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# STILL GOT THE GROOVE—RHYTHMIC PHYSICAL SYNCHRONIZATION TO INDIVIDUALIZED MUSIC LISTENING OBSERVED IN PEOPLE WITH DEMENTIA

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## 1 INTRODUCTION

Continuous developments in healthcare over the past century have resulted in people living longer and healthier lives. However, the ageing of the global population has also led to an increase in age-related diseases, including dementia. Currently, dementia represents the seventh leading cause of mortality among all diseases and is a major factor contributing to disability among the elderly (World Health Organization 2021: vii). It affects not only the people with dementia themselves, but also relatives, family caregivers, and society at large. Dementia plays a pivotal role in the need for care in old age, ranking as one of the ten most common causes of healthy years lost. Forecasts indicate that there will be approximately 78 million people with dementia worldwide by 2030 and around 139 million by 2050 (World Health Organization 2021: 3). In Germany, the number of individuals living with dementia in 2021 was estimated to be approximately 1.8 million. It is projected that by 2050, the number of those affected will reach 2.8 million (Deutsche Alzheimer Gesellschaft 2022: 1).

Dementia is a progressive and irreversible neurodegenerative brain disorder that represents the most common form of pathological ageing and is one of the most profound health, social and economic challenges of our time (Ferreri et al. 2019: 631). It is associated with a decline in cognitive abili-

ties, which can affect executive functions such as attention, learning, memory, orientation, and planning, as well as language, motor skills and social interaction (Deutsche Alzheimer Gesellschaft 2022: 1). Furthermore, behavioral and psychological symptoms of dementia (BPSD) can occur as neuropsychiatric concomitant symptoms, thereby complicating the treatment and care of those affected. BPSD include agitation or aggression, delusions or hallucinations, depression, and sleep-wake rhythm disorders (Savaskan et al. 2014: 135, 140). The wide range of symptoms affects the quality of life of people with dementia, including social isolation and agitation (Schmüderich et al. 2021: 1, 9).

There is no one-size-fits-all approach to treating dementia, so individualized approaches are needed (Kales et al. 2015: 5; Wilz 2024), while improving quality of life is an important treatment goal (Garrido et al. 2017: 1129; Gold et al. 2019: 2; Bernatzky et al. 2015). Research has shown that non-pharmacological treatments are particularly promising, with music being one of the most effective non-pharmacological approaches. It is considered cost-effective, non-invasive, comfortable for people with dementia and helpful for caregivers to create an environment that contributes to the well-being of those affected (Chang et al. 2015: 3439; Samson et al. 2015). In addition, the long-term musical memory of individuals with dementia is less affected by the degeneration of the disease, so that they can remember music into the late stages of dementia (Jacobsen et al. 2015: 2440-2446). Particularly in relation to BPSD, there are immediate positive changes that can be achieved by listening to individualized music (Hillebrand et al. 2023: 7). In addition to the scientific findings, the impact of music on individuals with dementia was brought to a wider audience through the documentary *Alive Inside*. It used several individual cases to demonstrate the extraordinary effect of music on care home residents diagnosed with the disease (Rossato-Bennett 2014).

## 2 MUSICAL EXPERIENCES FOR PEOPLE WITH DEMENTIA

For the majority of people, music is an integral part of their daily lives, including personal choices about what and when to listen to or play music. However, individuals with dementia often lose the capacity to make these decisions independently. Consequently, selecting music for people with dementia requires sensitivity to their background, preferences, and new rele-

vant factors that may be associated with their condition, such as a limited attention span.

