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Motivation and music interventions in adults: A systematic review

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ABSTRACT

Music is increasingly used in a wide array of settings, from clinical recovery to sports or well-being interventions. Motivation related to music is often considered as a possible working mechanism for music to facilitate these processes, however this has not previously been systematically evaluated. The current systematic review considered studies that involved music (therapy) interventions, together with motivation-related measures such as wanting to practise, liking the musical activities, or patient adherence to an intervention. Our objective was to examine whether music is related to increased motivation in task performance and/or rehabilitation settings, and whether this is in turn related to better clinical or training outcomes. Seventy-nine studies met the inclusion criteria, the majority of which (85%) indicated an increased level of motivation with music as compared to without. Moreover, in those studies where motivation was increased, clinical or other outcomes were improved in most cases (90%). These results support the notion of motivation as an underlying mechanism of music-based interventions, but more robust evidence is needed to ascertain which mechanisms are crucial in increasing motivation from a behavioural, cognitive, and neurobiological point of view, as well as how motivational mechanisms relate to other factors of effectiveness in music-based paradigms.

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Music is widely reported as one of the most emotionally rewarding experiences (Loui & Przysinda, 2017). Due to its potential to elicit dopamine release in the striatal system, music is an especially potent pleasurable stimulus that is often used to influence emotional states (Salimpoor et al., 2011). In everyday life, humans regularly seek participation in highly complex and pleasure-rewarding experiences such as music listening, singing, or playing (Ferreri et al., 2019). The rewarding aspect of music is hypothesized to contribute to the improvement of performance in sports, in learning tasks, and in health settings where music is used to work towards clinical goals (e.g., Gold & Zatorre, 2020; Schaefer, 2014). In clinical interventions, music is used as a key component to enhance motivation, which, due to its rewarding characteristics, can lead to increased attention, improved mood, longevity, and increased skill acquisition (Kim et al., 2011). The primary goal of this systematic review is to explore the *motivational* aspect of music by studying the relationship between music and motivation in settings of rehabilitation, task performance, or skill acquisition (Kanfer & Ackerman, 1989).

Motivation

The term *motivation* derives from the Latin *movere* (i.e., to move), and refers to those factors that cause an organism to behave or act in either a goal-seeking or satisfying manner. These factors may be influenced by internal physiological drives or by external stimuli (US National Library of Medicine, Medical Subject Headings, 2018). Aristotle used the term "kinetron" (derived from kinesis, or movement) to describe motivation as the result of a "drive", which always operates relative to some outcome or end (Hudson, 1981). Freud, on the other hand, proposed the "pleasure principle" as the primary mechanism of motivation. Pleasurable experiences, whether they are related to libido or not, are somehow rewarding and are regarded as prerequisites of maintaining "homeostasis" (Moccia et al., 2018).

Motivation plays an important role in any (human) activity or task; it has generally been categorized into two types: intrinsic and extrinsic. For intrinsic motivation, the inherent pleasure or satisfaction drives behaviour, whereas for extrinsic motivation the goal is an external reward, which happens outside the activity itself, such as money or status (Cerasoli et al., 2014). Self Determination Theory (SDT) is often used as a theoretical model of motivation (Deci & Ryan, 2002). SDT differentiates between the types of motivation by distinguishing a level of self-determination in tandem with the "degree to which people's actions are influenced by internal and external forces" (Lewis & Sutton, 2011, p. 86). Based on this idea, Deci and Ryan (2002) have used the SDT to guide and interpret research on various topics, such as motivation and wellness across cultures, enhancement and depletion of energy and vitality, and the roles of both mindful awareness and nonconscious processes in behavioural regulation.

Moving from theory to evidence from neuroscience, dopamine neurons in the midbrain are involved in the anticipation of reward. In this way, motivation is neurally implemented by the reward system of the brain (e.g., Bromberg-Martin et al., 2010; Mas-Herrero et al., 2023). Two different mechanisms, often translated in words as "liking" and "wanting", are neurally separable in animal models: incentive salience ("wanting") is generated by large neural systems that include mesolimbic dopamine, whereas the pleasurable impact of reward consumption ("liking") is mediated by smaller neural systems and is not dependent on dopamine (Berridge & Robinson, 2016).

Motivation is thought to have an important role in learning and rehabilitation. Whether the motivational stimulus is a monetary reward or the drive to remain cognitively healthy, it appears that the higher the motivation of the subjects, the higher the probability to perform better in a learning task (Ryan & Campbell, 2021). Regarding learning and performance, Wulf and Lewthwaite (2016) introduced the OPTIMAL (Optimizing Performance through Intrinsic Motivation and Attention for Learning) model of motor learning, which proposes an explanation of how motivational and attentional factors influence motor learning. Similarly, motivation has been shown to induce positive behavioural changes towards rehabilitation, influencing, amongst other things, a patient's goals, experiences of success and failure, physical condition, and cognitive functions (Yoshida et al., 2021). Unmotivated individuals are less likely to participate in a treatment, put less effort in understanding how learning or improving a particular skill will help them become more autonomous, and are less likely to adhere to therapy (Kusec et al., 2018).

In clinical observations, lack of motivation, or amotivation, is seen in a number of psychopathologies, especially in its extreme form, such as *avolition* (lack of drive or "wanting"), which is for instance often observed in people with schizophrenia (Comer & Comer, 2018), or *anhedonia* (lack of pleasure or "liking") in depression. In rehabilitation settings, therapy avoidance and/or lack of effort or desire to improve is observed in, amongst others, patients with multiple sclerosis or stroke sufferers (Jorge et al., 2010).

