Menon and Levitin, 2005; Salimpoor et *al*., 2011; Koelsch et *al*., 2013). In sum, the involvement of NAc in music occurs whenever it is evoked a pleasurable experience (Koelsch, 2014). Additionally, the activations of the old reward network, which include ventromedial OFC, cingulate cortex, amygdala, AI and mediodorsal thalamus (MD) (Sescousse, Caldú, Segura and Dreher, 2013) seems to be functionally connected with the auditory cortex. The ventral tegmental area (VTA), associated to both the ventral and dorsal striatum, which includes the NAc, constitutes an area with increased dopaminergic availability; additionally to the fact that the VTA shows an increased alteration in its activity during musical frissons (Blood and Zatorre, 2001), the activation of mesolimbic dopaminergic reward pathways of VTA plays a very important role in the pleasures evoked by music. Moreover, the anticipation of a musical frisson is also attributed to such dopaminergic neurons in the dorsal striatum (Salimpoor et al., 2011), such that the striatal regions are particularly engaged in the anticipation and experience of reward.

1.3 The hippocampus

A striking number of studies manifest a change in the activity of the hippocampal formation (HF) (Blood and Zatorre, 2001; Baumgartner, Lutz, Schmidt and Jäncke, 2006; Koelsch et *al*., 2013; Mitterschiffthaler et *al*., 2007; Mueller et *al*., 2011) during emotions evoked by music, which suggests that music provokes emotional responses that are beyond reward itself. The musical responses related with the hippocampal activity were associated with tenderness, peacefulness, joy (Mueller et *al*., 2011), music-evoked frissons (Blood and Zatorre, 2001) or sadness (Mitterschiffthaler et *al*., 2007), being associated with both positive and negative emotions - unpleasantness and fear (Baumgartner, Lutz, Schmidt and Jäncke, 2006).

The functional connectivity with HPA in the coordination of stress is also verified in music-evoked joy (Koelsch and Skouras, 2013), corroborating its involvement in the reduction of emotional stress by endocrine regulation. Individuals with a reduced tendency to experience tender positive emotions exhibit a reduced neural activity in the HF in response to musical stimuli (Koelsch, Skouras and Jentschke, 2013). On the other hand, the activity in hippocampus in response to strongly unpleasant or fear-evoking music is pointed to be due to automatic inhibitory processes that work for the prevention of hippocampal damage in response to stressors stimuli.

Moreover, the involvement of HF in attachment-related emotions might suggest that music might be linked with social engagement functions, since its establish, maintain and strengthen social attachments. Indeed, hippocampal activity increases when people tap in synchrony with music - a virtual 'partner' (Fairhurst, Janata and Keller, 2013). Music is extremely associated with social contexts at several levels like communication, cooperation

and social cohesion, but listening to music is also very prone to involve social cognition (Steinbeis and Koelsch, 2008).

2. From real emotions to musical emotions

These evidences concur for the argument that music activates areas of the brain devoted to emotional processing (Blood and Zatorre, 2001; Koelsch et al., 2006). However, the sadness provoked by music might not be so simply considered a genuine emotion comparable with the sadness of everyday life. As the previous chapter highlighted, emotions are the result of several factor that function as a process of homeostatic regulation of the body that aim to provide a balanced integration of the subject in its surrounding environment. These factors comprise various subcomponents, namely, the subjective feelings, the psychophysiology, the brain activation, the emotional expression, action tendencies and the emotional regulation. Musical sadness, being objectless, i.e. lacking the object towards what the emotion is directed to, in this case, a personal lost, and the usual action tendencies turns it into a more weakened version of real-life emotion. Levinson, for instance, proposes that the cognitive component of the emotional response - the behavioral and the regulatory properties - to music tend to be weakened relatively to the affective component. So, how to compare such process with the emotional reaction to music? How to say that Beethoven's Moonlight Sonata does not provoke at least *feelings* of sadness? Perhaps the emotions in music might represent only some features of the emotional process, which would nevertheless predict the avoidance of such unpleasant response rather than its appreciation and intentional pursuit.

The previous chapter provide already some evidence for the emotional processing of the musical stimulus by the activation of brain areas involved in the emotional process. There are also evidences from questionnaires of self-report that listeners experience emotions when they listen to music - even though positives are more frequent than negative (DeNora, 2000; Juslin and Laukka, 2004), which favours the assumption relatively to the subjective feelings experiencing through music (Juslin and Västfjäll, 2008). Moreover, physiological reactions provoked by listening to music are also reported (Lundquist et al., 2008), namely changes in "heart rate, skin temperature, electrodermal response, respirations and hormonal secretion" (Juslin and Västfjäll, 2008). Additionally, emotional expression is also commonly reported by listeners, who either cry or smile or instead use facial muscle in facial expressions as they listen to music (Gabrielsson, 2001; Witvliet and Vrana, 2007). Music listening is also reported to influence actions tendencies as it is noticed by the movements which it induces or the influence in the tendency to consume products or in the proclivity to help the others (North et al., 2004). Finally, some authors consider that some listeners tend to emotionally regulate their reactions to music according with the context (Gabrielsson, 2001; Juslin and Västfjäll, 2008). These studies contribute for the idea that music is also able to induce emotions similar with the real ones. However, it might still be argued that the sadness evoked by music lack the life-implications of its real counterpart, since it does not indicate any real problem demanding attention, does not imply any persisting pattern of behavior, neither compromise the future. Sadness provoked by music do not require action as a mean to remedy unhappy states, they rather involve the feelings of what is like to feel some emotion devoid from part of its behavioral consequences. In this sense, in order to assume that sadness in music is equivalent to sadness in real life, it will be assumed that music is able to induce the same feelings known

as sadness and part of the subcomponents of the emotion even though do not imply a real loss to deal with.

Indeed, an emotion corresponds to a reaction to a particular object, which means that one important part of the process involves the interaction with a stimulus, the trigger. Such interaction might occur either through perception or by evoking memories, ideas or projections. The two main processes involved in the emotional generation, accordingly with the previous chapter, involve the *identification* of a trigger and the *generation* of the emotion, which constitute the main processes to approach the generation of emotions through music, as a mean to answer the first research question. The third phase of the emotional processing, associated with the *regulation* of the emotions, will rather become important for answering to the second research question, being considered only in the next chapter.

Having music as the object of attention is a necessary condition to be open to its emotional content and do not only experience a distant contemplation. In this sense, the perception of music, more than being a requirement for an empathic engagement constitutes a component of the emotional processing itself. Perceiving a music constitute a condition to the listener be affected by it, otherwise there would not be anything to empathize with and the act of intentionally listen to music would not be properly represented. In this sense, the sadness might be is either a reaction to the perceived emotional quality of the music as to the emotions evoked by it. Thus, although the recognition of emotions in music and its real experience might be different constructs they might both contribute for the emotional response towards music. Musical emotions, then, might be compared with the real-life ones by emotional processing earlier described.Taking the music as the initiator object of such emotional processing and the two main processes considered to be responsible for emotional decodification, then, the musical emotions depend on the *identification* of music as an emotional stimulus and its capacity to *generate* emotional response.

The *identification* of music as an emotional stimulus correspond to a process of perception and, as it was previously referred, the barrier between the perception of the stimuli and the *generation* of emotional response is very subtle, being probably intertwined. What we perceive influences what we feel and vice-versa, such that an emotional response to a stimulus either depends on the emotional qualities perceived on it and on the emotions evoked by it and the emotions provoked might influence the emotional qualities attributed to the stimulus. Thus, the perception of the emotional content in a music might be either a result of its inherent properties and of its capacity to provoke emotional responses. The answer to the first research question is, then dependent of the verification of the *emotions perceived* in the music and *induced* by the music. Thus, the capacity to identify emotions in music, i.e. the ability to *perceive* emotions in music will constitute the ***first verification***, necessary for considering music a competent emotional stimulus. The same way people decode sadness in someone's face, they also might be able to decode emotions when listening to music. The social function of the emotions, i.e. our necessity to understand emotional signals in the others as a condition for its regulatory functions, constitutes the main driving force to be able to decode emotional signals. The fact that perception is involved in the emotional processing justifies the involvement of an empathic process through the perception-action coupling approaches, by which *mirroring processes* and *contagious mechanisms* could be involved in the emotional processing. However, it is also necessary to prove that real emotions are induced by the music, preferentially as a consequence of the action of such mechanisms. Thus, besides the capacity to recognize emotional information through perceptual cues, music needs to be also able to provoke

emotions, which means that, although the first verification is necessary, it is not sufficient to conclude that music provokes real emotions through empathic processing, being necessary a ***second verification*** congruent with the second phase of the emotional processing described in the previous chapter.

These two verifications correspond to two separate but interdependent steps of the emotional processing, involved in the emotional processing in music as well. This means that, the emotions perceived are prone to influence the emotions induced and the emotions induced also be prone to influence the emotions perceived in music. The process does not have to be unidirectional in order to be considered valid, on the contrary, the importance of this verification regards mainly to the interdependence of the mechanisms employed in both phases. In this sense, the next section will be devoted to the verification of the following propositions:

Verification 1: Emotions perceived in music depend on the same mechanisms responsible for the appraisal of emotions in social interactions.

Verification 2: The mechanisms involved in the emotion perception in music are involved in the induction of real or genuine emotions in the listener.

The evolutionary approach that will be next presented intend to show the reasons for music to be considered an emotionally competent stimuli grounded in the functions it might have played during evolution. After the exhibition of those arguments, it will be specifically presented the mechanisms that serve the coding of emotional cues in the auditory signal of music and the mechanisms we employ for decoding such cues. After the first verification, it will be presented neuroscientific evidence in favour of sadness provoked by music and the respective mechanisms for such *emotional induction* that will involve both *emotional* and *cognitive* components of empathy.

3. *First Verification*

3.1 The evolutionary approach - the communicative power of music

The fact that we evolutionarily came to the point of appreciate music seems intriguing, since such faculty is not apparently relevant for our survival - the reaction to a scream is clearly moved by survival reasons, signalizing a threatening situation, however the advantage of listening to Bach is not so straightforward. The appreciation of music entails the capacity to understand music as a communicative signal (Honing, 2018). *Communicative musicality* designates the psychobiological capacities inherent to music communication, however, when looking for the dispositions of musical abilities raises the question of the meaning of music itself. The definition of music according with the Concise Oxford Dictionary corresponds to "the art of combining vocal or instrumental sounds (or both) to produce beauty of form,

harmony and expression of emotions". However, a cultural bias may influence the meaning of music itself. The known 4'33 performed by John Cage is a striking example of this challenge, constituting a three movements piece of entire silence, where the pianist sits in front of the piano and only indicates through gestures the sections of the piece. The only discernible sounds are the ones that occur in the room. The conventional definition of music do not comprise such work, but what if the definition of music is not enough broad? What if the performer is indeed controlling the sound through the gestures organizing it in a piece with different parts? This might be also a way of establishing a connection between the performer and the public, where the absence of sound or the sounds not usually taken as musical become themselves the object of attention. In this sense, what is important about music regarding the *communicative musicality* do not concerns so much about the form that sound takes but rather its ability to communicate meanings. In this sense, it will be discussed two different approaches, which reflect a nature-culture dichotomy, for the explanation of the emergence of communicative musicality in human beings: (a) an evolutionary perspective, which defend its adaptive function for human behavior and, (b) a non-evolutionary perspective, which rather considers musicality as a by-product of other adaptations (Podlipniak, 2017).

The conception of music as a biological adaptation was introduced by Darwin (1871), who proposed that sexual selection was tied to the origin of music (Miller, 2000). Mithen argues that the emergence of the cognitively fluid mentality of Homo Sapiens allowed the emergence of the abstract, cross-modal and metaphorical thinking associated with cultural activities, such as language, technology, art and music (Mithen, 2005). In accordance with (a) it is argued that *musilanguage* was the earlier form of affective communication which resulted in the evolution of language (Brown, 2000; Fitch, 2006). Comparative studies allowed to support such theory, once they show a musical behavior analogous to human music-making in other animals like birds or whales (Fitch, 2006). Moreover, considering that the evolution of a system of communication based on arbitrary meanings, as language, occurred once and only in humans, whereas the evolution of a complex system like music rather evolved multiple times - at least three - contributes for hypothesize about an earlier development of a primary acoustic complex system (Fitch, 2006) that later evolved for a communication system based on semantic and propositional information like language. The *musilanguage* theory considers an early communicative system responsible for the dual acoustic nature of both music and language (Brown, 2000). A process of communication involves the capacity to understand the meaning of the signal being communicated. Mithen proposed that the development of cognitive functions occurred as a consequence of bipedalism, increased encephalo, Theory of Mind (ToM) and the necessary anatomical developments for complex vocalization and they were essential for meaning understanding in communication (Mithen, 2005).

The arguments against the adaptive theory of musical evolution are based on the idea that animal musicality is constrained to specific functions and contexts (mating and territory defense) possessing a solely communicative function, whereas human music-making is intrinsically associated with enjoyment (Hauser and McDermott, 2003). However, human music-making might not only be driven by hedonistic motives, serving several communicate functions as well (Blacking, 1973). The biological changes that took place in the brain were considered by Dissanayake as essential for communicative musicality, i.e. the communication of meanings through music. According with Dissanayake, communicative musicality evolved as a result of the phylogenetic interactions between ancestral mothers and infants. According with this proposal, human proto-musical capacities developed itself as a result of the

compromise between two incompatible anatomical changes for mothers to give birth: the necessity of a narrowed pelvis that supported a bipedal stance of the mother and the development of larger brains of the baby. In order to accommodate such changes in the parturition moment, selection tended to favour premature births. So, this compromise ended in the increasingly number of helpless human babies, therefore, more dependent on their mother for a longer time.

This multimodal interactions between mother and infants required then species-specific behaviors that serve the coordination of the behavior and emotions between two individuals who need each other for their individual reasons: the survival for the baby and the reproductive success for the mother. In that sense, they tended to recur to auditory signals organized in time and over time showing variations of rhythmic patterns, melodic vocal contours, body movements and expressive dynamics contours in space (large-small; up-down) and time (fast-slow, short-long) organized according with a common pulse as a mean of communication (Dissanayake, 2009). Cross affirmed "music is a cognitive capacity arising from an infant's propensities to search for 'relevance in', and mastery over, itself and its world ... particularly [in] the interactions with the primary caregiver" (Cross, 1999).

As brains got larger, increasingly complex neural connection took place supporting the expansion of memory. From one hand, that increased the capacity to remember significant events and, on the other, improved foresight by the augmenting of the capacity to plan and predict, instead of reacting instinctively to circumstances. As the awareness of the future and past became enlarged, human beings become more sensitive to uncertain situations, signalized by stressful and anxious states. Thus, the expansion of a general intelligence was, from one hand, adaptive due to its contribution for behavioural flexibility but, on the other, a source of anxiety and confusion (Dissanayake, 2009). The hypothesis designed by Dissanayake is grounded on the idea that ceremonial behavior functioned as an amelioration of stress (Dissanayake, 2009) due to the promotion of feelings of control and social support through vocal, visual and kinesic behaviors that permitted to cope with uncertainty. The tendency for human beings to come together is specially relevant in stressful and adverse situations and music is proposed to be an important mechanism to attract social support, bringing adaptive value through emotional and behavioral coordination that foster emotional communion and support between community members (Mithen, 2005; Dissanayake, 2009). Dunbar, for example, suggests that collective music making provokes endorphin releasing that imitates the "grooming" done by primates at larger distances (Dunbar, 2003).

Studies of socialization and human ontogenesis also offer responses for the adaptive functions of music, considering emotions in social interactions as the origin of musical behaviors. Music could have been a product of both subjective and intersubjective processes of meaning construction, functioning as a mean of social cohesion in our ancestors by favouring shared moods and the consolidation of bonds between individuals (DeNora, 2011). A range of research supports the hypothesis that the comprehension of any kind of communicative signal, whether visual or auditory, linguistic or musical, occurs through the understanding of the motor action behind the signal and the intentions and emotions behind that motor action. For example, simple actions like footsteps convey emotional clues for sadness, happiness, anger, fear (Gelder, 2006). The same might be applied to musical communication where the auditory movement is able to convey the clues for an emotional interpretation. For instance, the lament is a natural response to loss in the form of weeping and moaning, being associated with the expression of feelings of helplessness, individual isolation and despair. The same way, the

emotional response to music is present in early life and across cultures (Balkwill and Thompson, 1999), which indicate an innate sensibility to perceive emotions in music (Zentner and Kagan, 1996; Trevarthen, 1999).

Indeed, musical behavior is considered to favour the development of shared intentionality, promoted by Theory of Mind (ToM) capacities required for the cultural evolution of modern human cognition (Tomasello, 1999). Cross inclusively proposes that human musicality provided the tools for the evolution of *Human sapiens sapiens*, suggesting that music affords a communication with multiple meanings - the called floating intentionality- in a risk free environment that contributed for the development of cognitive flexibility and social understanding that fostered the interactions of a single mind with the society (Cross, 1999; Cross, 2001). This understanding of musicality positionate it as a facilitator of cognitive fluidity, responsible for the development of abstract thought and an increased capacity to recognize others as intentional beings (Tomasello, 1999).