Musical experiences for people with dementia are divided into different categories to differentiate their areas of impact. They are on a continuum from recreational to therapeutic experiences, with some cases containing both therapeutic and recreational elements. In the literature, musical experiences are divided into receptive experiences, such as listening to music and music for relaxation, or active experiences, such as playing instruments or moving to music (Clements-Cortés 2019: 3). Recreational music experiences can be either receptive (e.g., listening to music on various devices) or active (e.g., singing and playing instruments). Recreational music experiences differ from music therapy in that the focus of the interventions is on achieving health-related goals, such as reducing agitation or BPSD, rather than on the client-therapist relationship. For people with dementia, music can be applied in leisure time by a variety of people, including caregivers, volunteers, and family members (Clements-Cortés 2019: 10-11). Individualized Music Listening (IML), which involves creating playlists of music that is personally meaningful, is now used particularly frequently (Raglio and Oasi 2015: 2). IML is easy to implement, cost-effective and can be carried out by trained healthcare professionals or trained relatives and in a variety of care settings (Gaviola et al. 2020: 11). Many music interventions today consider the music preferences of people with dementia. However, interventions often focus either on preferred music without considering psychological symptoms, or on symptoms such as agitation without considering participants' individual preferences (Garrido et al. 2017: 1140). Research shows that both the pre-selection of individualized music and the setting of the music listening situation are crucial to the success of an IML intervention (Töpfer et al. 2024: 9).

While many studies consider the social structure of the music listening situation, there is still a large gap in research on music-related influencing factors (Bernatzky et al. 2015: 93). This raises the question of the music-related reasons why a particular type of music affects a person with dementia. In addition to the biographical significance of particular songs, musical factors such as harmony, rhythm or the length of individual pieces may also influence the success of a music intervention. This article uses case studies derived from observations made during an IML intervention with people with dementia living in nursing homes. These case studies serve as the framework for a comprehensive examination of the rhythmic responses shown by individuals with dementia in the context of IML. By analyzing these rhythmic responses, the article aims to illuminate the importance and the potential

benefits of rhythmic physical synchronization for people with dementia, framed within established principles of rhythmic synchronization.

# 3 RHYTHMIC PHYSICAL SYNCHRONIZATION OBSERVED IN PEOPLE WITH DEMENTIA

## 3.1 REFERENCE OF THE DATA USED

The data analyzed for this article were provided by the research project *Individualized music for people with dementia—improvement of quality of life and social participation for people with dementia in institutional care*, which was conducted from 2018 to 2021 under the direction of Gabriele Wilz at the Department of Counseling and Clinical Intervention, Friedrich-Schiller-University Jena and funded by the National Association of Statutory Health Insurance Funds (GKV Spitzenverband der Pflege- und Krankenkassen), Germany. The aim of the randomized controlled trial was to investigate the effectiveness, applicability and acceptance of an IML intervention for people with dementia in nursing homes, to improve the quality of life, well-being and social participation of people with dementia (Weise et al. 2018: 1). The project team was led by a group of psychologists, with the additional expertise of a musicologist, who is the first author of this article. The project team was put together on an interdisciplinary basis in order to ensure an adequate research of the topic, which itself includes various disciplines.

The study included people with medically diagnosed dementia whose relatives had given their written informed consent to participate in the study. Recruitment took place in five cooperating nursing homes in Thuringia. Participants were randomly assigned to either an intervention group, which listened to individually created music playlists, or a control group, which received standard care and no music, in order to prove the effect of music independent of social interaction. The nursing staff assessed participants' quality of life and problem behaviors at four time points: baseline, pre-test, post-test, and at the six-week follow-up.

Prior to the intervention period, individual music preferences were assessed using a music preference questionnaire, usually completed by family members. Questions included how important listening to music was in the person's life, whether they had learned to play musical instruments, sang, danced or what styles of music they preferred. They were also asked if they had any favorite songs, musicians, or artists. When possible, people with dementia were asked personally about their favorite music. The information

was used to create three playlists of about 20 minutes of music for each person. Based on the responses of the family members, music that aligned with the preferences of the care home residents was played. The responses were then analyzed to allow for adjustments to the playlists during the intervention period, if necessary (Weise et al. 2018: 5).

During the six-week intervention period, the intervention group listened to their individualized playlists on MP3 players and headphones every other day, ideally resulting in 21 listening sessions per person. People with dementia were accompanied by project staff, care home staff or volunteer supporters as they listened to their music. Behavioral observations of 60 minutes each took place at three times and were videotaped where consent was given. For the intervention group, the 60 minutes included listening to the individualized playlists. The design of the study is shown in Figure 1.