Motivation and music

When considering motivation in the context of musical activities, there appear to be several aspects of music that may lead to increased motivation for tasks carried out to music, such as sports, learning or rehabilitation. According to Dibben (2017), music is beneficial for creative tasks and activities associated with mood enhancement, which have an approach motivation and promotion focus (e.g., happiness) (Baas et al., 2008). Positive mood may not only increase general wellbeing, but also influence cognitive flexibility and focused attention (Nadler et al., 2010). Furthermore, Ferreri et al. (2019) encountered effects of dopamine signalling in liking in humans for music processing, showing that dopamine causally mediates musical reward experience. Music can elicit intense emotional and bodily sensations of pleasure, called "chills" (Laeng et al., 2021), rewarding experiences that are neurobiologically distinctive from other forms of psychophysiological hedonic responses, for instance through the use of opioids (Mas-Herrero et al., 2023).

The important role of reward and motivation as well as dopamine and learning have been explained in a recent review on the impact of music on stroke rehabilitation (Grau-Sánchez et al., 2020; see also Grau-Sánchez et al., 2022).

In line with this, motivational synchronous music (where someone moves in time with the rhythm of pleasurable music) has been shown to improve sports performance due to the potential of rhythm to facilitate entrainment (Karageorghis et al., 2009). In clinical settings music has been shown to improve motivation for motor rehabilitation (e.g., upper limb training for individuals with stroke related arm/hand paresis) enabling error correction and execution of precise and accurate movements (Thaut, 2015). Interestingly, the musical stimulus that results in a rewarding response is relatively specific to the listener, as there is large variability in musical preferences amongst individuals (Martin et al., 2016). This also means that the potential to motivate people may vary significantly for a specific musical stimulus or activity (Schaefer & Grafton, 2017).

Although there is ample evidence suggesting that music has the potential to harness intrinsic and extrinsic motivation, there has been no systematic inquiry to guide how music might be exploited to enhance motivation to engage in task performance, learning and/or health care settings. With regards to rehabilitation, for instance, motivation to engage is often hampered by the monotonous, repetitive, and sometimes painful nature of physical and cognitive tasks.

The goal of this systematic review was to build empirical evidence on the topic of music and motivation. To do this, we identified studies in which the effects of music interventions on motivation in adult clinical and non-clinical populations was measured. As such, our first research question was "(How) do music and motivation correlate with regards to task performance in non-clinical and clinical settings?". Secondly, we aimed to identify any relationship between motivation and the targeted outcome variables of the music interventions, such as motor function, cognitive skills, or perceived exertion.

Methods

Classification of different types of motivation measures

To allow for a systematic evaluation of the relationship between motivation and music, we distinguished different ways of measuring motivation-related variables that may be interpreted as an indication of motivational states. Accordingly, studies were organized into three different categories: firstly, measures of *prospective motivation*, indexing the drive to do something before doing it, that corresponds to "wanting" a particular reward; secondly, measures of *retrospective motivation*, indicated by ratings of enjoyment, or liking something, therefore being motivated to continue doing it, highly related to positive mood; and lastly, the *indirect* measures of motivation, that can be considered as being related to either prospective or retrospective motivation but do not directly measure this, for instance through monitoring therapy adherence in clinical studies, measures of quality of life, or self-efficacy.

These three types of measures may each contain both intrinsic and extrinsic influences and are only distinguished based on the way the variable is measured. Although retrospective assessments, in the second category, are known to entail high margin of bias (for instance due to social desirability) (Blome & Augustine, 2015), retrospective motivation measures are used here as an inclusive way to approach measures of motivation and are based on how it appears in literature. For instance, in Tang et al. (2018) motivation is seen as reduction of apathy and mood enhancement and in Madison et al. (2013) the authors assess changes in motivation measuring the psychophysiological wellbeing of the subjects. Rather than a theoretical model of motivation, this is used as a way to look at constructs that we think are tangentially involved with motivation. Arguably, how much someone enjoys a (musical) activity will affect the extent to which they would like to do it again, even when explicit motivation is not measured. By including retrospective judgements related to liking and enjoyment (Moumdjian et al., 2019), this aspect of motivation is included in our study. The third, indirect category is the least specified, as it is intended to cover measures that may be mediated by motivational subjective states and thus be positively related to the variables of interest even when they are not explicitly measured. For instance, although quality of life is a distinct construct, it overlaps with other clinical and non-clinical outcomes. Thus, we include it as an indirect measure of motivation, since motivation can serve as a predictor of changes in quality of life in different domains, e.g., physical and mental health, recreation and leisure time, employment or education (Grahn et al., 2000). For similar reasons we include self-efficacy in the same category, as self-efficacy beliefs overlap with key indices of motivation, such as choice of activities, level of effort, persistence and emotional reactions (Zimmerman, 2000). In the current work, we will refer to these outcomes as types of motivation for brevity's sake.

We expected that music would yield positive effects on each category of motivation, and that for these increases of motivation there would also be an improvement in the rehabilitation or learning process. Bearing in mind that motivation is described in the literature in different ways, we explored the possibility that in one category the results would be more prominent than in others. Additionally, various populations were distinguished, to potentially identify specific problems in motivation processing for certain groups and for specific complaints.

Framework for study quality evaluation

The systematic review was done following the PRISMA guidelines and the PRISMA 2020 Checklist was used. The protocol for this review was not prospectively registered.

Search strategy

The following search items, including exact terms and all relevant (medical) subject headings, were used: music AND motivation (e.g., drive, mood, liking, wanting, task performance, quality of life, patient adherence). Searches were conducted on 28 April 2020 of the following databases: PubMed, Embase, Web of Science, Cochrane Library, Emcare, PsychINFO, Academic Search Premier. For the full strategy, see the supplementary material S1.

The screening was performed by two independent teams of investigators (T.D., D.D.P. and J.P., A.Z.) to improve the detection of errors (selection of eligible studies, data extraction) and minimize study selection bias. Each team screened half of the total number of studies based firstly on title, secondly on abstract, and finally on full text. Each member worked independently until the full-text screening, after which, the members of each team met, compared the results, identified differences, and reached a consensus on which articles would be included. When consensus was not met, a fifth investigator (R.S.S.) was involved in the final inclusion.