These perspectives are proponents of the evolutionary proposal for the emergence of communicative musicality, recurring to arguments in favour of its adaptive value in the development of language and social interaction, due to the emotional information provided by the musical stimulus. Thus, this first approach unveil the emotional value of musical stimuli as the main factor of its survival value. On the other hand, the non-adaptationist views considered in (b) are mainly defended by Pinker (1997), who claims that music is just parasitic of the other cognitive domains, do not showing a specific adaptive value, but rather constitutes a pleasurable tool in human brain that parasites other functions of the brain. According with this view, the processing of complex auditory information by means of communication might have gave rise itself to musical behaviors that through pleasurable responses guided the creation of a new cultural manifestation different from the pre-existent cognitive module (Sperber, 1996). This explanation takes musical communication as a sub-product of other behaviors. Pinker (1997) considers that cultural transmission of abilities leads to the proliferation of this parasitic information that satisfy the "input conditions" of a given cognitive module in a way that resembles the actual cognitive domain. This means that musical communication is prone to activate an original cognitive domain that did not evolve for musical behavior.

This proposal takes human mind as a modular structure and refuses adaptationist proposal based in that statement, i.e. due to the non-existence of a modular area of the brain involved in musical processing. Nevertheless, seems more appropriate to consider a more parsimonious hypothesis relatively to human cognition assuming that human capacities are rather fluid system where important adaptations emerged as a consequence of an high sociability, for instance, the recognition of cognitive-emotional states in other conspecifics. Such ability derived from the integration of domain specific and general capacities, affording the development of complex cultural activities and behaviors through affective communication (Livingstone and Thompson, 2009). In this sense, considering non-adaptionists views might results in the understanding of communicative musicality as a cultural product of mind reading capacities. In the end, regardless the differences relatively to origins of musical functions, both perspectives share the claim that music is important for human well-being constituting a mean of affective engagement that instigates social cohesion, but also empathy.

A different proposal made by Patel considered musicality neither as an adaptation nor as a biologically useless ability as Pinker proposed, he rather suggested that musical activity provokes long lasting changes in the wiring of the brain due to mechanisms of neuroplasticity.

Moreover, the fact that development of musical abilities does not entail relevant costs associated with failures since it results from other adaptations, music becomes an universal human activity with transformative character for the mind and brain with benefits to the cognitive and social level (Patel, 2008, 2010), but do not presupposes a process of natural selection where it is possible to discern specific areas of the brain only committed to music.

Panksepp offers a similar notion though the consideration that there is no evolutionary determined modules for either music and language, but musicality had emerged from subcortical areas deeply involved in emotional communication, meaning that, the emotional proto-musical communication might had provide the arising of both music and propositional language, supported by the drives of the ancient emotional core of the limbic system (Panksepp, 2009). Such understanding, provides a base for the connection between the emotional communication in animals, infants musicality and the cultural musical activities where we engage. Thus, human behaviors involved in social cognition are considered to be as dependent on the environment as on innate dispositions, once we are remarkably suited with neuroplastic abilities and epigenetic effects that make the experiences of one's life change the neural connection and the expression of behavior (Doidge, 2007; Lickliter and Honeycutt, 2003; Sur and Leamey, 2001).

In this sense, the dichotomies between adaptation/nature or non-adaptation/culture relatively to the origins of human communicative musicality, might be interpreted in a more integrative way where neither specific areas of the brain are conformed to musical behaviors, as the modular approaches advocates, nor musicality represents a pleasurable by-product of circuits already existent. Thus, considering the commonalities of both perspectives, it might be said that music carries meaningful information in its signal (Cross and Tolbert, 2009) based on acoustic patterns and auditory representations (Bharucha et al., 2006) and human musicality provides biological tools for the interpretation of the musical signal in terms of emotions (Vand der Schyff, 2013), such that the communicative power of music is grounded in its emotional communication. Indeed, the main reason for people listen to music regards to its ability to induce emotions and modulate emotional states (Sloboda and O'Neill, 2001; Taruffi and Koelsch, 2014). The evolutionary reasons to accept music as an emotionally competent stimulus allow to proceed with the first verification, moving forward to the mechanisms that either encode emotional information in music and allow us to perceive it.

3.2 Mechanisms of emotional expression and perception in music

An emotionally competent stimulus constitutes any object or event able to provoke emotions (Damasio, 2006), it might be external or internal as already was described in the chapter III. However, the evolutionary reasons for music to be considered an emotionally competent stimulus are not sufficient for attribute it a communicative function, since it might be argued that a lot of objects are able to provoke emotions - a ball thrown in our direction without our awareness can be surprising or scary due to the triggering of such emotions. The crucial phenomena able to distinguish a ball and a musical piece corresponds to the ability of music to *express* emotions, which confers communicative properties to music that are absent in the ball. In order to music expresses emotions itself, regardless of the composer's intention or the musicians' performances, the listener might be able to perceive and recognize its emotional meaning through the *emotional perception* in music, which do not necessarily corresponds to the induction of an emotion in the listener (Juslin and Västfjäll, 2008, 2013).

Sometimes music might provoke emotions in terms of arousal, nevertheless the detection of meaningful musical information usually depends on its expressivity of emotions (Laukka, 2004). The process of perceiving the emotions music expresses is important for the attribution of its communicative functions, otherwise it would be just an object able to provoke emotions in the listener.

The perspective of music as a mean of "communication" of emotions requires simultaneously an *intention* to express a specific emotion, its coding and the posterior *recognition* by listeners (Juslin, 2013). We might identify with the emotions perceived in the music or with the person to whom the emotions own by the ability of music to communicate them in its expression and by our ability to perceive them. So, in this section it will be discussed the emotional content of music as a communicative signal, understanding how does music convey emotional meaning that we might be able to decodify either through an objective and subjective base of understanding, such that there is any restriction for the interpretation of the stimulus (MacDonald, Kreutz and Mitchell, 2012). This means that some perceptive cues are more universally recognized than others, such that there are emotions that concur for a greater agreement among listeners than others and fewer are considered to be accurately communicated from the musician to the listener, i.e. when an intention is reliably recognized at the reception point (Juslin, 2013).

The subjective approach to the emotional character of a music might, therefore, constitute a reliable method to access its emotional expression. For example, among three different studies where subjects had to choose the top-ten emotions expressed in music, happiness, sadness, anger, fear and love, tenderness tend to be present in all of them, despite the differences in the samples and the number of emotional terms employed (Lindström et al., 2003; Juslin and Laukka, 2004), which indicates the propensity of such emotions to be expressed through music. Gabrielsson and Juslin and Juslin and Laukka indicate that the highest agreement among listeners occurred for emotions like happiness, sadness, anger, and tenderness and in the emotional dimension of arousal. On the other hand, emotions such as jealousy, pity or shame are rather more difficult to achieve, which suggest that in music, there are some emotions easier to express than others (Gabrielsson and Juslin, 2003; Juslin and Laukka, 2003).

The mechanisms responsible for the perception of emotion in the music shall reflect distinct brain functions developed according with different evolutionary functions (Gärdenfors, 2003), constituting devices for processing information at different levels when the significant object of the environment corresponds to the music (Juslin and Västfjäll, 2008). In this sense, each brain function brings a survival value to the brain that is considered to be protagonized by different mechanisms. In this sense, for instance, I will focus on the mechanisms that might induce emotions that are dependent on the musical structure - in order to expose how the musical signal might have influence in the type of emotional response - and are associated with an early ontogenetic development - in order to associated them with an evolutionary relevance. The three mechanisms that satisfy such conditions are the *brain stem reflex*, the *emotional contagion* and the *visual imagery./imagination.* Brain stem reflex constitute quick automatic mechanisms that have the function of focusing the attention of the subject in potential threats in the surrounding (Joseph, 2000), through the activation of the reticular the formation in the brain stem, the nuclei of the thalamus, being mainly responsible for a general arousal of negative or positive valenced emotion (Juslin and Västfjäll, 2008). Although this mechanism might be useful to explain the relaxing or arousing effect of music,

it is difficult to associate it to a particular emotion, which leaves the two remaining mechanisms as the main candidates to explain the emotional perception of music.

Emotional contagion possess a function linked with social interaction and group cohesion (Wilson, 1975) which explains the fact of music facilitate mother-infant relations (Preston and De Waal, 2002), due to the affiliations provided (Lakin et al., 2003), such that the emotion expressed in the music activates its emotional representation in the brain, guiding the same emotional induction (Juslin and Västfjäll, 2008). This means that sad music might be able to induce sadness (Juslin, 2001), by the perception of its musical expression, which is evidenced in diverse studies (Kallinen and Ravaja, 2006; Lundqvist et al., 2008). The same mechanisms already was proposed for the explanation of the emotional "catching" of others' facial expressions (Hatfield, Cacioppo and Rapson, 1994; Dimberg et al., 2000), vocal expressions (Neumann and Strack, 2000) or emotional gestures (Preston and De Waal, 2002). Lipps proposed for the first time that such mechanisms might derive from empathic processes that involve emotional motor expression (Lipps, 1903), later suggested to be mediated by mirror-neuron system (Juslin and Västfjäll, 2008), a mechanism that responds automatically to musical signal due its similarity to voice-like aspects of emotional speech. The distinct nonverbal emotional expressions (Juslin and Laukka, 2003; Juslin and Västfjäll, 2008) perceived are internally mirrored being mainly related with basic emotions - listeners' emotional responses to the music may depend on emotion-specific auditory patterns of the music. It is important to note that mirroring processes constitute one example of a *low-level virtual simulation process* of empathy. The development of such mechanism occurs around the first year (Field et al., 1982), being considered almost independent from learning processes and cultural impact, meaning that it has a very innate nature. Moreover, *emotional contagion* is described to be highly modular, this means that it might be activated regardless of the action of any other psychological process. This means that responding to the emotional content of music as if it was an expressive voice occurs even though we consciously know that music is different from a voice (Juslin and Västfjäll, 2008).

The remaining mechanism is the *visual imagery/ imagination*, which function might had served the possibility to simulate situations and scenarios through self-conjured mental images deprived from sensory input (top-down processing), which confer vantages in risky behavior that might be evaluated before being implemented (Gärdenfors, 2003). Music has been considered to be specially efficacious in the stimulation of visual imagery (Quittner & Glueckauf, 1983), where the musical structure activate image-schemata rooted in bodily experience by means of metaphorical mapping (Bonde; 2006) acting as internal triggers of any kind of emotions. In this case, *high-level virtual mental simulation processes* mich act instead. Thus, music might be either responsible for the external expression of emotional content, constituting itself an emotional trigger and an inducer of internal triggers of emotions (Juslin and Västfjäll, 2008). In this case, *visual imagery/ imagination* is a mechanisms dependent on some level of culturalization and learning, being more susceptible of modulation for other factors due to a less innate nature.

A conceptualization for the underlying mechanisms of emotional meaning expression in music inspired by the ideas of Charles Pierce is proposed by Juslin to understand the different ways emotional meaning might be coded. Thus, Juslin considers that expressed emotions are dependent on different types of coding which convey different contents: The iconic coding, the symbolic coding and the indexing coding (Juslin, 2013).

i) *Iconic coding*, when the response is based on formal similarity between the music and some other signal, such as vocal expression or human movement. This type of coding is associated with "iconic" emotional expression in music.

ii) *Symbolic coding*, which refers to a response based on internal, syntactic relationships within the music itself. This coding, on the other hand, is related with an "intrinsic" emotional expression in music.

iii) *Index coding*, when the response derives from an "arbitrary" association between the music and some other event or object. Lastly, this coding is considered to lead to "associative" emotional expressions in music (Sloboda and Juslin, 2001).

i) Iconic coding

According with functionalist frameworks of emotions, iconically-coded emotions derive from the physiological components of emotions that are sensitive to sound, as it happens with the changes in voice production (Juslin and Scherer, 2008). Juslin proposes that the vocal expression of basic emotion were gradually transported into vocal music during cultural activities, like ceremonies, festivals, caregiving, where basic emotions played the most effective communication (Juslin, 2013). Once such coding is considered to have a very strong evolutionary root, it is expected an higher universality in the expression of musical emotions (Juslin, 2001). The association of emotions to music occur in a very automatic way, either in three year old children (Bella and Peretz, 2001) or in listeners completely unfamiliar with the music (Fritz et al., 2009). Basic emotions in terms of communication represent the optimal compromise between the intention to convey the maxim of information to the others in the most effective way possible (Juslin, 2001). *Happiness* and *sadness* are the emotions that tend to be more recognizable in music, either by adult or children listeners (Juslin and Laukka, 2004; Baumgartner, Lutz, Schmidt and Jäncke, 2006; Koelsch, 2010; Nieminen et al., 2012). The tendency to perceive emotional expressivity varying around basic categories, might be understood as a result of the value of an effective communication (Juslin, 2013).

ii) Symbolic coding

The expression of basic emotion in music do not constrain the expression of other emotions, even though listeners report less agreement on them (Laukka et al., 2013). However, more complex emotions require more complex mechanisms of emotional expression, as the intrinsic and associative emotional expressions previously referred. The symbolic coding of music refers specifically to its intrinsic emotional expression, i.e.derives from the internal syntactic relationships within music. Thus, the main candidates to convey emotional meaning to the music through this coding correspond to tempo/speed, loudness, timbre, mode, pitch rhythm, intervals, harmony, melody, articulation, pauses and musical form (Gabrielsson, 2008), through which is possible to create "tension," "release," "climax," "repose," and "relaxation" (Juslin, 2013). Such as language, the hierarchical organization of music allows the integration of low-level elements such as notes, rhythms, phrases and chords into a high-level structural organization that is able to convey meaning (Sloboda, 1985; Lerdahl and Jackendoff, 1983).

Recent interesting neuroimages studies show the involvement of Broca's area and its right hemisphere homologue in the processing of syntax both in language (Friederici et al., 2000) and music processing (Maess et al., 2001; Koelsch et al., 2002; Patel, 2003; Tillmann et al., 2003; Koelsch and Siebel, 2005). Along with the development of literature skills, infants also show knowledge about principles of hierarchical organization in music, being not only able to distinguish different scales but also to show preferences for consonant over dissonant tonal combinations (Trehub, 2003).

The perceived emotion is a result of different factors working in additive or interactive ways. The typical major-happy and minor-sad associations may be overruled by interactions with tempo. For instance, while differences between fast and slow tempo have been mainly associated with differences in the degree of activation, differences between major and minor mode have been mainly associated with differences in valence - positive or negative emotions. However, a major mode, mainly associated with the expression of happiness and joy, is not a necessary condition for that expression, since a piece in minor mode and fast tempo may also sound happy (Gabrielsson, 2008). Intrinsic sources of musical expression qualifies specific emotions conveyed by the others type of codings, dynamically influencing the levels of arousal or tension that are prone to express more complex emotions (Juslin, 2013).

iii) Index coding

Finally, music might also be perceived as expressive of emotions through index coding, which refer the cases when music is aleatorily associated with emotional external stimuli by associative mechanisms. This type of coding comprises the cases where the memory of personal life events and the emotions connected with them are triggered through music, such that, the emotional responses rather reflect extramusical associations than the direct effects of auditory inputs (Konečni, 2005). This explains why organ music may be perceived as expressive of solemnity due to its connection with churches or even why, for instance, "Grândola Vila Morena", from Zeca Afonso, the song that was the motto of The Portuguese Revolution of 1974 against the vigent dictatorship, expresses hope very powerfully. Another example comes from soundtracks, from where it is inevitable to do not link, for example, the Michael Nyman's themes to Peter Greenaway's movies or the Yann Tiersen's music to the beauty of *The fabulous destiny of Amélie Poulain*. The emotional expression under associative codings might be more complex due to an higher degree of variation across cultures, therefore more dependent on the context or on the listener's experience than any other coding. In fact, beyond a certain level, the associations will be deeply personal, a phenomenon that Cross called as *floating intentionality*, which expresses the idea that the same piece might convey different meanings for the performer and for the listener (Cross, 2012).

Therefore, this type of coding may be either divided into a more "communal" associative dimension involving mutual associations among particular social group or into an "idiosyncratic" dimension related with deeply personal associations. In this sense, music may convey emotions from the most personal to the most communal forms of expression, but definitely less cross-culturally stable (Juslin, 2013) (Figure 18).

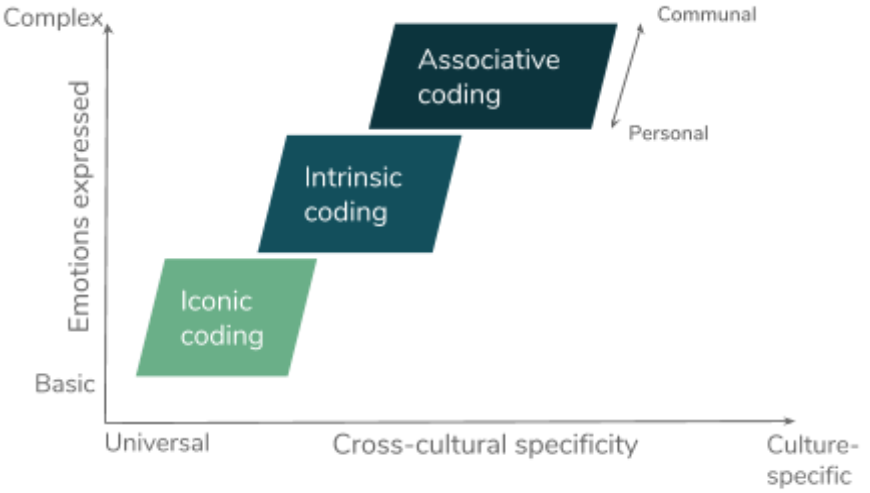

Fig. 18 | Conceptualization of the codification of emotions through layers from the more basic and universal to the more complex and culture-specific. Source: Juslin, (2013, p. 10).