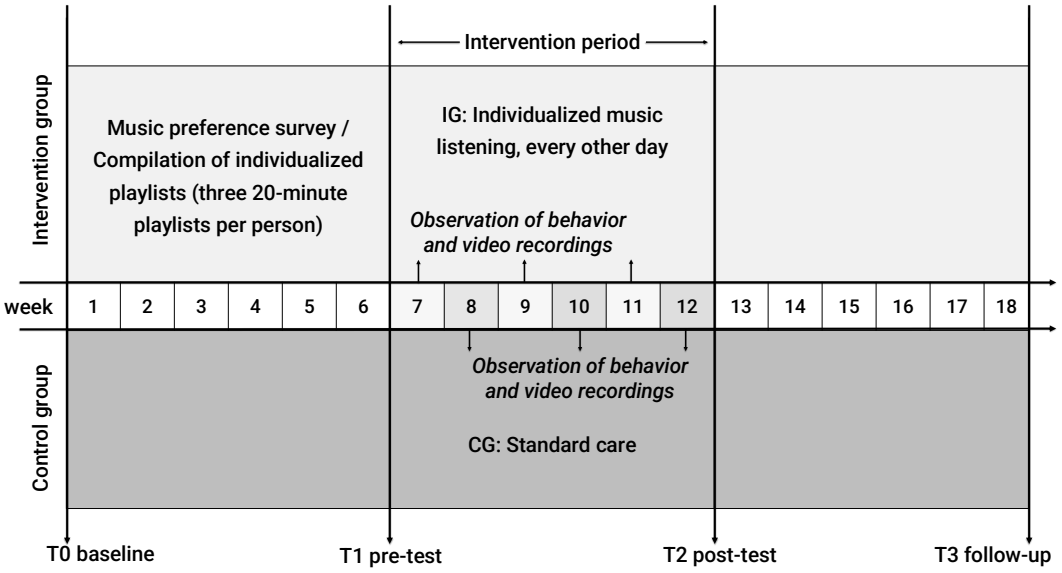


Figure 1. Study design.

A total of 118 people with dementia were included in the study. Satisfaction with the implementation of the individualized hearing intervention was very high. The duration (20 minutes) and frequency (every other day) seemed just right for the mostly severely affected dementia patients (Jakob et al. 2021: 55; Hillebrand et al. 2024).

Analysis of the behavioral observations using a self-developed behavioral observation scale with a time sampling approach shows that IML reduces behavioral and psychological symptoms of dementia (Hillebrand et al. 2023). In addition, the video recordings were evaluated qualitatively. All available video material from the 59 people with dementia in the interven-

tion group was examined by the project team in detailed video analyses. In preparation for the analyses, the project team members Lisa Schön and Elisabeth Jakob watched, documented, and provisionally analyzed all the available videos. The analysis of the video material raised various aspects of psychological, sociological, and music-analytical questions, which were discussed in the research group from different perspectives. Over a period of two years, a typology of reactions of people with dementia to IML was completed (Töpfer et al. 2024).

## 3.2 MUSIC-RELATED FACTORS INFLUENCING THE REACTIONS TO INDIVIDUALIZED MUSIC LISTENING

As the typology of responses of people with dementia to IML shows, the setting of the listening situation is essential for the success of a music intervention (Töpfer et al. 2024: 9-11). While this and similar studies primarily consider the social structure of the music listening situation, there is still a large gap in research into music-related influencing factors. Initial studies of music-related responses in people with dementia have compared the responses of people with dementia to individualized playlists with the musical criteria of tempo, mode, and text. The results show, for example, that fast tempo increases the level of emotional arousal, but at the same time reduces the feeling of pleasure or that minor keys trigger increased sadness (Garrido et al. 2019: 250-251). It is tempting to relate single musical parameters directly to the response of people with dementia in order to make generalized statements about the effect of music on people with dementia. However, music is a stimulus whose effect cannot be determined by isolated musical factors such as tempo or key, as the effect of each factor can be altered by any additional factor such as pitch or dynamics, making the prediction of a response unreliable (Gabrielsson and Lindström 2010: 388, 393).

To address the question of music-related influencing factors, further qualitative, in-depth musicological analyses were conducted using the video material recorded in the course of the research project. Based on ten case studies, music-related factors influencing the effect of music on people with dementia were examined. The case studies were selected from the video material of the 59 people with dementia in the intervention group of the research project.