Selection of studies

Only original experimental studies on music interventions of one week's duration or more were included, except for studies in which motivation was explicitly measured as a dependent variable. We only included studies with human subjects aged 18 years and older, both healthy and clinical populations, in various training or intervention settings; we excluded studies that had no outcome measures with a clear relation to any of the three motivation categories (as defined above), or studies focusing specifically on the hearing-impaired or on cochlear implant wearers, as timbre and pitch perception and appreciation have been reported to be biased by subjective factors (Filipo et al., 2008). Additionally, we excluded studies on music training with musicians, as well as studies where the full text was not available in English.

At the full text screening phase, we decided to include only randomized studies with a control group/condition, in order to narrow down the number of studies, as well as to minimize potential risk of bias. We included all kinds of music and music therapy interventions: active/receptive music therapy, either in an individual or in a group setting, singing, walking/running while listening to music, music-supported therapy, songwriting, playing an instrument or simply listening to music. We included studies in which the music interventions were delivered by qualified music therapists, trainee music therapists, or by professionals other than music therapists, such as sport scientists, neuroscientists, teachers, or rehabilitation musicians.

Data extraction and synthesis

To enable comparison, after full-text screening, data were extracted from each study and tabulated. This work was carried out independently by investigators (T.D., D.D.P. and J.P., A.Z.). In case of uncertainty, the final decision lied with the first author (T.D.). Specifically, studies were categorized by 1) motivation measures, (2) target group, and (3) outcome effect; this was further categorized based on the proportion of positive, partly positive, and absent or negative results. This categorization was given based only on the motivation (-related) outcome measure of interest, and considered partly positive if only part of the analyses showed a statistically significant difference between music-based and non-music-based methods (i.e., only for some relevant measures, at certain time points, or for certain subgroups).

To address the second research question regarding affected functional domain, studies with a positive change in motivation were categorized based on the additional outcomes being measured (where this did not overlap with the motivation measure, i.e., mood). This enabled an examination of correlations between improvements in motivation and other outcomes relevant to rehabilitation or task performance such as the level of perceived exertion, self-efficacy, or performance in cognitive tasks.

Due to the lack of homogeneity in the ways in which motivation was measured (i.e., prospective, retrospective, or indirect), and the inclusion of data from different populations, meta-analysis was not appropriate. Data were organized and categorized based on the type of motivation, population, as well as effects on clinical/learning/task performance outcomes, to observe correlations between changes of motivation and other variables. A positive effect indicates a p-value $< .05$ was found for all outcomes of interest and a partly positive effect when some, but not all, outcomes of interest had a p-value $< .05$.

Results

2834 studies were initially identified, leaving 2798 abstracts after removal of duplicates. 2648 records were excluded as they did not meet the inclusion criteria, or were reviews or records without data, leaving 150 full text articles. Following assessment of eligibility, 13 studies were excluded as they were not related to (one of) the three categories of motivation. 137 studies met all inclusion criteria. Based on our additional design exclusion criteria (no control

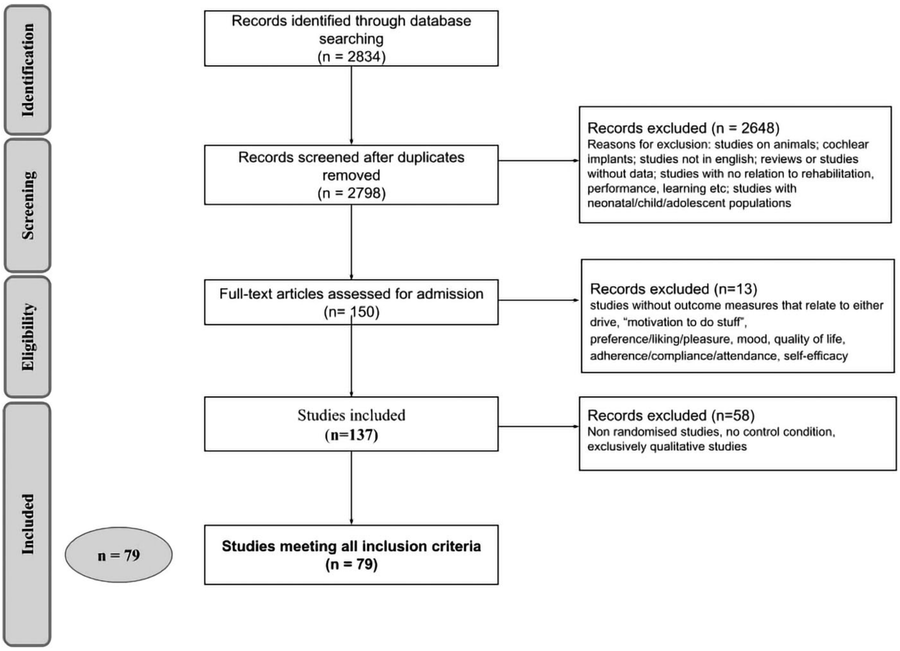

Figure 1. Flow diagram of articles selected for systematic review.

condition, no randomization or use of qualitative methodology) another 58 studies were excluded. Finally, 79 studies in total were included (Figure 1).

Sample characteristics

Motivation categories

Using our categorization of prospective, retrospective, or indirect motivation, as described in the methods section above, most selected studies used outcome variables that referred to more than one type of motivation. The ratio between studies on retrospective ($N = 63$) and prospective ($N = 11$) motivation was 6:1, amounting to about half (52%) of the used outcome measures versus 9%. As expected, most of the retrospective studies involved mood regulation (see Table 1). About 39% ($N = 48$) of included outcomes were categorized as indirect measures of motivation.

Thirty-seven studies used a single category of motivation, with the rest using at least two categories and 2 studies using all three categories (i.e., De Luca et al., 2020; Gold et al., 2013).