If, on one hand, iconic coding provides the musical expression of basic emotions cross-culturally (Laukka et al., 2013), the associative coding rather decodes more complex emotions in a more circumscribed sample of listeners belonging to the same familiar musical cultures or groups (Laukka et al., 2013). Thus, the core layer might be extended, altered and qualified by additional type of codes that justify the deep personal level where emotions in music might be perceived, including complex emotions (Gabrielsson and Wik, 2003). Mixed emotions might inclusively be considered under such analysis, being considering as the overlapping of different emotional meanings in different codings. However, in order to study emotional expression in music, basic emotions are considered the most reliable, once iconic sources tend to be more powerful - inclusively showing similar expressions across the vocal and musical channels of expression (Juslin and Laukka, 2003), although music presents a stronger personal character, more prone to variability among individuals and cultures. In this regard, basic emotions might provide the link between our moderns music making activities and our ancestral roots, being the possible candidates for being responsible for music being considered the universal language of emotions.

3.2.1 The mirror-neurons system proposal for the perception of emotions

A proposal made by Molnar-Szakacs and Overy, show an amazing relationship between musical processing, language and action supported by the involvement of human mirror-neuron system. Their hypothesis suggests that musical sound provokes affective responses based on the activation of the human mirror-neuron system, a mechanisms that permit the understanding of the meaning and intention of a communicative signal through its representation in the perceiver's brain, in the same way we are able to process the meaning of gestures (Molnar-Szakacs and Overy, 2006). As it was highlighted in the Chapter II, this system is involved in the coupling between the perception and experience of actions that contributes for the access to others' mental states by their simulation in the own self. Gallese considers mirror-neuron system as the main representant of the sub-personal level of

the *shared manifold* proposal for explaining empathy, as a mean to achieve a sense of similarity with our conspecifics. According with him the capacity to understand meaning behind perceptual cues constitutes the main precondition for any type of communication (Gallese, 2003). Furthermore, considering the sensitivity of the mirror-neuron system to auditory stimuli, the proposal of these authors converge to the idea that mirror-neurons might represent action and intentions of others through auditory stimuli like music (Molnar-Szakacs and Overy, 2006).

Almost all the musical production involves motor actions, from singing to drumming. In fact, the music corresponds to the organization in time of the auditory information caused by such action. When listening to music, it is proposed that the listener engages into a similar motor network involved in the activities responsible for producing the music, emerging a co-representation of the musical experience (Haslinger et al., 2005; Bangert et al., 2006). The auditory features of the musical signal - *symbolic coding* - are primarily processed in the superior temporal gyrus (STG), whereas the information about the 'motion' of the signal is conveyed by the activity of both the posterior inferior frontal gyrus (Brodmann Area 44) and the adjacent premotor cortex. The anterior insula, in turn, is involved in the mediation between the information from the mirror neuron system complex and the limbic system, whereas the appraisal of such information relatively to each one's emotional state takes place in the limbic system, which provides a complex affective response (Molnar-Szakacs and Overy, 2006). The involvement of mirror-neuron system is congruent with the neuroimaging studies made in the affective responses to music, where it was revealed the paralimbic network and neocortical regions involved in emotional processing and particularly involved in social relevant cognitions (Koelsch et al., 2006).

The main idea setted up in the proposal made about the involvement of mirror-neuron system in musical processing, regards the shared recruitment of mirror neurons network either in the sender as in the perceiver of the musical signal, suggesting a co-representation of a musical experience. Thus, the communicative signals, and specially auditory ones, might be understood in terms of the motor actions behind them and the intention behind such motor actions. The expressive nature of human action might be signaled through emotions (De Gelder, 2006) since they are intertwined with actions in such a way that during imitation of emotional facial expressions, the amygdala and the mirror neurons network show increased activity, which concur to consider them areas involved in the understanding of the emotions of others (Carr et al., 2003). Through the complexities of the hierarchical structure of music, human emotions might be transmitted such as they are transmitted through facial expression since they also activate the neuron-mirror system (Molnar-Szakacs and Overy, 2006).

Bangert and colleagues found that musicians, expert pianists, sowed an higher neural activity in their brain areas associated with mirror-neurons than a non-musician group (Bangert et al., 2006). Moreover, an important study conducted by Adolphs and colleagues demonstrates how patients with lesions in the amygdala and in the sensorimotor cortex - both belonging to the human neuron system - show an impairment in the recognition of facial expressions (Adolphs et al., 2000). In both cases, during the perception of an emotionally arousing stimulus, the ability to link perceptual and behavioral representation of a stimulus, provided by the activation of the mirror neuron system (Brodmann Area 44) and the anterior insula (Koelsch et al., 2006) offers the possibility to simulate an emotional state in a listener (Gridley and Hoff, 2007). The anterior insula establishes the connection between

the sensorimotor regions and the limbic system, through which the perception and the limbic system might be involved in emotional processing (Carr et al., 2003). Thus, the listener is potentially able to recognize emotions in music by the resemblance of the motion of the sound with a specific emotion (Figure 19).

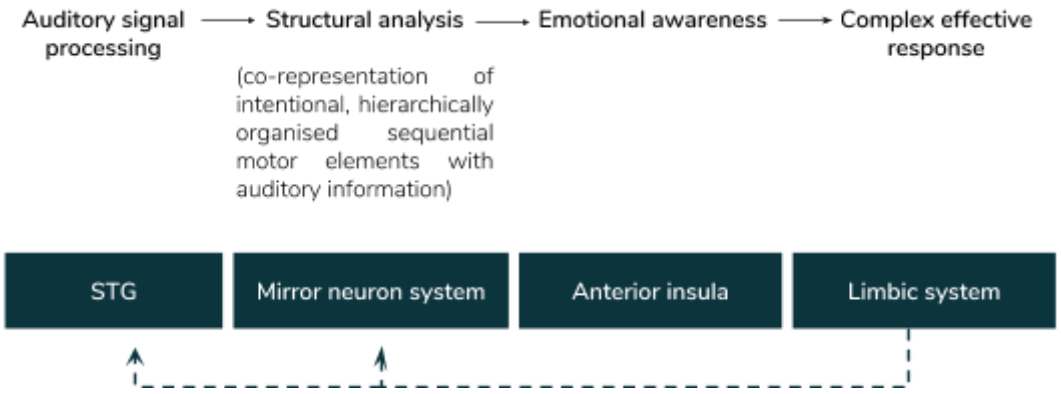

Fig. 19 | The model for the involvement of mirror-neuron system adapted from (Molnar-Szakacs and Overy, 2006, p. 237).

In sum, mirror neuron system might provide a link between music perception, cognition and emotion (Molnar-Szakacs and Overy, 2006), providing a mechanisms for the perception of emotions in music, but also an explanation for the importance of music in social interaction (Juslin and Sloboda, 2001), such that the perception of emotions in music are based on the same mechanisms that lead us to perceive sad or happy facial expressions. The emotional information coding of music might involve the same systems recruited for decoding emotions in the social interaction, i.e. the human mirror-neuron system, which is congruent with the hypothesis that music might itself be considered a signal with a *social stimulus*.

Such as referred in the Chapter II, the embodiment of perceived emotions, like the facial expressions, occurs due to the involvement of mirroring processes through which emotional contagion mechanisms as the mirror-neuron system lead to bottom-up processes of involuntary mimetic and affective resonances associated with emotional empathy. This mirroring processes, in the case of music, constitute low-level process of virtual simulation that might be responsible for the emotional perception in music.

As it was referred before, the separation between *emotional perception* and *emotional induction* is very subtle. In fact, the mirror-neuron system establishes direct connections with areas of the brain responsible for complex emotional responses. This prediction already advance the confirmation of the second verification, however, for the purposes of this first verification, the most important consequences of the involvement of mirror-neuron system in the simulation of hierarchically organized motor elements in auditory signal symbolically codified in music, regards the involvement of emotional empathy in the recognition of the emotional content of music by virtual simulation - the first step to "feel into" the music or "feel into" the emotions of the composer or the performer behind the music.

3.3 Conclusions of the first verification

The necessary verification that *perceiving* emotions in music involve the same mechanisms responsible for the perception of emotions in social interactions is based on the fact that they also possess a social function - they are also other-oriented. This means that we need to be wired with mechanisms able to detect perceptual emotional cues. The fact that music also constitutes a perceptual cue with an auditory nature, concurs for the hypothesis that the perception of emotions in music re-uses the mechanisms responsible for the perception of emotions in the others. This description is congruent with the *virtual simulation* proposed in Chapter II due to the fact that music does not possess real mental states. In this sense, it is considered that an emotional experience provoked by an external event crucially depends on a perceptual component causally responsible for the emotional process. The *emotional perception* is essential for the apprehension of the communicative quality of music in its own, since that it is an external signal expressing emotions - an individual expression through musical form.

Thus, the first argument in favour of the emotional expressivity of music come from the discussion of its evolutionary roots, through which it was showed its disposition to manifest emotions by the emotional early communication that it might had served. The *iconic* coding of emotions refers to a more universal expression of emotions based in the similarity of music with verbal cues, likely more linked with the perception of basic emotions, as sadness. Besides, the acoustic features of music are also a source such emotional expression and recognition, represented by *symbolic* coding, for instance, sad music is consistently reported to correspond to music played in a *slow tempo* and a *minor mode* (Brattico et al., 2011), however, such features of music might be dynamically associated with other information present in the contextual environment by means of *index* coding. The recognition of emotions is based on the employment of *mirroring processes* that function as *low-level virtual simulation.* The empirical evidence of the involvement of mirror-neuron system in this phase predicts the role of empathy for the appreciation of sad music, at least from its involvement in the first phase of the emotional process - the *identification* of the emotional stimuli.

Perceiving music as a communicating signal of emotions competes for the attribution of personal characteristics to itself, both by the *virtual mental simulations* employed as a means of perceiving them, and by the fact that the emotional content is inherent in its structure. Watt and Ash were the first proposing that the music might resemble an "undifferentiated other" manifesting emotions or the appearance of a human emotion in the form of a *musical persona* (Watt and Ash, 1998). The emotions expressed by the music become present in the mind of the listener, activating the idea of the emotion itself, in turn attributed either to the music as representing a sad entity or to somebody's expression of sadness through the music. The fact that the musical emotion becomes the object for a subsequent emotional response depends on the ability to empathically acquire the musical emotion as if it is really being experienced without its usual determinants. Thus, the capture of the emotional expressivity of the music by the listener constitutes the critical step to evoke such imaginary feeling.

Musical and social processing rely on the activation of shared neural resources as the mirroring processes, what turns music a stimulus similar with a social stimulus, being capable of recruiting areas involved in *emotional empathy* - the core supplementary motor

area (SMA), cingulate cortex and insula (Fan et al., 2011) - as well as paralimbic and limbic areas associated with the reward system (Wallmark, Deblieck and Iacoboni, 2018). This means that music presents a proclivity to provoke empathic emotions, through the emotional encoding in its signal and its effect in the perceptual system prone to understand emotional information. As a conclusion, **it is verified** that listeners perceive emotions in music through the natural disposition we developed to understand emotional meaningful stimuli, such that the same mechanism employed for the perception of emotions in others are reused for the music.

4. *Second Verification*

4.1 Emotions induced by the music

As previously notices, the recognition of emotions in music through its perception and the induction of musical emotions constitute very close phenomena. However, the emotions perceived in the music and the ones felt might diverge due to the involvement of different mechanisms for the different phenomena, which constitutes the main explanation for the cases of mixed emotions reported (Kawakami et al., 2013). Considering that the affective experience with music might be a consequence of the perceptual experience, means that both mechanisms might be related between each other. In that sense. if empathy is responsible for perceiving emotional cues in music, it might also be responsible for the embodied expression of such emotional cues. In order to explain the Paradox it will be considered the ability music has to evoke sadness or negatively valenced emotions through empathic processes.

Previously, the intense emotional response to music were described as frissons, however, such emotional events might also be described through categories of emotions (even beyond basic emotions), namely *calm-relaxation, happiness-joy, nostalgia-longing, interest-expectancy, pleasure-enjoyment, sadness-melancholy, arousal-energy, love-tenderness, pride-confidence* (Juslin and Laukka, 2004; Juslin et al., 2011; Zentner et al., 2008). The variety of emotions provoked by music is dependent on the underlying mechanisms of each interaction (Juslin and Laukka, 2004). The objectless nature of emotions provoked by music, i.e. their lack of the typical action tendencies and triggering stimuli (Scherer, 2004; Zentner et al., 2008), lead some to suggest that there are emotions uniquely aroused by music (Juslin, 2013), i.e. that musical emotions present a different nature from the genuine emotions of everyday life. However, physiological evidence associated with sad music listening suggests a real experience of everyday emotions due to the decreased skin conductance, higher finger temperature and decreased activity of facial muscles, also associated with self-reported sadness (Lundqvist et al., 2008). Neuroimages also offer some evidence in favour of the activation of regions associated with sad affective states (Mitterschiffthaler et al., 2003; Vytal and Hamann, 2010; Brattico et al., 2011). Moreover, taking into consideration that music-evoked sadness reveals positive psychological effects in some listeners effects, regulating their mood or providing social contact by consolation or mood-sharing, indicates that the emotions evoked by music might have real consequences and functions beyond the aesthetic appreciation (Taruffi and Koelsch, 2014).

Considering music to represent an imaginary persona that express emotions, the emotions that are causally aroused by listening to it might correspond to the same emotions aroused by empathetically engage with someone that expresses emotions - the known "empathic emotions" (Levinson, 2007; Sachs, Damasio and Habibi, 2015). Once empathic emotions occur in the real world, the evocation of such emotions by music might not be considered specific of music, since it involves the same mechanisms for empathic emotions induction employed in real life situation and the areas of the brain activated to process a negatively-valenced stimulus.

4.2 The underlying mechanisms of music-evoked sadness

The main mechanisms underlying the arousal of emotions by music was proposed by Juslin to be divided into *brain stem reflex, emotional contagion, evaluative conditioning, rhythmic entrainment, visual imagery/ imagination, episodic memory, musical expectancy* and *aesthetic judgement* (Juslin, 2013). However, recently, five categories were evidenced as the more important for the evoking of sadness, respectively from the more influential to the less influential one: *memory*, *emotional contagion, appraisal, imagination* and *social functions* (Taruffi and Koelsch, 2014). The prominence of memory over the other mechanisms shows the motivation of listeners to evoke valued events (Batcho, 2007; Van Goethem and Sloboda, 2017), recurring to a process whereby an emotion is induced by the conscious recollection of particular events from the listener's life (Baumgartner, 1992). This type of emotional evocations might be compared with the associative coding, since emotions are linked to an event rather than to the music, since the music is conditioned with a positive or negative emotional stimulus (Juslin, 2013). Thus, the intensity of emotions associated with the psychophysiological pattern of the original event is stored along with the memory trace (Lang, 1979) and the music is only able to retrieve that particular memory.

On the other hand, *emotional contagion* refers to processes where the listener internally mimics the emotional expression of a musical passage (Juslin and Västfjäll, 2008) in terms of motor expression (Lundqvist, Carlsson, Hilmersson and Juslin, 2009), evoking an emotion through an emotion-specific peripheral physiological feedback (Juslin, 2001). This process is congruent with the perception of emotions through *mirroring processes*. Similarly, emotional contagion was primarily associated with facial expression (Hatfield, Cacioppo and Rapson, 1994), and then considered to be involved in emotional speech (Neumann and Strack, 2000), which lead to consider that acoustic patterns were able to arouse emotions through the same mechanisms that occurred in emotional speech (Juslin and Laukka, 2003). For instance, voice-like cello timbre was featured with a sad emotional expression through a contagion reaction in a study conducted by Juslin and Laukka, such that, contagion usually reflects social responses to specific acoustic patterns of voice-like emotions (Juslin and Västfjäll, 2008; Juslin, 2013).

In this sense, *emotional contagion* is one of the main mechanisms to be considered responsible for the arousal of emotions in music. As Niedenthal (2007) proposes, the embodied simulation of an emotion might feel genuinely similar to a real emotion albeit the fact of being evoked in a fictional context or through music (Niedenthal, 2007). Indeed, *emotional contagion* is a process positively correlated with a personal disposition for general empathy (Taruffi and Koelsch, 2014). As previously considered, the human mirror-neuron is the main responsible for the *virtual simulation mechanism* of the emotional content of the

music, implemented through the activation of the posterior inferior frontal gyrus and the anterior insula. Thus, through the perception of emotionally arousing music, the mirror-neurons system shall guide the arousal of the emotional states (Molnar-Szakacs and Overy, 2006). In this sense, *empathic processes* are at the core of an emotional experience guided by *emotional contagious mechanisms*. Instrumental music involves *low-level virtual simulation processes* by allowing the embodiment of the affective content of music, associated with *emotional empathy*.