The case selection process excluded videos of participants who could not be analyzed, e.g., because they had not given permission for video recording. This left 108 60-minute videos of 45 people with dementia, which were viewed multiple times by the first author. Reactions to the music were

documented in bullet points (e.g., ›strong rhythmic response,‹ ›stimulation of episodic memory,‹ or ›person with previous musical training‹). After reviewing all of the video material, cases with similar reactions were grouped together. From these groups, cases were selected that were particularly relevant to the research question and representative of their respective groups, with the goal of demonstrating the musical influences through concise examples (Przyborski and Wohlrab-Sahr 2014: 177). Extensive qualitative video sequence analyses were carried out with all videos from the selected case studies. In the end, ten case studies with a total of 28 videos were completed. After creating and evaluating the case studies, five main fields of music-related influencing factors were identified: Aspects of the individualized music selection, music related memories and nostalgia, the influence of musical training, sadness and farewell, and synchronization and orientation through rhythm, which is the topic of this paper and will be presented in detail below.[1]

## 3.3 OBSERVING RHYTHMIC REACTIONS TO INDIVIDUALIZED MUSIC LISTENING

Since rhythmic responses to IML were frequently observed in the video analysis, rhythmic synchronization was identified as a particularly influential factor. The responses observed included continuous motor synchronized movements such as finger tapping, dancing, or conducting, and were evident even in participants with severe dementia. Hereby, rhythmic impulses were often picked up and translated into movement. In the analysis, the responses were described in detail in the qualitative video sequence analyses in relation to the specific music that the people with dementia were listening to.

These observations became the starting point for reflections on the basic rhythmic phenomena underlying rhythmic synchronization, their psychological potential, and the extent to which they can be adapted to music listening in people with dementia. In the following, the phenomena of rhythmic synchronization are first outlined. The effects of rhythmic synchronization are then examined and divided into two areas of impact: non-verbal communication and increased enhanced orientation through rhythmic syn-

1 An elaboration of all observed music-related influencing factors observed can be found in the volume *Musikhören mit Demenz. Fallstudien—Wirkungen—Anwendungen* (Music Listening for People with Dementia. Case studies—effects—applications) (Schön 2025).

chronization. Both areas of impact are described in conjunction with examples of reactions from participants in the research project.

### *3.3.1 Rhythmic entrainment and the potential of rhythmic synchronization*

When studying human behavior toward music, how it is perceived or performed, the same basic phenomena emerge that can be traced back to the rhythm of music. Responses to rhythm can be divided into three different aspects: experiential aspects related to perception, cognition and emotion; behavioral aspects related to responses such as movement to music; and physiological aspects related to breathing or heart rate (Gabrielsson 1982: 160). They all share the characteristic of rhythmic attunement to and synchronization with the music. Movements to the music can be highly varied and involve the whole body. While some people may follow the basic beat or imitate rhythmic patterns with their feet or hands, others may snap their fingers or make expressive movements with their head, arms, or upper body. In this way, discrete information about the rhythmic structure is transformed into synchronized body movements (Pfleiderer 2006: 100-101).

An important concept based on rhythmic adaptation that describes rhythmic synchronization is rhythmic entrainment. Rhythmic entrainment can be thought of as a corrective mechanism that constantly responds to the musical-rhythmic environment to make accurate predictions of the beat in order to achieve a result such as clapping or tapping to the beat. The aim is to sharpen perception and adjust responses based on inaccuracies that occur at the initiation of synchronization and are recognized as errors (Leman et al. 2017: 17). Rhythmic entrainment can therefore be understood as a progressive adaptation to synchronize two systems. The rhythmic events of the systems should be of the same duration (period) and occur at the same time (phase). People usually orient themselves to the most prominent rhythmic features, which often refer to the basic beats of a bar, such as the four quarters in a four-four time signature. These are often referred to as the beat, tap or footfall and are used as markers for synchronization (Leman et al. 2017: 13, 16).