Participant populations

The number of subjects per study varied from 12 to 200. In total 22 participant populations were identified, which were subsequently grouped into 10 clusters: healthy individuals (adults and elderly), oncology clients, people with

Table 1. Motivation Types Measured in Included Studies.

Type of motivation measure	Number of studies including a relevant outcome measure
Retrospective motivation (i.e., mood, preference, liking)	63
Prospective motivation (i.e., drive, wanting)	11
Indirect measures of motivation (i.e., QoL, therapy adherence, self-efficacy)	48
Total used outcomes from included studies	122
Total number of included studies	79

Note: The number of studies for each category of motivation is given, which in many cases contains duplicates, i.e., studies including variables for more than one kind of motivation measure.

neurological disorders/conditions (dementia, stroke, Parkinson's disease, Multiple Sclerosis-MS), mental health clients (depression, psychoses), detainees, persons with addiction problems, clients with Chronic Obstructive Pulmonary Disease (COPD), individuals with chronic pain (including fibromyalgia and osteoarthritis), cardiac rehabilitants and *others (*clients with chronic quadriplegia, sleep apnoea, haemodialysis patients, people with left behind experience, people with subjective cognitive decline (SCD), and blood/marrow transplant patients).

Music interventions

The following music interventions were identified: Music Listening (listening to sedative music, music while walking, didgeridoo meditation, music while exercising), Active Music Making (singing, harmonica therapy, playing saxophone, interactive music making sessions, creating and recording blues music, paced walking to music), Music Supported Therapy (including rhythm centred music making), Individual Music Therapy, Group Music Therapy, Neurologic Music Therapy Techniques: Rhythmic Auditory Stimulation, Patterned Sensory Enhancement, Therapeutic Instrumental Music Performance and Therapeutic Singing, vocal music therapy, Music and Movement Therapy (MMT), including the Ronnie Gardiner Method (RGM), Guided Imagery and Music (GIM), and Five Elements Chinese Music Therapy. Thirty-eight (48%) out of 79 studies involved Music Therapy interventions.

Outcomes of interest: Motivation

Table 2 shows a detailed description of all included studies, grouped by the motivation category, the target group, and the degree of the effect (i.e., positive, partly positive, and with no effect). The following motivation variables were identified: mood (alteration), (changes in) Quality of Life, Therapy Adherence, Task Performance, Patient Satisfaction, Drive, Enjoyment, Self-Efficacy, Motivation to move, rehabilitate, abstain from drugs, or perform a task.

In 67 (85%) studies a statistically significant positive effect on motivation measures was identified following music interventions: positive effect in 63% and partly positive effect in 22%. A further 12 studies (15%) presented no

Table 2. Summary of Results on indices of motivation extracted from Included Studies.

Type of Motivation	Population	Task and Outcome Classification		
		Positive Effect	Partly Positive Effect	No Effect
Retrospective motivation				
	Healthy individuals	Music intervention (mood) (Biasutti & Mangiacotti, 2021); music therapy (mood) (Hanser & Thompson, 1994; Murabayashi et al., 2019)* (Wu, 2002)*; music based multitask exercise (mood) (Hars et al., 2014a; Hars et al., 2014b); weight holding task with music (mood) (Crust & Clough, 2006); didgeridoo meditation (mood) (Philips et al., 2019); music listening (post-exercise enjoyment) (Stork et al., 2015)* (Stork et al., 2019)*	Song writing (mood): reduced levels of depression but no effect on anxiety (Gee et al., 2019)	Music making (mood) (Yap et al., 2017)*; PSE/NMT (mood) (Clark et al., 2012)* music therapy (mood) (Schwantes et al., 2014)*
	Oncology	Live music (mood) (Burrai et al., 2014) music listening and relaxation techniques (mood) (Clark et al., 2006); group/indiv. music intervention (mood) (Chen et al., 2018)*	Music therapy (mood) (Hanser et al., 2006)*	Music therapy (mood) (Bradt et al., 2015)
	Neurological disorders/ conditions	*Dementia:* active music therapy (mood) (Giovagnoli et al., 2017); music making and listening (mood): less apathy [Tang et al., 2018]*; 5 element Chinese music therapy (mood) (Liu et al., 2014)*; music therapy (mood) (Cho, 2018)*; singing (mood) (Pongan et al., 2017)*; *stroke:* music movement therapy (mood) (Jun et al., 2013); music listening (mood) (Särkämö, Ripollés, et al., 2014a); music group (mood) (Sarkamo et al., 2008); music supported therapy (mood) (Fujioka et al., 2018)* (Grau-Sánchez et al., 2018)*; music listening (mood) (Baylan et al., 2020); *MS:* NMT (mood) (Impellizzeri et al., 2020); *Parkinson's disease:* RAS (mood) (De Luca et al., 2020)**; music therapy (mood) (Biasutti & Mangiacotti, 2021)	*Dementia:* music sessions (mood) (Maseda et al., 2018)*; music therapy (mood) (Sakamoto et al., 2013)*; music listening and singing (mood) (Särkämö, Tervaniemi, et al., 2014)*	*Dementia:* music listening (mood) (Narme et al., 2014)*; live music (mood) (Cooke et al., 2010)