Cognitive appraisals constitute another way to induce emotions in music, which represent the subjective evaluation of an object/event relatively to the individual "goals, motives, needs and values" (Juslin and Västfjäll, 2008), such that the music is subject to an *aesthetic judgmen*t of its value and that judgment leads to posterior emotions. Moreover, *imagination* corresponds to the mechanism of creating inner images with an emotional nature produced by the listener through a metaphorical mapping of the music (Juslin, 2013). As it was previously referred *brain stem reflexes* do not constitute the type of mechanisms that suits the purposes of the work, due to the arousal of unspecified emotions rather than specific ones. On the other hand, *musical expectancy* is a mechanisms also highly dependent on acoustic features as a reaction to the expected or unexpected unfolding of the structure of the music (Juslin, 2013), however, highly dependent on acculturalization (Juslin and Västfjäll, 2008), which means that do not constitutes a candidate for automatic reaction to the music itself, involving a level of learning for the manifestation of emotional reactions. These conditions are not very much in tune with the empathizing dependence on contagion circuitry and automatic processes, being nonetheless considered a candidate to generate emotions.

The mechanisms involved in the generation of emotions present similarities with the ones employed for the perception of the emotions in music, specially at the level of *emotional contagion* mechanisms, which is a positive contribute for the defense of *empathic emotions* through music, through which the emotional expression of the music is captured by the listener (Evans and Schubert, 2008; Juslin and Västfjäll, 2008; Juslin and Lindström, 2010; Juslin, 2013).

4.3 Sadness induced by music

A model conducted by Zentner and colleagues distinguish the nature of music-induced emotions in a nine-factor Geneva Emotion Music Scale (GEMS), consisting of *wonder, transcendence, tenderness, nostalgia, peacefulness, power, joyful activation, tension* and ***sadness***. These nine emotions might be condensed into three categories: sublimity, vitality and unease. The features of the musical pieces that listener tend to agree as playing a crucial role in evoking *sadness* are considered to belong to the low energy and negative valence quadrant, which include timbre, pitch and mode. Contrary to happy music, sad music has been reported as eliciting an entire range of "sublime" emotions (Zentner et *al.*, 2008) and to be associated with a richness of emotional responses, with the number of emotions evoked by listeners being positively correlated with the enjoyment of the piece (Taruffi and Koelsch, 2014).

An important issue to be pointed concerns the fact the musical object do not determine the emotional experience of the listener i.e. the subjective experience of any listener adds an important source of variation in the response. Part of the emotional

expression of music is related with the associative coding of emotions in music (Juslin, 2013), such that the emotional experience through music may be very idiosyncratic, associated with particular conceptualizations of the emotional character of music, even when specific characteristics of the music associated with particular type of codings that are more prone to evoke one emotions in detriment of another.

When people are asked about whether or not they experience genuine sadness in response to music that they find pleasurable, one quarter of the answers is positive with *nostalgia* constituting the more reported feeling in such situation (Huron, 2011). Indeed, nostalgia - an ambivalent emotion associated with both positive and negative stimuli - is considered to be the emotion more experienced when listening to music that listeners appreciate, followed by peacefulness and tenderness, both positive emotions. According with the same survey, only 44.9% of the reported emotions included sadness (Taruffi and Koelsch, 2014). It is interesting to note that Eastern listeners reported a different scale of emotions relatively to the Westerns, with peacefulness being considered the more prominent emotion in appreciated music. The differences in cognitive and emotional processes between these two cultures (Murata, Moser and Kitayama, 2013), rooted in the different tendencies of construal of the self, where Western tend to be more individualistic and Eastern more collectivist. Episodic memories are very powerful in the evocation of sadness in music, but they also may function as a way to confirm one's identity, contributing to establish stronger perceptions about the inner and external world (Juslin, 2012). Barrett and colleagues found that the strongest predictor of the intensity of music-evoked nostalgia is the autobiographical salience of a particular song (Barrett et al., 2010) such that, nostalgia is indeed an emotion linked with the retrieval of autobiographical events (Batcho, 2007; Sedikides, Wildschut, Arndt and Routledge, 2008). These results are congruent with the prevalence of nostalgia over the other emotions in Eastern cultures.

The recognition and manifestation of basic emotions in music tend to be less dependent on musical training relatively to complex emotions (Vieillard et al., 2008; Yamasaki, 2002). Either nostalgia as all other emotions reported as a response to enjoyed music are considered complex emotions, less sadness. Accessing the recognition of a sad stimuli in music, through its capacity to evoke areas of the brain devoted to negatively-valenced stimuli, was assess in a study carried out by Mitterschiffthaler and colleagues where it was collected fMRI images while subject were listening to 30s of sad and happy instrumental musical extracts relatively to "neutral" instrumental music. Comparatively with neutral music, both sad and happy music revealed the activation of the posterior cingulate cortex and the medial frontal gyrus (Mitterschiffthaler et al., 2007), areas associated with the introspective emotional experience, self-control and attention (Koelsch, 2010), as well as the auditory primary cortex - due to the importance of the auditory features for the attribution of emotions as well (Brattico et al., 2011). Sad music, in particular, activated the **hippocampus** and the **amygdala** (Mitterschiffthaler et al., 2007), two areas reported as important in the perception of negative emotions (Gosselin et al., 2007), and also the **cerebellum** (Mitterschiffthaler et al., 2007).

The amygdala shows particular activation to emotionally salient stimuli before a conscious appraisal (Phelps, 2004) and it is also known to receive auditory projections from neurons involved in auditory transmission (Phelps and LeDoux, 2005) which make it an appropriate candidate for the rapid process of emotionally salient information in music. Another study conducted by Koelsch and colleagues revealed the activation of left amygdala

in the processing of unpleasant music (Koelsch et al., 2006). The activation of the hippocampus, on the other hand, confer an enhanced attention to the perceived stimuli for the ascertainment of the appropriate reaction. However, hippocampus is not strictly connected with the sadness, being also activated in response to pleasant stimuli (Brown et al., 2004; Koelsch et al., 2006). Moreover, the activation of hippocampus during music listening might be also involved in the generation of emotional responses attachment-related (Koelsch, 2014). In fact, hippocampus have an important role on social relations, which reinforces the fact of music being considered a virtual social stimulus.

In this account, the increased activity of hippocampus and amygdala during sad music processing might be interpreted as a sign of the appraisal and evaluation of an emotional stimuli, especially when it possesses a negative valence (Richardson et al., 2004). Moreover, it might be highlighted the neural connections that these two areas establish with the mesolimbic dopaminergic system, which concurs for the possibility that areas activated as a response to negative stimuli being also related with pleasurable emotional events (Gabrielsson, 2002), a relevant evidence for the later assessment of sad music appreciation. The **cerebellum**, the last area activated by sad instrumental music, is either associated with sensory-motor processing, with the monitoring of cognitive tasks associated with musical sounds, like the visual imagery. This area is also pointed as being involved in processing of emotional faces and empathy for another's pain (Fusar-Poli et al., 2009; Stoodley and Shmahmann, 2009).

In this sense, the emotional information of music represented by the sad and happy stimuli, relatively to the weak emotional information represented by the neutral music is associated with the activation of specific areas of the brain involved in the emotional processing, with the amygdala, hippocampus and cerebellum constituting the main areas associated with sad music. In the same study, it was also compared the neural activation between sad and happy music, such that, the main difference resided in the activity of the superior temporal gyrus (STG), which presented a greater activation in sad than in happy music. This area is involved in the auditory processing, including languages, and it is considered to be particularly enlarged in children and adolescents with autism, being associated with social perception of emotions when language is impaired (Jou et *al.*, 2010). STG is inclusively considered to be involved in facial emotions perception (Radua et *al.*, 2010), which corroborates the previous conclusions relatively to the involvement of perception of emotions when listening to music (Figure 20).

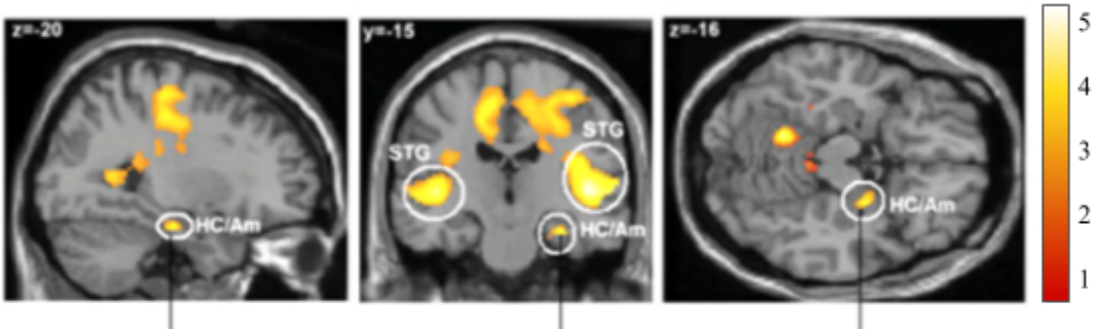

Fig. 20 | The areas of the brain predominantly activated when listening to sad classical music. Regions of increased brain activation during listening to sad classical music, displaying the difference comparatively to neutral music in the hippocampus/amygdala. HC/Am - hippocampus/amygdala; STG - superior temporal gyrus. Source: Mitterschiffthaler et *al.* (2007, p. 1156)

i) The effect of the lyrics

In order to expand the understanding of the processes of musical emotions, it is also necessary to consider the lyrics of music, once they constitute emotional competent stimuli as well. In that sense, a study carried out by Brattico and colleagues showed that the semantic messages provided by lyrics play a more efficient role in the evocation of sad emotions than the acoustic cues of sad music. This study suggest that the acoustic cues constitute a more efficient tool to convey happiness experiences through music, whereas, on the contrary, the lyrics provide better means to invoke sadness. Hence, it was concluded that the semantic information provided by lyrics has a differential effect in happy and sad music of different genres, from rock to pop, but they constitute a mean to activate limbic and paralimbic areas of the brain (Brattico et al., 2011). If, on one hand, the acoustic and perceptual analyses between happy and sad music with or without lyric are very well demarcated, where the pitch level, rate/tempo and intensity variation in both instrumental or vocal channels are means for conveying basic emotions (Juslin and Laukka, 2003), on the other, the differences in the fMRI brain responses and in the behavioral data obtained between the listening to sad music with lyrics and happy music without lyrics were not very significative since it was not found a specific correlation between the musical characteristics and the activation of the brain.

The structures of the brain particularly activated when listening to sad music with lyrics are the left hemisphere which is associated with auditory, syntactic and semantic processing of language (Vartiainen et al., 2009; Schön et al., 2010). The representative areas of the left hemisphere activated included the frontal gyrus, the putamen, the inferior parietal lobule and the bilateral auditory cortices. Listening sad music with lyrics reveal neural activity in the regions associated with the human mirror-neurons system, which includes Broca's area, involved in the processing of language representations, speech articulation and language syntax (Grodzinsky, 2000), cross-modal processing of language and chord sequence (Koechlin and Jubault, 2006; Koelsch, 2006; Tettamanti and Weniger, 2006). So, the involvement of mirror neuron system and Broca's area when processing sad music with lyric might be related with the representation of the content of the lyrics associated with a certain sequence of pitches - perhaps linked with the imagination of singing the lyrics along with music. However, a study conducted by Nussbaum also showed that songs with the same lyrics played under different musical interpretations generate different emotional experience (Nussbaum, 2001), which indicates that lyrics might indeed led to provoke sadness, but their emotional content is prone to be modulated by the musical content, such that both factor influence the emotional response of the listener regarding his focus of attention.

Additionally, the insula, considered the main area involved in the subjective experiences of emotions - the feeling of an emotion (Damasio et al., 2000) - was also activated during the listening of sad music with lyrics (Brattico et al., 2011), participating in the connection between emotional processing and motor representation in the generation of an integrated musical representation (Molnar-Szakacs and Overy, 2006). Additionally, sad music with lyrics also activated the limbic system indicating their propensity to induce emotions (Brattico et al., 2011) and subjective report also corroborates the power of lyrics to evoke sadness (Ali and Peynircioglu, 2006). Hence, the results of Brattico and colleagues highlight the importance of lyrics to induce sad emotions due to the strong activation of areas previously connected with the processing of basic emotions, but also with the *semantic*

representation processes (Brattico et al., 2011). *High-level virtual simulation*s rather allow the listener to access the emotional content expressed in music by processing the semantic content of the lyrics through which the listener is able to feel accordingly employing *cognitive empathy*. The mechanism related with the induction of sadness through cognitive empathy might be particularly related with *imagination*, through which is possible to transpose oneself to the emotions portrayed by the lyrics. In this regard, the emotions provoked by the lyrics might represent the only case where music do not induce emotions by *low-level virtual simulation processes*. *Cognitive* and *emotional empathy* were previously referred to play an important role in the evocation of sadness, such that fantasy and empathic concern influence sadness evoked by unfamiliar music, whereas fantasy plays a greater contribute for sadness evoked in familiar music (Vuoskoski and Eerola, 2012).

4.4 Conclusions of the second verification

The brain activations here described to be involved in the arousing of emotions support the fact that areas of the brain related with the processing of negative stimuli as amygdala and hippocampus, might also be involved in the processing of sad music. Reducing sadness to specific brain activations patterns is not coherent with the CAT framework for emotional processing, which considers the contextual appraisal as an important part of the emotional processing. However, the fact that music activates those areas constitutes a prove that it has the power to generate responses similar to the everyday life but in the context of music. The sad music, being recognized as a negative emotional stimulus is prone to activate areas of the brain related with the processing of negative stimuli. Empathic individuals are referred to exhibit stronger motor and sensory resonance to the observed actions of the other and to their manifestation of a specific affective state (Gazzola, Aziz-Zadeh and Keysers, 2006; Avenanti et al., 2009), which might be related with the dispositional tendency to resonate with the acoustic and gestural features of sad music. If, in the first place, the emotions in music are not perceived, the listener lacks the object to empathize with. The sadness expressed is perceived by means of *mirroring processes* and, by *contagious mechanisms*, the music arouses feelings of sadness embodying the object perceived. In this sense, feeling sadness through music derives from an empathetic engagement resulting in an empathic emotion, such that the sadness expressed by the music is activated in the listener.

The connection between the mechanisms that allow the detection of the sadness in the music and the ones responsible for emotional embodiment of such musical expression occurs through the intervention of empathic processes. The *virtual simulation* of the emotional expressivity of music might provide the access to its emotional content through the induction of congruent feelings guided by empathic processes. *Low-level virtual simulation* processes might play a very important role in the simulation of the valence of the stimuli, carried by *mirroring processes* employed through *contagious mechanisms*. These mechanisms are dependent on the activation of mirror-neuron system responsible for the representation of hierarchically organised motor auditory cues, providing the base for the emotional intentional information of the music. Then, they can lead to the activation of the insula, responsible for generating an integrated musical representation through the embodiment of the emotion expressed in the music, connecting the motoric representation of mirror-neuron system with the emotional response by *emotional empathy*.

However, the fact that lyrics activate areas of the brain involved in the different phases of the emotional processing, as the insula and the limbic system, support the assumption that emotional apprehension might occur not only by the *mirroring* of the motor expression of the musical signal but also by the understanding of the meaning of sad music's lyrics. Such apprehension shall occur at the cost of *high-level virtual simulations* associated with *cognitive empathy* processes, which are also responsible for provoking emotions. High-level processes might be used to understand the situations portrayed by the lyrics, such that, the representation of the expression of a particular message or idea with an emotional content by the music itself. The semantic representation of such ideas shall evoke mechanisms of *imagination* to conjure mental images associated with such messages connotated with an emotional value, which might activate the emotions associated with them. Such mechanisms might be associated with the involvement of *as-if-body-loops* proposed by Damasio, through which it is possible to simulate the affective narratives experienced in the past. Moreover, such images are accompanied by the emotional expressivity of the music behind the lyrics, which is also able to modulate its emotional value. In this regard, the representation of an idea or an experience linked to human behavior is accessed by putting oneself in music's shoes, such that the way a person empathizes with fictional characters or a person might be also employed in music with lyrics.

In both cases, empathic emotions might derive from *virtual simulation* processes that permit to access the emotional content of the musical piece, such that the empathic processes drive the affective experiences towards sad music (Scherer and Zentner, 2001). Indeed, the greater the empathy indexes of a person the stronger its affective response to music (Egermann and McAdams, 2013; Wöllner, 2012). The psychological mechanisms involved in such affiliation with the music include *emotional contagion*, *semantic representation* and *imagination* (Inzlicht et *al*., 2012), which means that empathy in music might arise either from music with or without lyrics, involving both *emotional* and *cognitive empathy*. Then, music is considered a mean for the facilitation of shared emotions between the listener and the music itself, which interfere directly with the listener, because when emotions are shared they structure the agentive character of individuals, leading them to be ready to act under specific psychological configurations (Krueger, 2014). In this sense, music listening involves the interaction between top-down and bottom-up processes (Brattico, 2015) modulated by empathy, such that the affective responses provoked by the music might either be a result of the incoming musical signal as well as the higher level modulatory processes of the first affective information (Schubert, 2017).