The ability to synchronize movement to music is highly individual. While some people find it easy to move to music in a stable phase, others show greater difficulty or even an inability to do so (Leman et al. 2017: 18-19). At the same time, rhythmic adaptation is linked to cognitive mechanisms that, among other things, trigger reward effects, which can be understood as the psychological potential of rhythmic synchronization. In the context of rhythmic synchronization, people respond to their rhythmic environment. This re-

sponse is based on sensorimotor control mechanisms that are related to the prediction of upcoming rhythmic events. This process makes use of sensorimotor prediction models in the brain, which require limited cognitive resources, such as attention and short-term memory. Subsequently, imitation can be used to coordinate body movements with the tempo of the music. Motivation is a key driver of these processes. This demonstrates that a potential reward is a powerful motivator for synchronizing to music. The reward is closely linked to the accurate prediction of rhythmic events, which in itself is associated with cognitive arousal and physical effort. Synchronization to the beat involves prediction models that can produce rewarding effects, which in turn influence cognitive activity (Leman et al. 2017: 14-15). Regular beat patterns can drive synchronized movement, particularly when they correspond to the moderate tempo range. Studies of synchronized body movements to metronome beats and music show the influence of a natural, presumably innate, tendency towards frequencies close to 120 beats per minute, which means that people have a higher capacity for accurate rhythmic prediction within this range (Leman et al. 2017: 16-17). The tempo range of human walking movements, which are perceived subconsciously as a part of everyday life, is also within the same range (Fraisse 1982: 150).

### *3.3.2 Rhythmic synchronization and dementia*

The mechanism of rhythmic synchronization and rhythmic entrainment plays a crucial role, especially in the context of IML for people with dementia. Accessing their own physicality through rhythmic movement may serve as a means of self-assurance, enabling people with dementia to synchronize with the music and maintain a sense of their own body. This is particularly the case when individuals with dementia are less restricted in their movements to music than to other forms of movement. As with all responses to music, the extent to which rhythmic synchronization occurs is dependent on the severity of the disease. Nevertheless, there are several reports of people moving to the rhythm of music even in advanced stages of dementia (Ghilain et al. 2019: 29).

There is evidence that rhythmic entrainment appears to affect not only the motor system, but also cognitive, emotional, and social functions. The perception of rhythmic repetition results in neural synchronization with respect to temporal expectations between the auditory and motor systems. This results in an audiomotor coupling that is essential for the perception and integration of sensorimotor information, which in turn triggers coordinated movements in time with the music. Rhythmic synchronization to music is thought to affect executive and attentional functions, which may suggest

a link between rhythmic synchronization to music, cognitive function, and dementia. However, the theoretical impact of rhythmic synchronization on executive and attentional functions has yet to be empirically verified (Ghilain et al. 2019: 25-26).

Rhythm affects the autonomic nervous system, which can synchronize breathing cycles and heart rate with musical rhythms (Ghilain et al. 2019: 27). This effect is independent of an individual's prior musical knowledge or current cognitive ability. Concurrently, musical synchronization can also enhance interpersonal coordination and non-verbal communication skills, particularly through rhythm, which is crucial in the context of dementia, as many people affected by dementia struggle with verbal communication and therefore experience a loss of social interaction (Cason et al. 2017: 304).

### *3.3.3 Non-verbal communication through rhythmic synchronization*

As dementia progresses, many people with dementia encounter a multitude of illness-related symptoms that impair their capacity for verbal communication, often leading to a decline in interactions with other people. The synchronization of rhythmic movements has been demonstrated to improve motor function in select patient populations. The non-verbal communication of individuals with dementia encompasses a range of behaviors, including posture, gestures, facial expressions, and gaze which also have been observed in responses to music. The need for social contact can be met, at least in part, by rhythmic interaction, which can have a positive effect on the mood of people with dementia (Cason et al. 2017: 308-309).