	Mental health care	music therapy (mood) (Degli Stefani & Biasutti, 2016; Gold et al., 2013; Shirani Bidabadi & Mehryar, 2015)**; music therapy (mood) (Erkkilä et al., 2011)* (Fachner et al., 2013; Hamid & Biat, 2019)*; GIM (mood) (McKinney et al., 1997)		Group music therapy (mood) (Carr et al., 2012)
	Detainees	Group and indiv. music intervention (mood) (Chen et al., 2016)*	Group music therapy (mood, only significantly reduced anxiety and depression) (Gold et al., 2014)	
	Addiction	Group music therapy (mood) (Wu et al., 2020)*		
	COPD	Music while walking (mood) (Bauldoff et al., 2002)*; singing (mood) (Lord et al., 2010)*		
	Chronic pain	Vocal music therapy (mood-depression) (Low et al., 2020)*; music listening (mood) (Innes et al., 2018)*; music therapy (mood) (Onieva-Zafra et al., 2013)*		
	Cardiac rehab	Music listening (mood) (Murrock, 2002)*	Music listening (mood) (Ashok et al., 2019)* (Gupta & Gupta, 2015)*; music therapy (mood) (Mandel et al., 2007)*	
	Others	*chronic quadriplegia*: music therapy (mood) (Tamplin et al., 2013)*; *haemodialysis clients:* live saxophone music therapy (mood) (Burrai et al., 2014); *Left behind experience:* music listening (mood) (Tian et al., 2020); *subjective cognitive decline:* music listening (mood) (Innes et al., 2016a)*		*Subjective cognitive decline*: music listening (mood) (Innes et al., 2016b)*
Prospective Motivation				
	Healthy individuals	Music exercise groups (motivation to engage in effortful exercise) (Madison et al., 2013); music listening (motivation, drive, task performance) (Stork et al., 2019)*; music listening- self-selected (goal achievement) (Hallett & Lamont, 2019)*		Music listening (task motivation) (Stork et al., 2015)
	Neurological disorders/ conditions	*Dementia:* music making and listening (apathy: drive to do something) (Tang et al., 2018)*; *Parkinson's disease:* RAS (drive to walk), task performance (Calabrò et al., 2019; De Luca et al., 2020)**		

(*Continued*)

Table 2. Continued.

Type of Motivation	Population	Task and Outcome Classification		
		Positive Effect	Partly Positive Effect	No Effect
	Mental health care	Music therapy (motivation for change) (Gold et al., 2013)**		
	Addiction	Group music therapy (drive: motivation from abstaining from drugs) (Wu et al., 2020)*		
	Cardiac rehab		Music listening while walking (drive to do task) (Clark et al., 2017)*	
	Others		*Blood/marrow transplant*: cognitive behavioural music therapy (fatigue, motivation), (drive) (Fredenburg & Silverman, 2014)	
Indirect Measures				
	Healthy individuals	Music therapy (self-efficacy) (Wu, 2002)*; music therapy (QoL) (Murabayashi et al., 2019)*		Music listening- self-selected (adherence) (Hallett & Lamont, 2019)*; music therapy (QoL) (Schwantes et al., 2014)*; PSE/NMT (adherence) (Clark et al., 2012)*; music making (QoL) (Yap et al., 2017)*
	Oncology	Music therapy (QoL) (Hilliard, 2003); group/indiv. music intervention (self-efficacy) (Chen et al., 2018)*	Music therapy (QoL) (Hanser et al., 2006)*	
	Neurological disorders/ conditions	*Dementia:* music therapy (QoL) (Cho, 2018)*; music (QoL) (Pongan et al., 2017)*; *stroke:* NMT (adherence, attrition) (Street et al., 2018); music supported therapy (QoL) (Fujioka et al., 2018)* (Grau-Sánchez et al., 2018)*; *Parkinson's disease:* group music intervention (QoL) (Pohl et al., 2020); RAS (QoL) (De Luca et al., 2020); music therapy (QoL) (Pacchetti et al., 2000)*	*Dementia:* music sessions (QoL) (Maseda et al., 2018)*; music therapy (QoL) (Sakamoto et al., 2013)*; music listening and singing (QoL) (Särkämö, Ripollés, et al., 2014a)* *stroke:* receptive music therapy (QoL) (Poćwierz-Marciniak & Bidzan, 2017)	*Dementia:* 5 element Chinese music therapy (life satisfaction) (Liu et al., 2014)*; music listening (QoL) (Narme et al., 2014)*; *stroke:* music listening (adherence) (Baylan et al., 2020)*
	Mental health care	Group music therapy (QoL) (Grocke et al., 2014); music therapy (adherence) (Gold et al., 2013)** music therapy (QoL) (Erkkilä et al., 2011)* (Hamid & Biat, 2019)*		
	Detainees	Group and indiv. music intervention (self-efficacy) (Chen et al., 2016)*		

Addiction			Music therapy (self-efficacy) (Silverman, 2014)
COPD	Music while walking (adherence & QoL) (Bauldoff et al., 2002)*; singing (QoL) (Lord et al., 2010)*; paced walking to music (QoL) (Ho et al., 2012)		Harmonica therapy (QoL) (Alexander & Wagner, 2012)
Chronic pain	Vocal music therapy (self-efficacy) (Bradt et al., 2016) music therapy (QoL) (Onieva-Zafra et al., 2013)*; music listening (QoL) (Innes et al., 2018)*	Vocal music therapy (adherence & self-efficacy: sign, satisfaction in social roles: not sign) (Low et al., 2020)*	Patterning music/standard music (self-efficacy) (Siedlecki & Good, 2005)
Cardiac rehab	Music listening (adherence) (Murrock, 2002)*	Music listening (QoL) (Ashok et al., 2019)*, (Gupta & Gupta, 2015)*; music therapy (QoL) (Mandel et al., 2007)*	Music listening while walking (self-efficacy) (Clark et al., 2017)*
Other conditions	*Chronic quadriplegia:* music therapy (QoL) (Tamplin et al., 2013)* *subjective cognitive decline:* music listening (QoL) (Innes et al., 2016a)*; *sleep apnoea:* music + patient education (adherence & patient satisfaction) (Smith et al., 2009)		*Subjective cognitive decline*: music listening (QoL) (Innes et al., 2016b)*

Note: in each column, the music interventions are listed with the specific target group shown in cursive where relevant, with the related outcome measure shown in brackets. Studies with * appear in two different categories of motivation, e.g., prospective and retrospective, and studies with ** appear in all three categories of motivation. Abbreviations: MS: Multiple Sclerosis; NMT: Neurologic Music Therapy; PSE: Patterned Sensory Enhancement; QoL: Quality of Life; RAS: Rhythmic Auditory Stimulation.