Even though music-evoked sadness involves particular brain activation associated with the processing of negative stimuli (Mitterschiffthaler et al., 2007), along with subjective reportings associated with sad feelings (Juslin and Laukka, 2004), physiological activation (Lundquist et al., 2008), as well as the regulatory effect of its evocation in the improvement of well-being (Sachs, Damasio and Habibi, 2015; Taruffi and Koelsch, 2014), music sadness lacks the fundamental object or situational context of sadness. This means that music might evoke analogs of everyday life emotions, such that music sadness might feel like sadness (*as-if-sadness*) by the activation of the areas of the brain responsible for the mimicking of the *feelings* of sadness. According with Damasio, *feelings* represent the conscious access to the state of the body through a qualitative experience (*valence*) orienting the organisms relatively to the type of behavior to engage with. Moreover, it was also recognized that *feelings*, the conscious experience that accompany the bodily changes associated with the emotion,

provide the template to categorize the emotion according with past experiences regardless of its different patterns of activation. In this sense, considering sadness an emotion negatively valenced, the natural behavior to expect from a music that evokes *as-if-sadness feelings* would be of an aversive nature, which would lead to the avoidance of sad music listening. This means that, according with Damasio's theory and with this proposal, if music correspond to a stimuli that, by its inherent properties and by the effects of empathic processes activates characteristic feelings of sadness, it is paradoxical to appreciate such music. In this sense, the next Chapter will provide *conversionary explanations* for this Tragedy Paradox, based on the regulatory mechanisms of emotional processes.

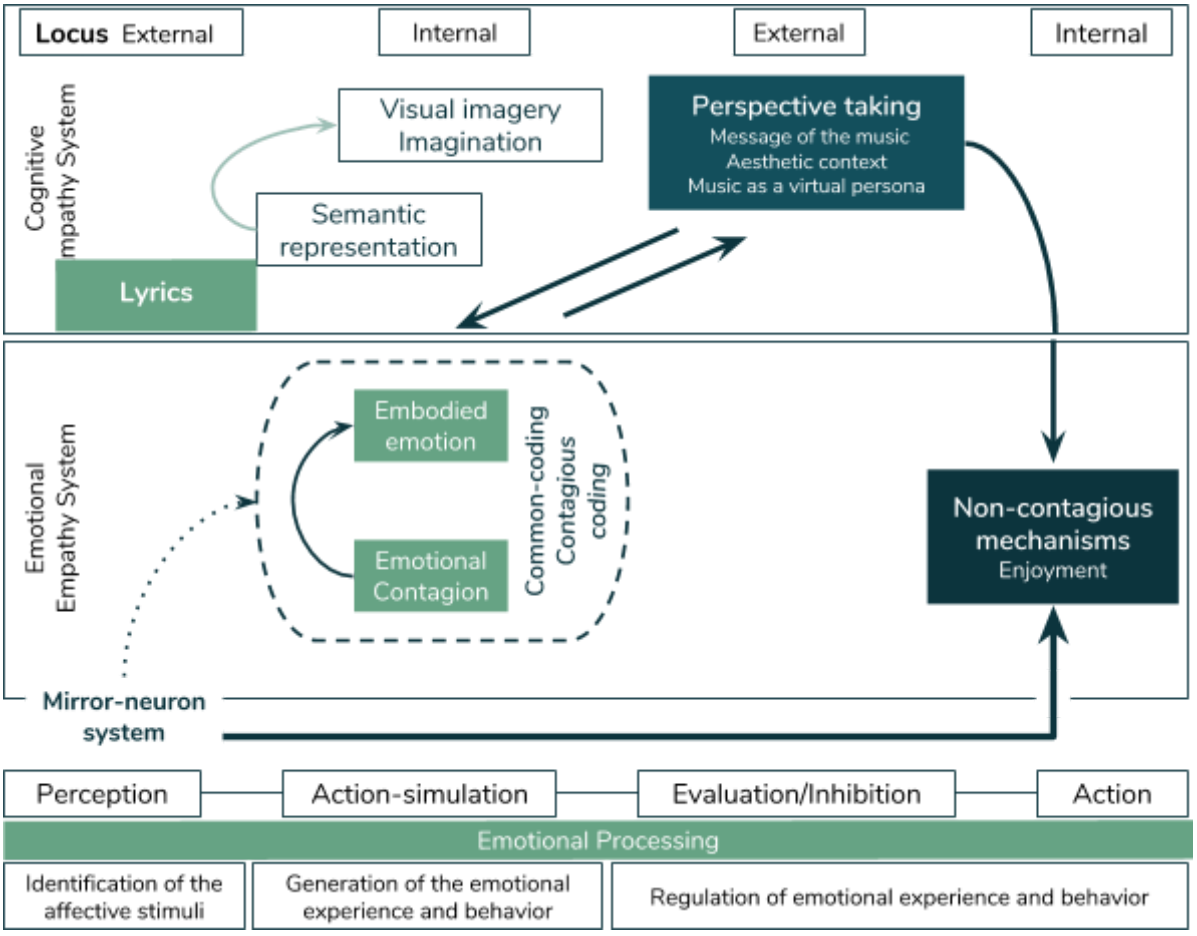

Fig. 21 | Diagram of the perception-action coupling mechanisms driven by emotional empathy and semantic representation of the lyrics in the cognitive empathy systems for the generation of emotions through music. Correspondent relation with the processes involved in the emotional processing: the perceptual processes associated with identification of the affective stimuli and actio-simulation with the emotional experience generation. Made by the author.

Briefing - The defeat of *Deflationary Explanations*

The reasons for *deflationary explanations* do not being employed in the explanation of the Tragedy Paradox are the same that allow to answer to the first research question, since this answer exposes evidences to understand how music is a possible cause of genuine emotions as long as the processing of musical stimulus coincide with emotional processing circuits.

As social beings with complex behaviors human beings are equipped with mechanisms that allow them to recognize the emotional states of others in order to guide their behavior. These mechanisms involve the experiencing of empathic emotions, which means that sadness functions not only as the experience of a homeostatic imbalance, but also as a signal prompt to be recognized by others as a way to favour of prosocial behaviors. Music, from evolutive reasons might be interpreted as a social signal as well, having been preserved as a mean of communication of emotional information that may had facilitated the intersubjectivity between individual besides language, being supported by specific brain circuits involved in emotional process and psychological processes responsible for emotional arousal, as *emotional contagion* and *visual imagery*. The expression of emotional cues in the music is accomplished by specific musical codings, more universally or personally recognizable. Having music as a significant emotional sign, empathic processes might lead to the induction of the emotions it expresses by *virtual mental simulations*, specifically through *mirroring processes* or *imagination*, whether the emotions are triggered by the acoustic features of the music or the meaning it provides by lyrics, which correspond to *emotional* and *cognitive empathy* processes, respectively. *Mirroring processes* are carried out through the activation of the *emotional contagion* mechanisms leaded by human mirror-neuron system. These mechanisms might be able to activate circuits responsible for the representation of what it means to be sad (*as-if-sadness*) through external triggers. On the other hand, *imagination* which correspond to high-level processes of simulation might be able to either activate the semantic networks correspondent to the meaning of the lyrics of music with sad lyrics and the high-level circuits that activate the imagining of what means to be sad (*as-if-sadness*), which work as inner triggers of the emotion. In this sense, empathic experiences related with the *affective resonance* mechanisms are at the core of the emotional arousal experienced in music, which defeats the *deflationary explanation* for the Paradox and rather justifies the pursuit of the reasons for people listen to music evoking sadness supported by pleasure-centered answers which permit to understand the benefits of such experience by means of *conversionary explanations.*

Part II.

Conversionary explanations

How does empathy explain a cathartic process in music?

Chapter V

The rewarding aspects of sad music

Hey Jude, don't make it bad, Take a sad song and make it better
Beatles, "Hey Jude"

Assuming that music evokes feelings of real emotions, inclusively, negative emotions as sadness, the rewarding aspects of such artistic expression - as people affirm to experience (Eerola et *al.*, 2018) - might come from other sources rather than the emotional experience. Levinson proposed that the absence of real life implications in music-evoked sadness is indirectly connected with music-evoked reward (Levinson, 1982). A proposal named as "control theory" (Eaton, 1982; Morreall, 1985) considers that we find pleasure in situations over which we are able to feel some degree of control, such that the negative emotions experienced would feel less painful when listening to music, once the lack of real painful causes (a loss or failure) would ascribe them as more controllable. However, a case of controllable pain, do not satisfy the question of why do people seek out for such painful experience in the first place (Smuts, 2009). According with David Hume, unpleasant emotional experiences felt through artistic means might be converted into pleasant ones by the predominance of positive emotions over the initial negative ones (Levinson, 2006). However, the mechanisms behind such conversionary operation still remain unclear. The replacement of pain by a pleasurable experience requires a compensation mechanism - what is it precisely? This chapter will specifically focus on the way empathic processes are responsible for the rewarding value of sadness feelings when listening to music.

The function of sadness arousing from distressing and complex fictional scenarios might be redirected, for example enabling us to put ourselves in other's shoes and simulate life events, behavior and emotions that would be difficult to experience in the reality and might culminate into a benefic experience (Johnson-Laird and Oatley, 2010) enhancing our ToM and empathy skills (Mar and Oatley, 2008; Kidd and Castano, 2013). This inherent rewarding activities might be important building blocks for the resolution of the paradox (Eerola et al., 2018), considering how important it might be to acquire new perspectives about human conditions regardless the cost of such learning, broadening the understanding of human behavior and improving the capacity to predict it (Frith and Singer, 2008), however, they seem to be mainly applicable in the realm of fiction. Nevertheless, the fact that music is a medium for a potential empathetic experience and that, when listening to music, individuals employ brain networks involved in empathizing (Wallmark, Deblieck and Iacoboni, 2018), brings the necessity to understand how empathy also modulates pleasurable experiences when listening to music, since the primary source of empathizing with music are the emotions it expresses and not the tragic journey of an hero.

Levinson proposals for explaining the reward of sadness provoked by music unveil that the rewards might derive from the awareness of the ability that music has to sadden us, through the perception of the relation between the musical form and the feelings evoked.

Through his point of view, the rewards come from the "music-qualified feelings" and not the feelings itself, in abstract, demanding a musical environment for means of appreciation. The feelings are not detached from the music, such that its experience is part of the music (Levinson, 1982). The rewardings he offers depend either on the lack of contextual implication of the sadness provoked by music or on the capability to imagine oneself in the emotional state depicted in the music. In the first condition, Levinson basically proposes that the pure feelings of an emotion are something we can appreciate to experience, either for savoring the qualitative aspects of the emotion for its own sake (*savouring feelings*), for the contribution of a better perception and appraisal of sadness (*understanding feeling*) or, lastly, for the self-assurance of the ability to experience intense feelings (*emotional assurance*). On the other hand, the rewards with real-life implications include the sense of control listeners might derive from the identification with a sad piece of music that resolves itself with positive feelings (*emotional resolution*), the imagining oneself to manifest a similar expressive property and richness expressed by sadness in the music (*expressive potency*) or, lastly, identifying with music as if it was expressing the feelings of another human being (*emotional communion*) (Levinson, 1982; Taruffi and Koelsch, 2014). These rewarding mechanisms, however, do not encompass the role of empathic processes in the appreciation of the feelings of sadness evoked by music.

Empathy conceptualize a range of "affiliative, social bonding and identity-forming" capacities in relation to music (Clarke, DeNora and Vuoskoski, 2015), which is intuitively very strong, considering the ability music has to bring people together, instantiate moments of synchrony, and foster a sense of togetherness in time (McNeill, 1995), whether in public or private moments. The intercultural understanding that music offers, makes it a very strong candidate for activating empathy channels between people (Clarke, DeNora and Vuoskoski, 2015). The relationship between music and empathy started to be already unveiled in the previous chapters, since empathic processes are deeply connected with the mechanisms involved in the emotional response to music, as the feelings of sadness. Now, for the purposes of this chapter, it is known that empathy is positively associated with the intensity of the emotional response to music and, more importantly, to the enjoyment of sad-sounding pieces (Vuoskoski et al., 2012; Garrido and Schubert, 2011; Juslin and Västfjäll, 2008; Vuoskoski and Eerola, 2012). So, in order to understand the pleasure associated with sad-sounding music, it will be first discussed how empathic processes call forth the rewardings of the sadness evoked by music (Clarke, DeNora and Vuoskoski, 2015), proposing cognitive empathy as having the main role in such rewarding responses.

1. The individual differences in the enjoyment of sad music

The musical empathy has been related with individual differences for the enjoyment of sad music (Garrido and Schubert, 2011) according with empathy dispositions, i.e. the variability in the "contagious susceptibility". The individual differences for empathy dispositions are reflected in the dissimilar recruitment of core empathy networks (Fan et *al.*, 2011) during music listening, such that, individuals with higher level of general empathy trait show greater activity in regions associated with *emotional empathy* and *cognitive empathy* during passive listening tasks (Wallmark, Deblieck and Iacoboni, 2018). The individual differences for the recruitment of cognitive and emotional empathy areas influence the

accuracy of recognized emotions in musical pieces (Taruffi et al., 2017) as well as the self-reported liking of sad music (Eerola, Vuoskoski, and Kautiainen, 2016).

Empathic concern and *fantasy* are tendencially associated with the enjoyment of sad music (Vuoskoski and Eerola, 2011; Vuoskoski et al., 2012; Eerola, Vuoskoski, and Kautiainen, 2016) and also more directly associated with the levels of sadness experienced after listening exclusively to unfamiliar sad music (Vuoskoski and Eerola, 2012). The isolated vocal and instrumental sound processing, like the timbre, constitute low-level stimulus associated with emotional empathy. Individuals with high empathic concern trait tend to be more responsive to high-arousal and negative affective states, since they are more sensitive to harsh vocal timbres that signalize endangered situations. Their responsivity is mostly associated with sensorimotor areas - pre/primary motor cortices and SI/SII (Carr et al., 2003; Gazzola et al., 2006; Pfeifer et al., 2008), inferior frontal gyrus (IFG) and inferior parietal lobe (IPL) (Carr et al., 2003; Shamay-Tsoory, 2010) and "pain circuit" areas as the anterior insular cortex and anterior cingulate cortex (Singer et al., 2004; Shamay-Tsoory, 2010). *Empathic concern* present a great vulnerability to signal negative stimuli related with the first *contagious mechanisms* of *emotional empathy*, presenting a high contagious vulnerability to stimuli. However without a real dangerous situation, the activation of such alert might be modulated and end up in pleasurable responses by the activation of prefrontal areas (indicative of a general empathic disposition), reward areas and sensorimotor-affective areas (generally involved in musical processing, regardless of the dispositional empathy of the individual, the emotional valence of the music and its familiarity) (Zatorre et al., 2007), such that *empathic concern* dispositions are related with the pleasurable responses to sad music (Garrido and Schubert, 2011; Vuoskoski et al., 2012; Eerola, Vuoskoski, and Kautiainen, 2016) (Table 1).

One interesting point relatively to the enjoyment of sad music by *empathic concern* individuals consists in the fact that the low-level stimulus processing does not restrict itself to the involvement of *emotional empathy* areas, but also *cognitive empathy* areas - mainly the DLPFC. In this context, the studies that indicate both *empathic concern* and *fantasy* as the main empathic dispositions associated with the enjoyment of sad music, concur for the hypothesis that the rewarding side of negative *valence* stimulus processing stems from high-level contextual appraisals that indicate the harmless nature of the signal. Moreover, individuals with high *empathic concern* and *perspective taking* activate predominantly areas involved in **executive control, regulation of emotions, mentalizing, contextual appraisal** and **enactment imagination** when listening to music (Goldman, 2006; Wallmark, Deblieck and Iacoboni, 2018). The *perspective taking* disposition supports the contextual appraisal of the signal which might occur at the cost of the interpretation of the affective experience, attributing to it to the musical context (Wallmark, Deblieck and Iacoboni, 2018).

Thus, the rewards from sad music might be attributed to the propensity to be over and above the *emotional contagion* mechanisms in order to recognize the affective intention and agentive quality of the musical signal. This hypothesis points out the main role of *cognitive empathy* in the modulation of the emotional response, being the candidate responsible for the enjoyment of the sadness evoked by music. Such proposal is in line with what Coplan already considered as being in the roots of empathizing with other, considering that such process requires necessarily cognitive mechanisms for the differentiation between the self and the others (Copler, 2011). Thus, *cognitive empathy* in music seems to be the

component responsible for the psychological reward of the sadness provoked by music through its influence in the differentiation between the self and the music (the other).

Brain regions recruited by *Empathic concern*	Associated activity	Behavioral responses
Dorsolateral prefrontal cortex (DLPFC)	Crucial executive control area in cognitive empathy (Christov-Moore and Iacoboni, 2016); Important role in emotional regulation (Ochsner et *al*., 2004; Quirk and Beer, 2006).	Activation of this region may reflect top-down control over affective responses to familiar music, involving up-regulation in liked music and down-regulation in disliked music (Wallmark, Deblieck and Iacoboni, 2018).
Reward areas (dorsal striatum)	Pleasurable responses	Increased pleasure to familiar music (Pereira et *al*., 2011).
Sensorimotor affective areas (ACC, paracingulate cortex, SMA and dorsomedial PFC; IPL and IFG).	Mirror accounts of empathy (Shamay-Tsoory, 2010) Main areas involved in empathy network (Fan et *al*., 2011):	Participates in simulations during the observation of others, which reflects specific socially relevant tasks that might underpin prosocial decision-making (Christov-Moore et *al*., 2017; Fan et *al*., 2011).