This phenomenon can be derived from the various situations observed in the case studies. In one illustrative example, the rhythmic impulse of the music is transferred to the person with dementia, who then translates it into movement and establishes non-verbal contact with the project team through their movement and gaze:

> *At the beginning of the German song »Wenn ein junger Mann kommt« (»When a young man comes«), the person with dementia turns to the project team and taps her intertwined hands several times in her lap from left to right to the beat. The lively start of the music seems to be transferred to her, she moves her hands and looks at the project team as if she wants to share her joy [case study 10, behavioral sequence 21].*[2]

2 The excerpts presented here are drawn from the volume *Musikhören mit Demenz. Fallstudien—Wirkungen—Anwendungen* (Music Listening with Dementia. Case studies—

Although the person with dementia is physically and cognitively impaired and has difficulty communicating verbally, the musical impulse provides an opportunity for interaction with the project team. In another example, a person with dementia who is listening to a waltz makes a dance-like movement and looks at the project team as if asking them to dance:

> *At the beginning of the playlist, which features a potpourri from »Die Fledermaus« (»The Bat«), the person with dementia smiles and says »Beautiful!«, shortly thereafter she makes a swinging and dancing movement with her upper body from left to right, accompanied by arm movements, and looks at the project team as if asking them to join in the dance. She makes the movement at a point in the piece where, following a brief interlude (bars 89-92), the waltz is taken up again (bar 93) [case study 1, behavioral sequence 22].*

From a neurocognitive perspective, interpersonal coordination and synchronization to music are based on the same principles of perception and action. It is also known that increased familiarity results in enhanced synchronization between individuals. In sensorimotor synchronization to musical rhythms, music can play a supporting role in synchronizing with others (Cason et al. 2017: 305-306). In this example, the rhythmic accents and structure of the three-four waltz help the person with dementia to use music as a means of communication. She then transfers the impulses originating from the music to approach the project team with a non-verbal communication offer. The impact of a shared musical experience can be a decisive factor in activating people with dementia. In a similar vein, rhythmic synchronization can evoke the emotions experienced when listening to music. The neuronal structure of the basal ganglia, which is linked to both rhythmic behavior and the development of emotions, has been identified in relation to pleasant emotions during rhythmic synchronization. Consequently, synchronized movement can contribute to social bonding and group identity (Cason et al. 2017: 308).

As the examples show, rhythmic synchronization gives the person with dementia the opportunity to make non-verbal contact and the monitoring person the opportunity to respond non-verbally by mirroring rhythmic impulses. For people with dementia who use rhythmic impulses to synchronize with others, mirrored movements can also increase their enjoyment of music.

effects—applications). The complete case studies, including all behavioral sequences, are available for reference in the published work (Schön 2025).

### *3.3.4 Orientation through rhythm*

People with dementia frequently experience challenges in orienting themselves in space and time. The impairment of short-term memory makes it increasingly difficult to retain and relate incoming information. As a consequence, people with dementia frequently encounter challenges in recalling specific periods of their lives and therefore to locate themselves in time and space. Music provides a fixed framework within which the listener is given a temporal structure. It can be understood as a continuous stream of information that is processed by the auditory tract within milliseconds and can therefore have a direct impact on the well-being of the listener.

In contrast to other musical parameters, rhythm bears the cross-cultural characteristic of being associated with specific bodily movements and the duration of particular time intervals. Four distinct tempo ranges can be identified, each representing a spectrum of movement. The range of temporal intervals with the largest duration includes periods of one to ten seconds, in which breathing or arm movements occur. It is followed by sections of a third to a whole second, which can be translated into tempo ranges of 60 to 180 beats per minute and correspond to the human heartbeat, walking, running or head nodding. The range from 180 to 600 beats per minute includes speech, tongue movements and hand gestures. Speech phonemes and musical ornaments are found in the final range, which encompasses the smallest temporal intervals (Fraisse 1982: 150–153; Pfleiderer 2006: 101). The so-called moderate tempo is approximately 100 beats per minute. This is the mean tempo that is perceived as neither fast nor slow by most individuals. Given that people find it easier to synchronize to the beat at this tempo than in other tempo ranges, it is to be expected that this range will also strongly encourage people to move along (Fraisse 1982: 153). The broader tempo range surrounding the moderate tempo (60 to 150 beats per minute) is where listeners are most likely to perceive the basic pulse of a musical piece and most likely to respond physically, for instance by tapping their feet. The proximity of everyday movements to this tempo range makes it easier to adapt synchronized movements (Snyder 2001: 167–169). Rhythms permeate many areas of people's lives unconsciously, structuring the flow of time through a particular sequence of events, as well as through their duration and weighting (Pfleiderer 2006: 9). The structuring component is of particular importance in this context, as it can contribute to enhanced orientation, especially for individuals with dementia.