Table 3. Overview of the proportions between (partly) positive effects for type of motivation measure.

Type of Motivation Measure (number of studies)	Positive Effect	Partly Positive Effect	No Effect
Retrospective (63)	73% (46/63)	14% (9/63)	13% (8/63)
Prospective (11)	72% (8/11)	18% (2/11)	9% (1/11)
Indirect (47)	58% (27/47)	19% (9/47)	23% (11/47)

Note: studies may appear in more than one category of motivation. A study was considered to have *positive* results when all motivation outcomes were significantly improved ($p < 0.05$), *partly positive* when some but not all motivation outcomes were improved and *no effects (absent)* when the improvement between the music intervention and the control condition was not statistically significant.

statistically significant effect of music interventions on motivation measures, the majority of which targeted healthy individuals (adults or elderly). For a summary of the reported effects structured by motivation measure type, see Table 3. No negative results, indicating a detrimental effect on the relevant outcome measures, were found in any of the papers.

Studies explicitly targeting motivation

Nine studies explicitly use the term "motivation" as an outcome variable, or discuss the motivating aspects of music even when their outcomes were either mood (for instance anhedonia) (Gold et al., 2013), fatigue (Fredenburg & Silverman, 2014) or adherence (Hallett & Lamont, 2019). In a study on upper limb function after stroke, Street et al. (2018) states that high adherence may suggest that the intervention is motivating, possibly supporting high repetition of target movements. A different study from sports science on healthy individuals suggested that "music provides motivation to engage in effortful exercise" (Madison et al., 2013, p. 792). Finally, a study on addiction (Wu et al., 2020) found that group music therapy increases motivation for rehabilitation and abstaining from drugs.

Effects of motivation on rehabilitation or task performance outcomes

Clinical or performance outcomes that were measured in addition to increases in motivation were identified in 39 studies and included physical/athletic performance, cognitive performance, pain, physiological markers, respiratory function, dyspnea/fatigue, treatment-related distress, neuropsychological functioning, use of psychotropic drugs, sleep quality, itch, obsessive behaviour, and spirituality (see Table 4).

In studies with healthy individuals, Stork et al. (2015, 2019) found that both motivation as well as peak and mean power over the course of an exercise session were higher in the music condition. Crust and Clough (2006) present a possible relationship between improved mood and longer time holding a dumbbell in a music condition when compared to without music. Similarly, Jun et al. (2013) observed increased shoulder and elbow joint flexion in motivated stroke patients. Improvements in physical functioning, including fall risk and frailty, were observed in studies with healthy elderly with increased motivation (Hars et al., 2014a).

Calabrò et al. (2019), De Luca et al. (2020) and Pacchetti et al. (2000) all studied Parkinson's disease noting similar improvements in physical functioning, gait quality and rigidity, as well as mood. In Ashok et al. (2019), indices of perceived exertion of cardiac rehabilitants improved slightly, but not significantly, in the music condition although the motivation was increased.

Improved cognition was identified in substantially more studies (26%) with positive effects on motivation, compared to other clinical/task performance parameters. As shown in Table 4, the majority of these studies targeted people with neurological disorders/conditions: dementia (Pongan et al., 2017; Tang et al., 2018); stroke, where attentional control, verbal learning and/or cognitive processing was significantly improved in the music condition (Baylan et al., 2020; Fujioka et al., 2018; Grau-Sánchez et al., 2018; Särkämö, Ripollés, et al., 2014a; 2008); and Parkinson's disease, where improved alertness was observed (Pohl et al., 2020). Significantly better scores on cognitive outcomes were also found in studies with oncological clients (Chen et al., 2018) and healthy elderly (Hars et al., 2014b).

Other clinical outcomes that improved in music interventions together with increases in motivation were pain experience (Onieva-Zafra et al., 2013; Innes et al., 2018; Low et al., 2020; Bradt et al., 2016), neuropsychological functioning (Hars et al., 2014b; Impellizzeri et al., 2020), itch (Burrai et al., 2014b), blood pressure (Madison et al., 2013), treatment related distress (Clark et al., 2006), use of psychofarmaca (Degli Stefani & Biasutti, 2016), obsessive behaviour (Shirani Bidabadi & Mehryar, 2015), abstaining from drugs (Wu et al., 2020), dyspnea/fatigue (Bauldoff et al., 2002), spirituality (Grocke et al., 2014), sleep quality (Innes et al., 2016a), and respiratory function (Tamplin et al., 2013).

Finally, in some studies ($N = 4$, 10.2%) motivation indices were improved, but there was no statistically significant effect on clinical outcomes, such as control of breathing (Lord et al., 2010), perceived exertion (Murrock, 2002), physical status (Hilliard, 2003), or upper limb function (Street et al., 2018), where there was a trend in favour of the music intervention, but not enough to support robust evidence. In the remaining 35 studies (89.8%) however, improvements in motivation were accompanied by significant or partially significant improvements in other outcomes (see Table 4).

Discussion

The current study aimed to review the literature on the relationship between music interventions and motivation. We approached motivation from three contrasting perspectives of prospective, retrospective, and indirect measures, attempting to better illuminate the role of music as a stimulus of change in human behaviour and actions. We also aimed to examine whether changes in

Table 4. Summary of results on outcomes of clinical or task performance parameters of studies reporting improved motivation.