Table 1 | Description of the functions attributed to Empathic concern component of empathy when listening to music. Made by the author according with information from Wallmark, Deblieck and Iacoboni, (2018, p.3-16).

In fact, the involvement of areas related with *cognitive empathy* plays an important role in the modulation of the activity of areas involved in *emotional empathy*, even in conditions of contextual impoverishment (Wallmark, Deblieck and Iacoboni, 2018). *Perspective taking* trait is linked with the heightened emotional response to music (Kawakami and Katahira, 2015) but also with an higher tendency to recruit mirror neuron system in response to sounds in comparison to images (Gazzola, Aziz-Zadeh and Keysers, 2006), which might be explained by the explicit nature of images compared with the more implicit nature of the auditory signal prone to be completed by contextual information (Iacoboni, 2012). Moreover, this subcomponent of empathy involves a greater recruitment of sensorimotor areas involved in emotional empathy, which suggest that its influence in the low-level simulation concerns to its modulatory effects on them (Figure 22).

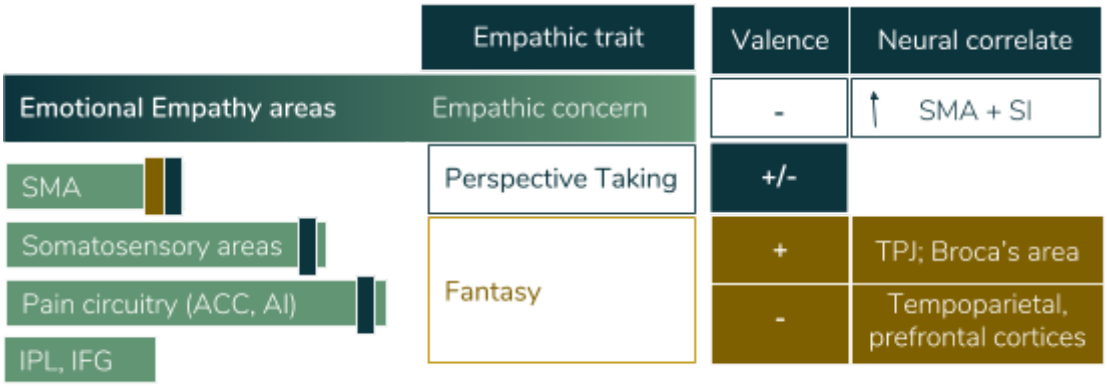

Fig. 22 | The influence of empathy subscales in the processing of musical stimulus. In *fantasy* subscales, positive valenced music predominantly involves areas associated with mentalizing capacities, as TPJ, which indicates a correlation between liked music and the role of cognitive empathy. Cognitive empathy subscales modulate sensorimotor areas responses, such that high *perspective taking* and *fantasy* influence, respectively, the areas marked with a dark blue and yellow bars. Made by the author according with data from Wallmark, Deblieck and Iacoboni, (2018, p. 10-13).

The preference for sad music among children was greatly associated with the cognitive components of empathy, i.e. *fantasy* and *perspective taking*. Children with greater disposition for *fantasy* tend to directly like sad music, regardless of the emotional response to it (Kawakami and Katahira, 2015). On the other hand, children with predominant *perspective taking* dispositions tend to report indirect preference for sad music, since this preference is mediated by the emotional responses to it. In this case, through *perspective taking* dispositions children report ambivalent emotions when listening to music, i.e. both tragic and enjoyable emotions, such that the modulation of tragic emotional responses to the music might guide their transformation into positive emotions. In the end, the enjoyable emotions are the ones who better predict the preference for sad music (Kawakami and Katahira, 2015).

Perspective taking subscale does not involve different circuits according with the valence of the low-level stimulus, on the contrary *fantasy* subscale recruits different regions of the brain depending on the different valences attributed to the music, such that the positive valenced auditory signals recruit the temporoparietal junction (TPJ) and the Broca's area of the inferior frontal gyrus (IFG) (Wallmark, Deblieck and Iacoboni, 2018) (Figure 22). TPJ is an area activated by listening to familiar liked music (Salimpoor et *al.*, 2011, 2013) reported as playing an important function in theory of mind capacities (Saxe and Kanwisher, 2003; Young et al., 2010), while Broca's area corresponds to the well-studied language and voice-specific motor region not only involved in mirroring actions (Watkins and Paus, 2004; Brown et al., 2008) but also in the syntactic prediction of the musical structure (Juslin and Västfjäll, 2008). On the other hand, negatively valenced stimuli tend to recruit areas involved in visual imagery (Juslin and Västfjäll, 2008), which is congruent with the proclivity fantasizers have to imagine themselves in other realities.

This results reveal that individuals who are prone to fantasizing may exhibit greater tendency to understand the music they prefer as a manifestation of a fictional other (Watt and Ash, 1998; Levinson, 2006; Wallmark, Deblieck and Iacoboni, 2018), combining the mirroring capacities with the attribution of mental states to the music itself and being more dependent of *low-level virtual simulation processes* on a first level. This means that bottom-up processes might guide the top-down processes involved in the processing of the musical

stimuli in fantasizers, which justify the fact that they are more sensitive to the valence of the stimuli. Negative valenced stimuli might evoke imaginary scenarios, imagining how is it to be in a certain emotional state as a mean to deal with the quality of the stimuli. F*antasy* has being associated with preference for imaginative art, which includes fictional literature (Mar et *al.*, 2006) but might also comprise with music, since it also plays a significant effect in imagination.

The preference of sad music listening in a mood-congruent state (listeners in a negative mood listening to music evoking sadness) is predicted by an higher level of general empathy disposition, while mood-incongruent category was rather predicted by *cognitive empathy* subscales, namely *fantasy* and *perspective taking* (Taruffi and Koelsch, 2014) (Figure 23), an evidence that reinforce the role of *cognitive empathy* in the pleasurable effects of listening to sad music. In this sense, high-empathy listeners are more prone to experience greater affective responses to sad music by the increased activation of contagious circuits, but also more capable of generate higher rewarding responses from the changing of the emotion locus to the music, i.e. directing the emotional response as being caused by the musical stimuli - an action that governs the attribution of social properties to the musical stimulus. The attribution of emotional properties to the music is reflected in the modulation of the sensorimotor responses that favours the transformation of the initial negative experience into a positive one. *Perspective taking* is a component that dominates the modulation of the sensorimotor responses to the stimulus (Wallmark, Deblieck and Iacoboni, 2018), enabling the transformation of the affective states generated by the music. This potential might be understood as an act of regulation of the emotional process that occurs to minimize the negative experience of a contagious mechanism. On the other hand, fantasy might be directly related with the capacity to imagine the emotional condition portrayed by the music as being experienced by oneself, which might lead to rewarding responses as well (Taruffi and Koelsch, 2014).

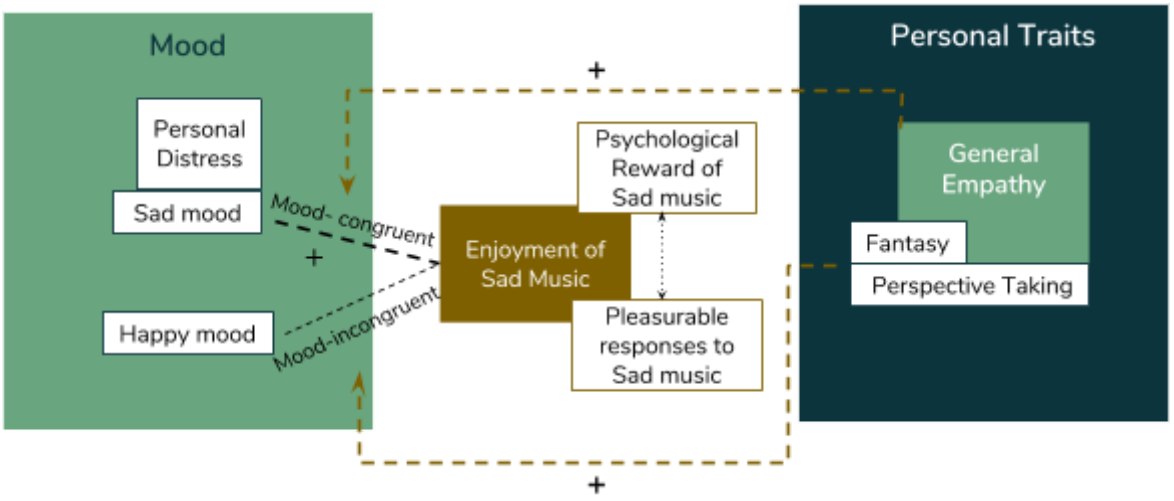

Fig. 23 | Individual who enjoy listen to sad music when they are sad show high levels of general empathy (mood-congruency). Listeners who enjoy listen to sad music when they are happy show high levels of *fantasy* and *perspective taking* subscales of empathy (mood-incongruent). Made by the author.

2. The special case of musicians

In an interview with Roger Water, the vocalist and guitarist from Pink Floyd, the interviewer asked him how music allowed him to overcome the bad events of his life and, in special, the early loss of his father, to which he responded:

> "I was fighting my way through fear in order to understand what makes me feel good, and what makes me to feel good is (...) that I developed my deep desire to develop my capacity to empathize with other human beings"

The ability to empathize with others through music might "feel good" as Roger Waters affirmed, which indicates that the act of empathize through music might represent a rewarding activity - even though it also leads to negative feelings experiences.

Musicians, i.e. musical experts, represent a group of people reported as showing greater capacity to empathize through the musical stimulus, first due to the increased emotional response to the musical signal as a result of an increased sensitivity developed through continued exposure (Salimpoor et al., 2009; Van den Bosch et al., 2013) and second, due to the increased pleasurable response showed comparatively to non-musicians. The first reaction corresponds to an enhanced *emotional induction* by music, while the second one correspond to an enhanced rewarding response to the music. The sadness perceived and induced by music tends to activate the superior temporal gyrus (STG), cingulate cortex, hippocampus and amygdala (Mitterschiffthaler et al., 2007; Brattico et al., 2011). On the other hand, liking or disliking activate activates networks responsible for controlling emotional and motivational experiences, namely the limbic and paralimbic system - which involves the activation of the amygdala, the parahippocampal gyrus, the media prefrontal cortex and the anterior cingulate gyrus - along with the reward circuit - the caudate, the medial prefrontal cortex and the mediodorsal thalamus - associated with the activation of the the striatal-thalamo-cortical loop - a circuit that connects reward signals with higher cognitive functions particularly associated with the appreciation and conscious liking of a music (Brattico et *al*., 2016).

The *contagious mechanisms*, led by mirror-neuron system and involved in the perception of sadness in music and consequent embodiment of the emotion, are activated in neural structures physically separated from the ones activated by motivational and evaluative processes involved in conscious liking of the music, which depend on the appraisal of the affective state of the body induced by the music upon which the conscious act of judgment is based on. Thus, basic emotions are associated with an earlier process followed by an aesthetic judgment that originates conscious emotions of liking and disliking (Brattico et *al*., 2016).

Affective listening to music by musicians showed an enhanced activity, relatively to non-musicians, of the limbic system in ventral striatum, insula, hippocampal gyrus and in the orbitofrontal cortex associated to conscious liking of music (Brattico et al., 2016). The greater involvement of insula (Kleber et al., 2007, 2013) was first attributed to the fine-motoric demands of the musical practice (Zamorano et al., 2015), since it is particularly involved in body awareness. However, when musicians were relaxing with the eyes closed it was also verified an increased connectivity in brain areas belonging to the salience network -

the insula, the anterior cingulate and temporoparietal junction, all involved in high cognitive functions (Luo et al., 2014). The affective neuroplasticity stemmed from the musical training was previously suggested due to the increased activity of anterior cingulate cortex and right ventral striatum activity during music listening by musicians relatively non-musicians (Chapin et al., 2010). Moreover, a particular effect was found for sad music, where it was reported the higher activity in the right dorsolateral prefrontal cortex and in the right parietal areas of musicians (Park et al., 2014), which are areas particularly involved in the executive control required by *cognitive empathy* (Christov-Moore and Iacoboni, 2016) associated with the top-down regulation of affective states (Wallmark, Deblieck and Iacoboni, 2018).

These results suggest that musicians show an enhanced affective neuroplasticity associated with the activity of limbic system. The enhanced functionality of the limbic system might be considered an adaptive positive counterpart of the repeated activation of the limbic areas involved in the processing of negative emotions. Interestingly, the findings of such a modulatory effect of musical expertise on limbic system, resembles those obtained in compassion meditation experts, which aims to foster empathy towards other people's suffering (Lutz et *al*., 2009). Anterior insula has been particularly related with the generation of predictions about the affective states of others, inclusively considered to be involved in social emotions, whereas temporoparietal junction is activated for mental inference functions (Lamm and Singer, 2010). Empathizing with other's pain requires representations of the global emotional states given by insular cortex along with the interaction with *mentalizing* mechanisms. In general, it is proposed that the anterior insula and anterior cingulate cortex are responsible for empathic responses with others mainly for the involvement in the emotional awareness of negative affective experiences (Lamm and Singer, 2010) - *emotional empathy* - that lead to homeostatic adaptations through the employment of mechanisms of *cognitive empathy*, which result in the understanding of others' affective states. The areas of the brain who showed an enhanced activity related with the conscious liking of the music in musicians involved the fronto-insular and cingulate areas (insula, striatum, cingulate and thalamus), are particularly involved in the creation of body maps (Habibi and Damasio). On the other hand, sadness-evoking music present more prominent activation of brain areas involved in the regulation of emotions, which contributes to propose a connection between the rewarding side of music and homeostatic regulation of emotions.

From one hand, *cognitive empathy* seems to play the biggest role for the enjoyment of sad music, on the other, that enjoyment is what predicts the pleasant emotions reported by listeners regarding sad music (Kawakami and Katahira, 2015). In this sense, *cognitive empathy* might influence the pleasure derived from music, participating in the modulatory effects of the emotions felt through the music. Indeed, highly empathic people tend to process music with a greater involvement of the brain's reward system and areas of the brain associated with social information processing (Wallmark, Deblieck and Iacoboni, 2018), such that, the neurophysiological differences in music liking are dependent on that areas. The sensibility musicians have for sadness in music and their heightened responsiveness in limbic systems, might contribute for an improved capacity to understand the feelings transmitted by the music through their own simulation and derive pleasure from the employment of *cognitive empathic* responses. The other-centered empathy is considered to be developed later in childhood, which means that in order to enjoy the sadness induced by sad music it is

necessary to overcome the self-centered negative emotions it might provoke (Kawakami and Katahira, 2015) by the employment of *cognitive empathy* mechanisms. These mechanisms shall move the locus of the emotional response from the internal to the external locus (Schubert, 2017), which ends up in the attribution of the emotion to an external cause. The example of musicians prove that the repeated exposure to the emotional stimuli of music contributes for an improved capacity to derive psychological pleasure from it, which in turn imply an improved capacity to employ cognitive mechanisms of empathy, and through them be more capable to employ homeostatic regulatory functions.

3. Empathy as a rewarding aspect of sadness in music

From the previous chapters it is proposed that the rewarding side of sadness in music derive from the individual disposition to employ cognitive empathy mechanisms that allow to regulate sadness feelings. However, the reasons why would someone in the first place seek such negative experience are still puzzling. In order to provide a more comprehensive answer to the appreciation of sad music, it is important to understand the real life situations that take people to seek sad music and relish it for its own sake. The most common moments when people listen to sad music involves emotional distress situations as failures, stress, frustrations, breaking-ups or death, assuming the function of negative-mood regulation, comfort and consolation or reflection in the current emotional state. The second most reason reason for people to engage in sad music listening has a social nature, being motivated by loneliness feelings, the need to be understood or longing feelings when missing someone or homesicking, such that music plays a function of consolation through mood-sharing or virtual social contact (Garrido and Schubert, 2011; Van den Tol and Edwards, 2011; Taruffi and Koelsch, 2014). On the contrary of happy music, sad music is particularly directed to inner functions - the control of inner feelings and thoughts - mainly linked with solitary settings (Van den Tol and Edwards, 2013) and personal distressing situations, being especially appreciated in mood-congruent situations. These facts highlight the potential that sad music holds for the regulation of emotional states through consolation and comfort (Taruffi and Koelsch, 2014), which justify that the explanation for its appreciation be done at the cost of the last phase of the emotional processing proposed - the regulation of the emotional response.

The lack of the action tendencies responses associated with the role of sadness in everyday life when listening to music, prompted Huron to propose that the physiological responses associated with sadness without a real-world loss are responsible for pleasurable feelings of *being moved* - stronger aesthetic musical responses accompanied by higher emotions induction levels for sad music - and comfort, due to the oxytocin releasing action (Huron, 2011). However, the evidences for such claim are still not available (Eerola et *al*, 2018). Moreover, such effect is not directly linked with sad music listening, once listeners show variations in the responses to sad music according with their current states. For instance, happy mood people worsen their mood when listening to sad songs, whereas sad-mood participants manifested that happy songs would feel inappropriate, counteracting the mood enhancement effects of happy music by emotional contagion. The appreciation of different kinds of music is very connected with the type of emotions triggered by the music but also with current mood of the listener: from one hand, listeners prefer to listen to sad

music for the expression of their current feelings, on the other, the appreciation of a sad-sounding music may be a result of an aversion to happy-sounding music (Friedman, Gordis and Forster, 2012).

The interpretation of sad music as a *virtual person*, to which people attribute psychological characteristics of a real person might be a consequence from the act of empathizing with music, such that a listener responds similarly to the emotional expression of the music as it would to a conspecific (Watt and Ash, 1998; Livingstone and Thompson, 2009). In this sense, when listening to music, the subjectivity attributed to the music reflect the music itself as a personified element, which only occur through the act of listening to it and perceive it as a communicative signal of a certain emotion. Without the musical signal the effects of its emotional response vanish, such that, in order to attribute a character to the music to the composer or the performer it is necessary that music affects the listener in the first place - the performer or the composer or the instruments become just devices of expression. The possible connection between the listener and the composer might occur through the sharing of a music that is very likely to move them in similar ways, not because the music is literally expressing what the composer is feeling or already felt, rather because either the listener, the performer or the composer might be able to extract the same emotional experience from the music. In a recent documentary named the "Art of Listening", Jack Douglas, a producer and an engineer of sound, responsible for the recording of music, its masterization and mixture, affirms:

> " Every sound that I use is one that I try to turn into an individual character to suit the personality, the lyric, the tempo, the temperament and the character of the song."

Further, the following words are mentioned by Scott Hansen, known as Tycho:

> "We do have the ability to create this thing that moves other people so much in communicating ideas that were totally unable to articulate through verbal or any kind of communication. Is really this important way of transfer emotional ideas to other people".

Emotional ideas might be term that best suits the communication provided by music, according with what was previously described. Thus, in the first place, the listener empathize with the *emotional idea* expressed in music as a representation of an anonymous subjectivity. The difference between a musical subjectivity and a person is that the sadness evoked from a person is scarcely associated with a pleasurable response, due to nature of sadness in real-world conditions, whereas in the case of music, the same emotional response is devoid from the real world contexts. Furthermore, the recurrent psychological situation of the listener of sad music allow to attribute more value to the emotional expressivity of that anonymous subjectivity, such that through the action of cognitive empathy mechanisms and homeostatic regulatory process of emotions might conduce to an overall appreciated experience.

At the biological level, the simulation of loss feelings by music (Eerola et *al*., 2018), associated with *as-if-sadness* feelings, rely on *cognitive empathy* mechanisms to mitigate such

mental state through the attribution of the feelings to the music. The main cognitive empathy subscale responsible for such apprehension might be the *perspective taking*, previously referred to be involved in the modulatory functions of the emotional contagious mechanisms, which might be done at the cost of the contextual appraisal. This type of reward is denominated as the *no real-life implication reward* and it is actually reported as the more salient reward of sad music listening (Taruffi and Koelsch, 2014). In this rewarding condition, it is highlighted the satisfactory nature of the emotional experience itself within an aesthetic context, which match the proposal of Levinson for the rewarding experience of sadness devoid of the contextual consequences, such that listeners can derive pleasure from the savouring and higher understanding of the emotion.

At the psycho-social level, this process of simulation rather occurs through the interpretation of the musical signal as a social stimulus, through the simulation of the emotional expression of the music as if it was another person (Eerola et al., 2018). In this case, the cognitive mechanisms likely associated with the fantasy allow the understanding of the music as an anonymous subjectivity, through which is possible a person to feel identified with, as if it the sadness manifested by the music was the one's own sadness. Such mechanism generates a rewarding effect stemmed in the sharing of the sadness portrayed by the music, the *empathy reward*. This rewarding effect is particularly important for the pleasurable effects provided by sad music - the consoling and comforting effect (Taruffi and Koelsch, 2014), a rewarding aspect of sad music that shall moderate feelings of *being moved* for sad music. Such empathic engagement with music, a culturally valuable mean of expression, might be particularly rewarding due to the virtual social contact done through a sharing-mood (Taruffi and Koelsch, 2014) that turns to be pleasurable due to the signalization of sadness' value or its acceptability. In this case, employing the perspective of the music through cognitive empathy mechanisms contributes to achieve such console, at the same time that music represents a surrogate empathic friend (Lee, Andrade and Palmer, 2013; Van den Tol and Edwards, 2013; Eerola et al., 2018). Such experience is described in the following quotation:

> "I felt befriended by the music – by this I mean that if you were to pretend the music/lyrics was a real person, with its lyrics of understanding, friendship, comfort and confidence, then surely the song would be your best friend, your soul-mate . . . Music personified is your soul-mate, your trusted secret friend who can empathize with you" (Van den Tol and Edwards, 2013)

In psychological distress moments, it might be rewarding or, at least, helpful to acknowledge the universal nature of negative emotions as part of human life. This recognition occurs through the employment of the *cognitive empathy* components, namely fantasy and perspective-taking and helps the restitution of the homeostatic balance to the emotional unstable state. In this sense, the relationship between the eight principles suggested by Levinson, (1982) for the function of negative emotions and the rewards proposed here are described in the Table 2.

In this table it is represented the relationship between *empathy* and *no real-life implications rewards* and the proposed mechanisms by Levinson for the enjoyment of sadness

in music. The mentioned *understanding feelings*, *emotional assurance* and *savoring feelings* were easily matched with *no-real-life implications rewards*. However, the *emotional resolution* mechanisms - the composition of the music changing from the dark moments to a triumphant denouement which makes the listener derive the same sense of mastery over emotions in real-life situations - do not particularly fit in the main rewards here exhibited. Similarly, the *expressive potency* mechanisms, which are related with the imagination of expressing the same sadness feelings with such a free and spontaneous caliber as the music, do not manifest the main rewards of sadness in music as well. The *apprehending emotions* mechanism describes the reward of grasping the emotional content of the musical work through an emotional response, which involves empathic processes, is associated with the reward of the empathic response itself. Lastly, the *emotional communion* mechanism as described by Levinson, reflects a reward based on the intimacy established with another person through the music. It might be imaginable that the composer or composers use the music to express moments of their biography, however the contact that happens through the music is due to the expression of the own music's emotion at the first place rather than the composers' one. Then, this connection is interpreted as a mean to establish a sense of intimacy with the anonymous subjectivity of the music (which is not hindered to be attributed to the composer) that activates the perception of one not being clearly alone in that specific emotional universe, which might be particularly helpful to regulate the social withdrawal and the sense of disconnection that situations of personal distress might create. However, as a mean to answer the second research question of the work, how does *catharsis* relate with all the rewards here presented?

	Real - Life Implications Reward	Empathy Reward
Understanding Feelings	X	
Emotional Assurance	X	
Savoring Feelings	X	
Apprehending emotions		X
Emotional Communion		X
Catharsis	?	?

Table 2. | Relation between the rewarding aspects of sadness in music proposed by Taruffi and Koelsch (2014) and the mechanisms proposed by Levinson (1982).

4. Catharsis as an emotional regulation process based on empathy

According to Aristotle, a negative emotional response allows one to “bleed off in a controlled manner” (Levinson, 1982) purging a certain amount of negative emotions that

function as a momentarily painful dose of "emotional medicine", that leads to future mental health of the listener (Aristotle, 2010; Levinson, 1982). Considering the previous section discussion, where it was assumed that the main reasons to listen to sad music are related with personal distress situation, taking place mainly in solitary setting where the music assumes functions of console and comfort, indicates that the cathartic explanations apply to the situational factors that contribute to the appreciation of sad music. In this sense, sad music appreciation might result from a emotional regulation process guided by *cognitive empathy* mechanisms. In this sense, the regulatory mechanisms might occur at several different phases: 1) the contextual appraisal through which is assessed the safety of the emotional experience free of nocive consequences; 2) the attribution of the emotions' cause to the music; 3) the empathizing with the emotions perceived through i) perspective-taking: assuming the perspective of music as if it was another person and an optional attribution of the emotions to an external entity as the composer and ii) fantasy: the identification with the emotions perceived in the music and 4) purgation of the negative emotions through the realization that one is not alone in the emotional universe. This regulatory behavior associated with emotional experience is depicted in the figure 24.

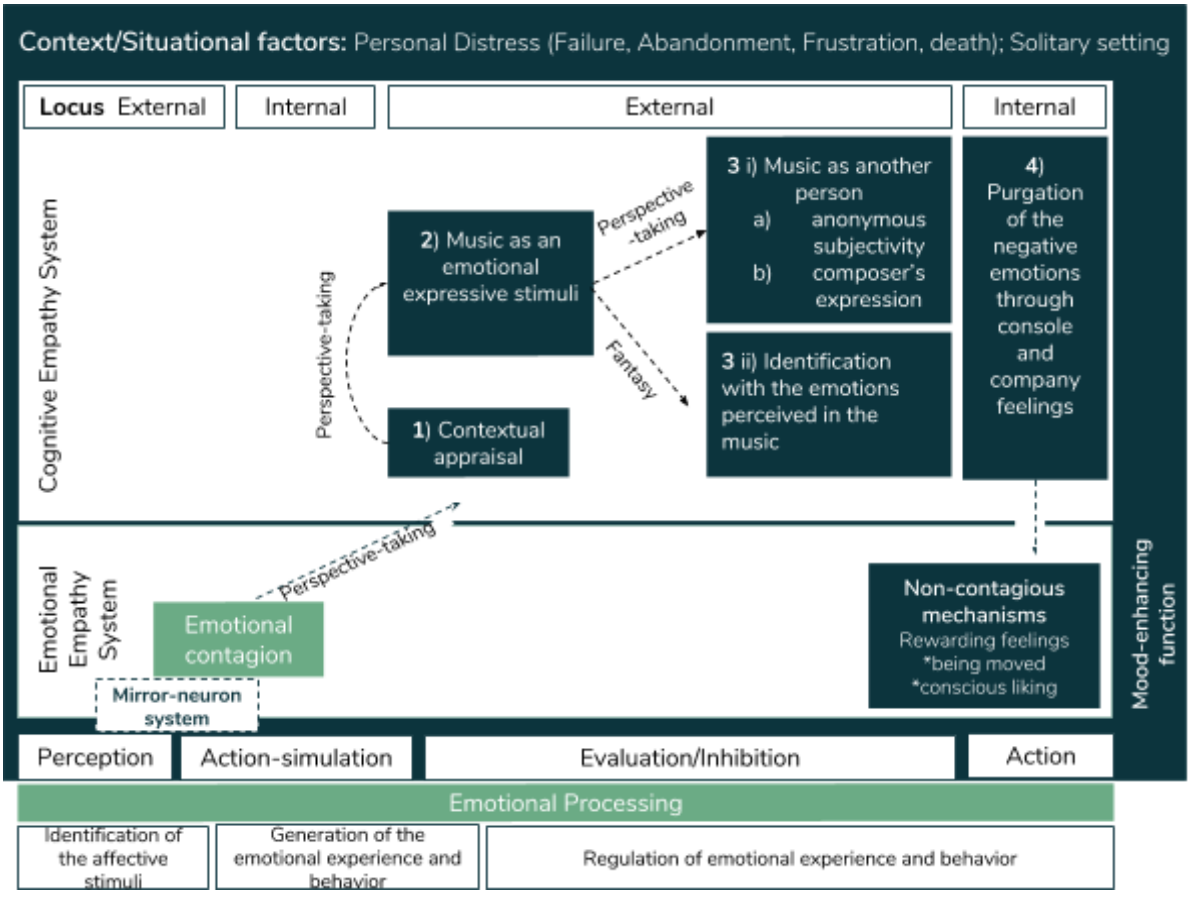

Fig. 24 | Diagram illustrating the relation between the regulatory processing of emotions and the cognitive empathy mechanisms that give rise to the appreciation of sad music when listeners are in the grip of negative emotions. Made by the author.

The cathartic process depends on specific rewards when people listen to music in the course distressful emotional states. From the first phase, where it is considered the musical

context where emotions take place, it might be implied a *no-real life implication rewards*, mostly associated with the *savoring feeling* mechanism through which is possible to appreciate the qualitative feeling of the negative emotions. However, contrarily to what Levinson argued, such reward only signals the safety of the aesthetic context where the emotion is being felt, not being itself the justification for people to appreciate the sadness of the music. The second phase of recognition of the emotional expressivity of the music might rather be associated with *apprehending expression*, the reward that comes as an outcome of the empathizing process that take the listener to grasp the expression of the musical work. Nevertheless, this reward proposed by Levinson might be extended to the point of the emotions grasped are being expressed specifically through music, i.e. a cultural valuable and acceptable device that functions as a mean to elevate the character of the emotion. The third step of the cathartic process involve *emotional communion* rewards, since through cognitive empathy mechanisms is possible for the listeners to comprehend how sadness might be a shared feeling, whether with the musical piece or with a composer, identifying themselves with the emotion expressed by the external subjectivity. The last two rewards belong to *empathy rewards*. The last reward associated with the cathartic process is, evidently, *catharsis* itself, such that, the listeners vent their negative emotions or moods as a result of listening to sad music when they need psychological comfort and support. In this sense, catharsis rewards involve either *no real-life implications rewards* and *empathy rewards*. The *catharsis* allows the listener to derive pleasurable aesthetic feelings from the music, associated with *being moved* feelings and enjoyment, which precede the conscious act of judgment that leads to the appreciation of the sad music, i.e. the conscious liking (Figure 25). This appreciation, in turn, has origin in the mood-enhancing functions that sad music assumes in these particular situations, such that, it might be associated with the memory that predicts the next recurrence to sad music in similar contexts. Through this explanation it is possible to understand how empathy explains a cathartic process in sad music listening, answering to the *second research question*.

Thus, music represents a medium that plays a fundamental role in self-construction, reinforcing the organization of identity in the immediate or short-term circumstances of mood-management, but also in long-term processes of identity construction and maintenance through the modulation of listeners' affective states (DeNora, 2013). Considering that an emotion represents an experience of meaning attribution to external stimuli and of promotion of behaviors that help the organism to be in tune with a complex environment (Clarke, DeNora and Vuoskoski, 2015), music constitutes a tool for the embodiment of meaningful conditions and sensations that favours valuable behaviors for the individual development. In this sense, playing an important role in emotional regulation, music might be interpreted as a "social processes of self-construction", even in solitary settings, since it contributes for the formation of a social agent. In sum, music offers a form of extending the processes of self-regulation promoting a type of homeostatic regulation that depends on the interaction of the subject with the environment (DeNora, 2000).

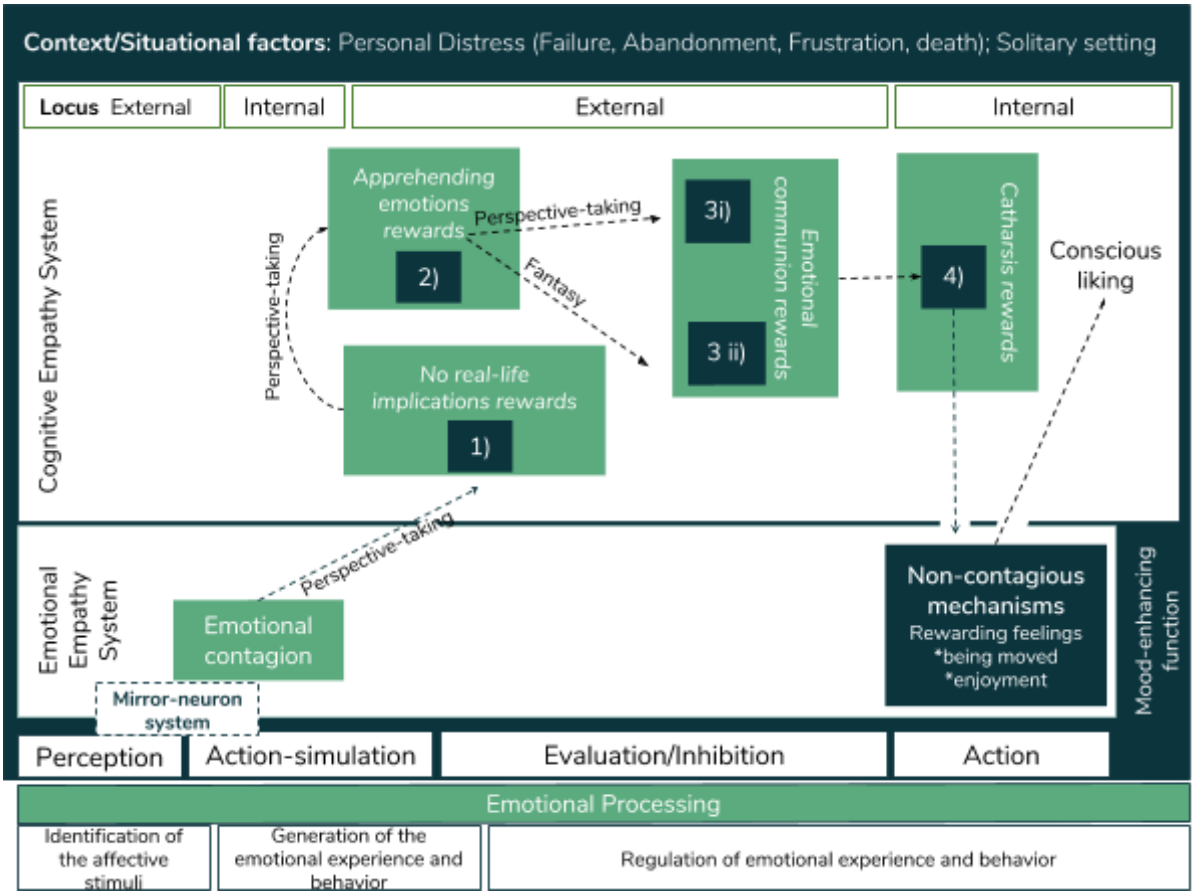

Fig. 25 | Diagram for the explanation of the appreciation of sad music through a cathartic process driven by empathic mechanisms. Made by the author.