Population	Outcome Classification		
	Positive Effect	Partly Positive Effect	No Effect
Healthy Individuals	Improved motor skills (Crust & Clough, 2006; Hars et al., 2014a; Stork et al., 2015; Stork et al., 2019); Lower blood pressure (Madison et al., 2013); Improved cognitive skills (Biasutti & Mangiacotti, 2021); Improved scores in NPI (Hars et al., 2014b)		
Oncology	Less experienced treatment related distress (Clark et al., 2006); Improved cognitive skills (Chen et al., 2018)		Physical status (Hilliard, 2003)
Neurological disorders/ conditions	Improved cognitive skills (Baylan et al., 2020; Pohl et al., 2020; Pongan et al., 2017; Sarkamo et al., 2008; Särkämö, Ripollés, et al., 2014a; Tang et al., 2018); Improved NPI scores (Impellizzeri et al., 2020); Improved motor skills (Calabrò et al., 2019; De Luca et al., 2020; Pacchetti et al., 2000)	Feasibility and acceptability (Jun et al., 2013); improved cognition but non-robust improvement in motor function (Fujioka et al., 2018); no functional improvements, but improved verbal learning (within group) (Grau-Sánchez et al., 2018)	Upper-limb function (trends visible) (Street et al., 2018)
Mental Health Care	Decreased dose of psychotropic drugs (Degli Stefani & Biasutti, 2016); significant improvement of obsessions (Shirani Bidabadi & Mehryar, 2015); increased spirituality (Grocke et al., 2014)		
Addiction	Improved abstinence from drugs (Wu et al., 2020)		
COPD	Decreased dyspnea/ fatigue (Bauldoff et al., 2002)		Control of breathing (Lord et al., 2010)
Chronic pain	Pain reduction (Innes et al., 2018; Onieva-Zafra et al., 2013)	Pain reduction or coping with pain (Bradt et al., 2016; Low et al., 2020)	
Cardiac rehabilitation		Improvement in perceived exertion (within intervention group) (Ashok et al., 2019)	Exertion (Murrock, 2002)
Other conditions	Itch reduction (Burrai et al., 2014a); better sleep quality (Innes et al., 2016a); better respiratory function (Tamplin et al., 2013)		

Note: in each column, the outcome is listed that co-occurred with improved motivation. Abbreviations: NPI = Neuropsychiatric Inventory: a questionnaire that assesses 10 behaviour domains including delusions, hallucinations, dysphoria, euphoria, anxiety, agitation/aggression, apathy, irritability/lability, disinhibition, and aberrant motor behaviour.

motivation correlate with changes in other parameters, such as clinical, task performance, or learning outcomes.

An overall positive effect of music interventions on motivation was indicated by 80% of the studies, which reported statistically significant positive or partly positive results. Moreover, in 90% of the studies where motivation was increased, this was associated with improvements in a relevant clinical outcome measure or task performance, such as pain, itch, cognition, blood pressure, respiratory function, endurance, or motor skills. No clear differences in proportions of positive results were found between the three measurement categories of motivation (prospective, retrospective, and indirect), suggesting that for the purposes of this review, categorizing different ways of measuring motivation did not provide further definition in considering these separate constructs. Most of the studies involved measures of retrospective motivation (mood/liking) with fewer studies referring to prospective motivation (drive/wanting). Moreover, more than half of the studies used multiple measures, falling into more than one category of motivation. The results support the general hypothesis that music has positive effects on mood, but also suggest that music can serve as a driving force in goal-oriented activities or a catalyst in clinical settings for therapy adherence and higher indices of self-efficacy.

No studies were identified where music had a negative impact on motivation, indicating that music was not found to reduce motivation or be demotivating. However, this conclusion should be drawn with care, as the music used in the studies was carefully selected according to the task or the personal preferences of the participants. To be more specific, dynamic music, loud and with a strong sense of beat, was used to improve motivation for physical activity (Madison et al., 2013) and soothing, melodic, and low-paced music for relaxation (Low et al., 2020). The effects might have been different if sad or dramatic music was used, for example, in walking/movement tasks, or if atonal, unpredictable, and fairly dissonant music was utilized for attention/concentration tasks. The fact that music was carefully selected to match a task or the need of the client implies, and in a way emphasizes, the importance of personalized music (instead of "any" music), which targets the goal of the activity.

Of the 15 studies reporting no effects of music on motivation, eight were carried out with healthy individuals involving physical/somatic outcomes, such as exertion or physical status. Although the study sample is relatively small, the proportional difference is notable when compared to other populations/outcomes, where studies reporting no effects are reported less often. This suggests that the effect of music interventions on motivation may also depend on the population, task, or outcome variable. Specifically, the motivation for clinical goals appears to be more effectively supported by music interventions than non-clinical goals, however the large heterogeneity in goals precludes making strong conclusions.

Most of the included clinical studies showing improved motivation were focused on neurological populations (e.g., dementia, stroke, Multiple Sclerosis, or Parkinson's disease) indicating the relevance of examining motivation in people with neurological conditions. In these populations improved motivation was associated with higher cognitive skills (e.g., attention/concentration or speech/language), improved neuropsychiatric scores (e.g., less inhibited, or irritable behaviour), but also improved motor scores (e.g., kinetic parameters of upper limb function or gait). Treatments for long-term conditions are limited and adherence to treatments is often challenging for a complex combination of access, funding, and motivation. Furthermore, mood, cognition, motor, and communication functioning are often difficult to treat for the reasons already listed in combination with natural disease progression and degeneration. Therefore, these findings are important due to the potential impact music interventions may have for treatment options for such complex patients.