Briefing

The cathartic process analysed in this chapter permits to give *conversionary explanations* for the Tragedy Paradox in music. The *feelings* of sadness provoked by sad music by means of *emotional contagion* mechanisms permit to grasp its emotional expressivity, being, simultaneously, the origin of the appreciation of sad music. This explanation only fits the situations when it is reported to be more common having listeners recurring to sad music: personal distress moments when they look for comfort and console as part of a solitary practice.

The reward feelings are consequences of the employment of *cognitive empathy* mechanisms that modulate the contagious experience, such that the pleasure that derives from the sadness is more intense as higher the capacity to modulate the negative emotional responses to the music - affective neuroplasticity. In musicians, this capacity is remarkably more prominent due to their repetitive exposure to affective stimuli from music, negative ones inclusively. Such modulatory action is mostly attributed to the function of *striatal-thalamo cortical loop*, which is particularly involved in homeostatic regulation of emotions.

Two types of rewarding are considered to be involved in the appreciation of sadness-evoked by music: *no real-life implications* and *empathy rewards*. The first one concerned with the aesthetic context where sadness is evoked, the second ones rather concerned with the perception of the emotional expression of the music and the sharing of emotions with the anonymous subjectivity that it represents. Thus, listening to music in the course of personal distress and loneliness, listeners might experience particular rewards associated with these two groups, namely, *savoring feelings, apprehending emotions* and *emotional communion* that provide means of purging their initial negative emotional charge. This purgation is carried out by *perspective-taking* and *fantasy cognitive empathy* dimensions and these rewards end up in the final reward of *catharsis*, supporting the cathartic process that leads to the appreciation of sadness in music and favours the intentional pursuit of sad music. In sum, the fact that are the sadness feelings experienced through the music (*as-if-sadness*) that govern its own enjoyment constitutes the main reason to defend a *conversionary explanation* for the Tragedy Paradox in music.

Chapter VI

Conclusions

This work provide a *conversionary explanation* for the puzzling fact that people intentionally listen to sad music and appreciate to do so, which was descripted as the Tragedy Paradox in music. From centuries such Paradox has been considered by philosophers as Aristotle or Schopenhauer to understand the "delightful horror" of spectators. However, for music the approach might assume different angles, dut to its lack of the representational content of theater or literature. The problem was considered by Levinson in 1982, who offer eight possible answers to justify the pleasantness of sad music listening. Moreover, recent studies report the influence of individual empathic dispositions for the appreciation of sad music. These works constitute the background knowledge for edifying a plausible answer based on empathy for this very Paradox. The conversionary explanations consider that the negative emotions provided by the music would be rather transformed into positive emotions when listening to it and, through that transformation, people would derive pleasant responses.

Music became a widespread cultural activity of humankind that provided a tool for social, participatory and communicative achievements which complemented other human cultural practices as language or religion (Cross, 2012). Such achievements were due to the specific human capacities that music fostered, mainly at the emotional level. In this work, such capacities were explored in terms of empathic experiences, a topic that, although the fact of already having been unveiled by several authors (Clarke, DeNora and Vuoskoski, 2015; Eerola, Vuoskoski and Kautiainen, 2016; Egermann and McAdams, 2013; Laurence, 2008; Miu and Baltes, 2012; Molnar-Szakacs and Overy, 2006; Stavrova and Meckel, 2017; Vuoskoski and Eerola, 2012; Wallmark, Deblieck and Iacoboni, 2018), can still be considered an emergent issue.

Considering empathy as a fundamental social capacity that supports intersubjective interactions, by enabling people to understand or take part of another person's feelings, and taking the fact that empathic experiences explain the appreciation of sad music, means that the same capacities employed with human beings might also suit aesthetic objects as music. However, the struggling fact of the musical object does not possess mental states in order to mentally identify with or take perspective, was the first barrier to overcome. In order to achieve such goal it were adapted the mechanisms responsible for empathy between subject to the music. First, it was rejected the proposal from Philosophy of Mind that suggests that human beings employ a theory to understand other people's behavior and attribute them mental states, called *Theory of Mind*; then, it was taken *Simulation Theory* as a plausible source of explanation of empathic processes with music only with the clause that *mental simulations* rather be *virtual mental simulations*. Having established *virtual mental simulations* as a plausible theory for empathizing with music, were distinguished *high-* and *low-level* processes as possible candidates for such act, namely *imagination* and *mirroring processes*. After such considerations, it was pointed that *emotional empathy* processes would better explain low-level processes of empathy while *cognitive empathy* processes rather would better explain high-level processes of empathy. In this sense, it was considered that empathic experiences

might occur at diverse levels of resonance between the listener and the musical context, namely, through *perceptuo-motor resonance*, *synchronization*, *perceptual-cognitive resonance*, *mimetic resonance* and *affective resonance channels*. However, for the purposes of this work, where empathy might concur to explain the intriguing fact of listening to music that potentially sadness the listeners, the last two channels are considered the most relevant, the *mimetic resonance* for the attribution of human qualities to the music and *affective resonance* for the sensibility to the expressive properties of the music. Moreover, it was setted that the greater proclivity to empathize with music is based on the higher susceptibility to activate contagious circuits derived from bottom-up automatic resonances, through which it is possible to establish a more accurate matching between the emotions expressed by the music and the emotions felt by the listener. In this sense, it is considered that emotional empathy might act at the first place, for the listener to capture the the emotion musically expressed. Relying on cognitive empathy mechanisms would rather lead to the reconstructive processes provoked by imaginative *perspective-taking* or *fantasy*, employed under the emotional contagious mechanisms as a mean to understand them.

The negative emotional experience with the music that concretizes the pursuit of *conversionary explanations* has been confirmed at the cost of the verification of the potential genuine emotional response to music. Thus, in order to understand how music truly saddened listeners, it was necessary to answer to the research question of *how it is possible to experience real emotions through music governed by an empathic experience*. In order to come up with this first answer, it was first gathered neurobiological evidence and social cognitive information for the understanding of the emotional process in real-world contexts and, lastly, of sadness itself. Later, such explanation serve as a mean of comparison with the emotional processing associated with musical processing.

The understanding of emotional processing was achieved by the employment of two complementary frameworks, the Conceptual Act Theory (CAT) considered by Barrett and the homeostatic vision of emotions from Antonio Damasio's perspective. According with CAT proposal, emotions represent events of meaning creation that guide the subjective experience which are supported by general cognitive capacities as memory and perception. The meaningful experiences rely on the categorization acts of bodily reactions, in turn dependent on previous experiences and contextual appraisals, being associated with specific regulatory actions or action tendencies. In this sense, such perspective permit to conclude that an emotional process do not correspond to a rigid event with particular characteristics, but is rather dependent on *perceptual acts*. On the other hand, Damasio defends that emotional processes serve homeostatic functions in the world, providing information for the organism that promotes behavior that is benefic for its life management. Moreover, Damasio proposes that emotions might occur through the activation of brain circuits that spare the bodily reactions for the activation of the emotions, rather understanding the feelings of the emotions responsible for representing the knowledge of what *means* to be in a certain emotional state, referring to such circuits by *as-if-body loops*. In this sense, it was considered several sub-components of emotions, the subjective feelings, the physiological arousal, the expression, the action tendencies/behavior and the regulation; as well as three important phases of the emotional process, the identification of the affective stimuli, the generation of the emotional experience and behavior and the regulation of the emotion and behavior. Finally, it was concluded that sadness corresponds to an emotion that either signals homeostatic imbalances for own subject as do it for the others, as a mean to call forth the

attention to activate mechanisms of regulation, whether auto regulatory mechanisms or prosocial behavior. This meaning that emotions possess a social function of facilitating to the others the access to the mental states of their conspecifics extending the regulatory mechanisms to the social realm. The emotions experienced in response to the expression of human's emotions might be considered under the umbrella of *empathic emotions*, might vary according with the mechanisms underlying them: low-level mechanisms promote immediate responses of *emotional contagion* whereas high-level mechanisms rather lay on *imagination* likely involving the *as-if-body loops* proposed by Damasio.

In the same way, in order to consider music a competent emotional stimulus, its expressivity might enable people to experience "empathic emotions" as well, with the music constituting a surrogate *other*. The assessment of the neurobiological circuits employed in the processing of music become a valuable clue for the argument that musical processing was much related with emotional processing. However, the fact that listeners employ a certain level of emotional process when they listen to music do not justify an empathic experience with the music, strongly dependent on the matching between the emotions expressed from the music and the ones induced through it. The *perception* of an emotion in the music is very dependent on the characteristics of the musical signal, whether the *induction* of emotions through the music is rather dependent on the listeners dispositions to be affected by the emotional information of the music. In order to confirm such relation it was verified that, by evolutionary reasons music is expected to present emotional information coded easy to grasp, being considering the iconic, symbolic and index coding as the three possible forms of expressing emotions through music. Additionally, the *neuron-mirror system* is considered to play a crucial role in such perception, being particularly involved in the representation of intentional and hierarchically organised motor elements of the auditory information. In this sense, the emotional perception of emotions occurs through *low-level virtual simulation* carried out by bottom-up processes - *mirroring processes*. The emotional perception of the music was compared to the process of identification of the affective stimuli in present in the emotional processing of real-world situations.

On the other hand, *induced emotions* were confirmed by the assessment of literature that highlight the manifestation of the sub-components of emotions when listening to music. In the first place the brain areas activated in musical processing show a significant overlap with the areas of the brain responsible for emotional processing. The processes here considered shall mimic the ones involved in the second phase of the real-world emotional processing: the generation of emotional experience. Moreover, in order to attribute emotional response to music to the activity of empathic processes, the emotions perceived in the music might be able to match the emotions felt through the music. The *emotional contagion* mechanisms, carried out by *mirror-neuron system*, are either engaged in *emotional perception* processes and in *emotional induction* ones as they guide the generation of the emotional experience through the bridge done by mirror-neuron system mechanisms - which establish connections between insula and limbic system - becoming the main candidates to take on *empathic emotions*. Therefore, these mechanisms rely on *emotional empathy* to extract the musical features and decode them into coherent emotions, which predicts the activation of the *mirror-neuron system* for the appreciation of music.

Concentrating the emotional response to music in the induction of sadness, it was revealed that specific areas of the brain are activated as a result of feeling sadness with the music, namely the superior temporal gyrus, the hippocampus and the amygdala, which are

areas mainly responsible for negative stimuli processing. Besides, it was also considered the potential of lyrics to evoke sadness, involving semantic representation for the extraction of its meaning, which are rather governed by *high-level* processes of *virtual simulation*. Such results lead to the conclusion that emotional induction through virtual simulations might be carried out by mechanisms of *visual imagery/ imagination* associated with top-down processes of *cognitive empathy* that transport the listener for the context of the message conveyed by the music. The fact that emotional process is either initiated by competent external or internal triggers, means that the imaginations carried out by cognitive empathy might be able to activate the neural circuits involved in emotional events from inner *high-level* triggers - imagining how is it to be in the situations portrayed by the lyrics or activating the knowledge about how it feels to be the situation portrayed. This high-level processes of simulation resemble the *as-if-body-loops* proposed by Damasio. In both cases responsible for the generation of emotions a common trait remains: the lack of real world reasons for the evocation of sad. As a consequence, both emotional and cognitive empathy paths of emotional generation might be able to activate circuits of *as-if-sadness feelings* that resemble the ones experienced in real-life situations, which agrees with the *emotivist* theories of music.

Answering to the first research question allowed to conclude that music is a competent emotional stimulus able to induce emotions through bottom-up and top-down processes (Brattico, 2015) correspondents to mechanisms of *emotional* and *cognitive empathy*, respectively. Moreover, the fact that, more than a stimulus able to provoke emotions, music represents a signal able to express emotions from itself constitutes the reason to attribute to it social properties. A manifold of objects can trigger emotions - a ball thrown in our direction or a needle in a finger - however, only sentient being are able to express emotions. This is the reasons why music might be interpreted as a social signal, with a proclivity to be heard in a humanized way. As a consequence, these conclusions support the pursuit of conversionary explanation for the Tragedy Paradox in music.

The negative valence of sadness constitutes a reason *per se* to avoid listening to music that evokes sad feelings, nevertheless, listeners with higher empathic dispositions display, not only greater tendencies to saddened with sad music, but also to appreciate it. *Conversionary explanation* is based on the premise that sadness is transformed into a positive emotion. The second part of the work provide an explanation for such transformation based on empathic processes, firstly through the illation that for listeners to appreciate the sadness evoked by music they might be able to overcome the contagious effects by employing mechanisms fundamentally grounded in cognitive empathy; and secondly, that the recurrent situations that take listeners to recur to sad music listening involve personal distress moments of failure, loneliness, breaking-up, frustration or death and are particularly associated with solitary setting. These illations represent the main premises for answering the second research question of how empathy can explain a cathartic process in music, which is supported by the regulatory mechanisms of emotional processing.

The first premise was corroborated by the improved capacity of musicians to derive pleasure from music that might trigger negative emotions related with the enhanced activation of limbic areas associated with *striatal-thalamo cortical loop*, which are devoted to the homeostatic regulation of emotions in functions as contextual appraisal, executive control, mentalizing and enactment imagination. This means that the listener, in order to overcome the unattractive side of sadness feeling, might establish a causal relation of such feelings to the music itself through the awareness of how emotional response is rooted in the

relation with the music. This might be one fundamental element of the empathic experience itself, associated with the capacity to distinguish the self-from the others and at the bottom of what might allow someone to put in other person's shoes, indicating the fundamental implication of *cognitive empathy*. The involvement of such regulatory functions of emotions and the ability to keep the difference of the self from the other, nevertheless, are not sufficient for explaining why would people appreciate such experience anyway.

In order to get such conclusion, it was considered the situational factors that lead people to listen to sad music. The second premise to answer this research question permit to conclude that the listeners who tend to enjoy the sadness evoked by the music are already in psychological unstable states provoked by tragic situations or in loneliness states. This piece of the puzzle guides an answer based on *catharsis* that considers several rewarding processes that occur along the way of the cathartic process that derive from *cognitive empathy* mechanisms. The first musical contextual appraisal discussed before predict a *no-real life implication reward* comparable with the *savoring feeling* reward proposed by Levinson, derived from the *as-if-sadness feelings* free of the imbalances from which they are expected to be a result of. Secondly, the reward that derive from the attribution of the sadness' cause to the music itself, matching the *apprehending emotions* reward proposed by Levinson, in this case, not only valuable for the grasping of the expressivity of the music but also from the elevation of the sadness itself by being expressed through music. Moreover, recognizing a signal as expressive of emotions puts someone on the track to attribute human properties to the signal. In such way it is becomes possible to empathize with the emotions recognized, either as if music was an anonymous subjectivity or was expressing someone's feelings, either by identifying oneself with the emotions perceived in the music, which is a result of employing *perspective-taking* or *fantasy* mechanisms, respectively. Such empathizing match another reward proposed by Levinson: the *emotional communion* reward. Such steps might lead to the cathartic experience of purge, that brings psychological comfort for the fact that someone is sad or alone through the confirmation that sadness is a valuable emotion to be felt and that the anonymous subjectivity represented by the music might understand what sadness feels like and what means to be sad, through which the listener do not feel so isolated in its emotional universe. This acknowledging constitutes the sum of the previous rewards in the form of *catharsis reward*, constituting the main reason for listeners *being moved* by the music and consciously appreciate it, which constitutes a reason to predict their return intentionally to sad music in similar situation.

Through this explanation, the sadness provoked by the music becomes the main reason for its own appreciation, and the *conversionary explanations* are justified through the fact that the empathic experience governs the interaction with the sad music to the point that the greater the empathic experience, the most intense is the negative emotional response to the music and greater the possibility to employ the music perspective that predicts the rewarding cathartic experience. The dissociation of the areas of the brain involved in the perception of sadness and in the appreciation of the music do not allow to conclude that the sadness is transformed into a positive emotion, because it does not need to disappear in order to the experience become positive. This explanation rather suggests that it actually needs to be felt in order to be appreciated and it is that appreciation what better predicts the value that it is attributed to the all process, only worthy when the listener is in the specific psychological conditions already described. In this sense, the explanation for this

Paradox is considered conversionary due to the psychological transference of the importance attributed to a negative emotion to a positive one.

The main differences between these explanation and the ones proposed by Levinson concern the main role attributed to cognitive empathy mechanisms and to the homeostatic regulatory function of emotions for the appreciation of sadness-evoked by music relatively to the main reasons for people to recur to sad music. Such conclusions predict a relation between cognitive empathy and homeostatic regulation of emotions might, which might be a topic passible of being explored in the future. Moreover, considering the importance of music for empathic experiences also constitutes a topic with potential to be further explored, inclusively in a therapeutic level as music therapy. Understanding the roots of empathy is a benefic endeavour for all of us as a community and society - as the poet Percy Bysshe Shelley wrote: "A man, to be greatly good, must imagine intensely and comprehensively. The pleasures and pains of his species must become his own" (Shelley, 1965, p.111).

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