This review of the literature suggests that music interventions tend to be related to increased motivation, and in turn related to improvements in clinical outcomes or task performance. However, based on the available information, this relationship can only be established as correlational, rather than causal. Music could however be a facilitator for positive changes in motivation. This in turn may enhance a subject's performance during a task, which might be a motivating factor, for example in terms of enhancing mood. These possible (theoretical) correlations appear to be in line with Self Determination Theory (Lewis & Sutton, 2011) and the concepts of intrinsic and extrinsic motivation that we used as the theoretical underpinning of this review. Based on the results from the included papers, a hypothesis on the interactions between music interventions, motivation, and outcomes can be formulated that may be useful in future considerations of the concepts described here (see Figure 2 for a graphical representation). Here, music interventions can have direct effects on the outcome they are intended to affect, but also yield an indirect effect through motivation or related concepts. Motivation itself might also be influenced by internal factors (e.g., self-efficacy improvement through exposure to a music intervention) or external factors (e.g., increased motivation because of improved performance, which leads to gratification through reaching an achievement). A clinical or task performance outcome may thus be directly altered by a music intervention, which in turn may (or may not) influence the participants' motivation. For instance, group music therapy in adult health care can significantly improve a patient's mood (increased retrospective motivation), as well as decrease the use of narcotic

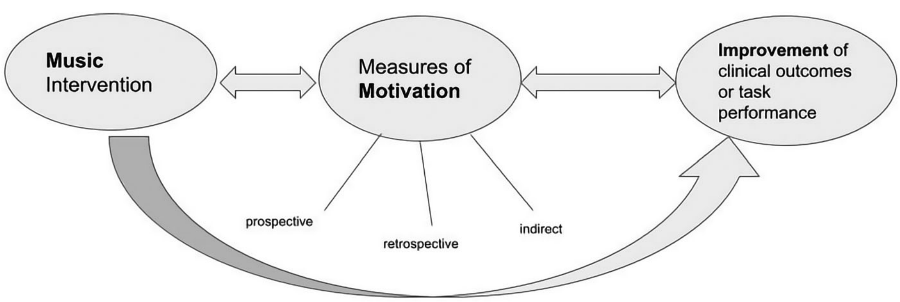

Figure 2. Hypothesised relationship between music interventions and selected outcomes.

psychopharmacological medication (additional clinical outcome) (Degli Stefani & Biasutti, 2016). These types of improvements in clinical goals might in turn contribute to further increase of indirect measures of motivation (e.g., further improvement of mood or therapy adherence).

While the current study supports the assumption of motivation as one of the working mechanisms of music interventions, the lack of causal evidence warrants further examination. It is worth stating that, based on the included studies, it was not possible to ascertain whether it is the music interventions that influence motivation or the other way round. We can therefore only confirm an observed correlation (rather than causality) between constructs, leaving this question open to follow-up investigations. In addition, future research may focus on how to measure motivation in a more standardized way.

Recent developments

Studies published after the systematic search took place represent largely the same tendencies as the studies that were included. For instance, Kaasgaard et al. (2022) and Burt et al. (2020), looking at singing compared to physical therapy in pulmonary disease, and walking to music compared to without music in PD, respectively, did not find any significant differences between the music intervention and the control condition on measures of retrospective and indirect motivation, whereas Greco et al. (2022) and Douglass-Kirk et al. (2023) reported significantly better results in endurance, mood and/or reduction of abnormal movement for a "Self-selected music" (SSM) condition as compared to non-self-selected or no music, in healthy or post-stroke populations, respectively (prospective/retrospective motivation). These findings highlight the need for suitability in music choices, but also that musical activities may function as adjacent or supportive measures, without removing the need for other medical disciplines.

Strengths and limitations

Several strengths and limitations of the review need to be considered. The total number of 79 studies included in this review resulted in a large heterogeneity of the outcomes, the populations, as well as the wide range of music interventions used. This heterogeneity complicates drawing strong conclusions about specific interventions or groups. However, having such varying studies enabled an examination of the different types of music interventions being used to address motivation, and ensured the multidisciplinary perspectives represented, including neuroscience, (music) psychology, music therapy, music & medicine, sports science, psychotherapy, and musicology.

Sample size continues to be a factor that should be addressed in future studies. The sample size in some of the studies included in this review was relatively small (N = 10-15), suggesting that future studies may benefit from using power analyses to ensure sufficiently well powered designs. Moreover, the quality of the studies and the possible risk of bias, e.g., publication bias, was not (always) possible to be checked. However, including only studies that use randomization and control conditions, as well as utilizing the PRISMA checklist, does exercise some level of quality control. Bearing in mind that the literature into music interventions may be vulnerable for false positives or publication bias, the potential impact of low-quality studies in the results could not be controlled.

A final, yet considerable, limitation has to do with the difficulty in defining motivation and most importantly measuring it. We have argued that motivation is a multifaceted construct. Very few studies (9) explicitly measured motivation, but even within those studies the outcome measures used to evaluate the motivational changes differed significantly, with each of the 9 studies using a different measure. These variations in measurement tools and approaches make it challenging to establish a standardized and consistent assessment of motivation across studies. In terms of recommendations for future directions, the use of more standardized or broadly used measures of motivation in future studies would potentially make a meta-analysis possible.

For the current purpose, it was crucial to approach motivation from different angles, namely in terms of liking (e.g., mood alteration), wanting (e.g., drive to achieve a result) or indirect measures (e.g., self-efficacy or therapy adherence). The ratio between positive and null results per type of motivation over all studies was proportionally equal, indicating that this categorization was not relevant to our study outcome, possibly due to the complexity of the construct and the lack of sensitive measures. Nevertheless, this framework for examining motivation, namely using several measurable aspects of constructs related to motivation, will hopefully be useful in future research studies.

Finally, what is not taken into account here are the individual differences that might make a music-based method more motivating to one person than another. As standardized measures of musical reward are available (Mas-Herrero et al., 2013), inclusion of these measurements may further clarify for whom music might be the most effective.

Conclusions

The results of this systematic review show clear evidence for positive effects of music interventions on motivation in various laboratory and clinical settings. Music interventions are often related to increased motivation in humans, which can in turn be related to improvements in clinical outcomes and task performance, thus supporting the notion of motivational processes as a part of the underlying working mechanisms of music-based interventions. More robust evidence is needed to ascertain which mechanisms are crucial in increasing motivation from a behavioural, cognitive, and neurobiological point of view, as well as how motivational mechanisms relate to other factors of effectiveness in music-based paradigms.

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