The regularity of a beat is a central aspect to the orientation established by rhythm. Continuous basic pulses, groups of bars and recurring accentuations run through entire pieces as a fundamental experience of regularity.

The speed of the basic pulse defines the tempo of a piece (Gabrielsson 1993: 96). The inter-onset intervals (IOI), defined as the equal distances between the starting points of the individual beats, determine the tempo. The metrical hierarchy is dependent upon the spacing and repetition pattern of the intervals. The basic pulse forms the level with the smallest IOI, on which, depending on the emphasis, sound events may be placed in larger IOI. The resulting structure of accentuation determines the metre of a musical piece (Pfleiderer 2006: 70). The metrical organization of music is not a prerequisite. However, the absence of metrical clues makes it more difficult to identify the musical structure, anticipate its progression and to synchronize movements with the music (Pfleiderer 2006: 72). The processing of rhythmic structures engages auditory memory, which is dependent on attention. Attention in essential when listening to music, as it enables the active perception and interpretation of musical information (Pfleiderer 2006: 37). The focus of attention may be directed towards the melody, form, rhythm, or articulation, depending on the listener's interest, and is also influenced by factors such as metrical hierarchy. A clear hierarchy makes it easier for listeners to focus their attention on future musical events and to synchronize with the music. The greater the degree of uncertainty generated by non-hierarchical structures, the more listeners are forced to focus their attention on the present, and the more challenging it becomes to achieve synchronized movement (Pfleiderer 2006: 42). It can be assumed that rhythmic structures in the moderate tempo range, with clearly perceptible pulse structures and a discernible hierarchy, facilitate synchronization to music for people with dementia.

In addition to bodily movements, auditory memory has a temporal component and can be divided into three process levels, corresponding to three different temporal levels of musical experience: echoic memory, which corresponds to the level of event fusion, short-term memory as the level of melodic and rhythmic grouping; and long-term memory, which corresponds to the level of musical form (Snyder 2001: 11-12). At the level of event fusion, changes in pitch and volume are discernible. The smallest perceptible grouping at this level is a single sound event. The level of melodic and rhythmic grouping includes events that are individually distinguishable (which is possible from less than 16 events per second) but are not separated by a temporal interval that exceeds the limit of short-term memory, which is an average of three to five seconds per event. At this level, the individual events that are perceived during event fusion are grouped together. The main difference between this level and event fusion is that boundaries between individual events must first be established in order to then bundle them into larger, meaningful patterns (Snyder 2001: 12-14). If initially, only a single beat

is perceived, after several repetitions it can be identified as part of a measure at the level of rhythmic grouping. While the event fusion level deals with pitches or individual beats that are then grouped into melodies or rhythms, the musical form level deals with larger formal structures such as phrases or choruses. The role of long-term memory in this process is crucial, as it provides the context in which certain formal parts are given meaning through comparison with existing knowledge and previous listening experience (Snyder 2001: 15).

In response to rhythm, synchronization may occur at the lowest level of event fusion to a continuous basic pulse without metric hierarchy, even in the absence of discernible patterns. In contrast, the processing of rhythmic or melodic grouping requires a higher level of cognitive performance, and the reference to musical form even requires prior knowledge that may not be accessible, for instance, due to a lack of prior knowledge or in the case of dementia. A case study with two visits on different days shows the reactions of a person with dementia who, despite a notable change in her mental condition, shows consistent rhythmic leg movements to music on different days. The following excerpt depicts the situation during the first visit:

> *At the outset of the song »Ganz in Weiß« (»All in white«), the leg of the person with dementia immediately moves as if by itself. The person with dementia moves to the basic beat, but also to the rhythm of the melody. She sings along, but is not quite sure of the lyrics. Despite lagging behind the singer, she maintains a consistent movement of her leg [case study 3, behavioral sequence 25].*

On the following visit, the person with dementia exhibits notable changes in her mental condition. She appears to be less oriented and does not sing along with the music as before:

> *As the song »Wunder gibt es immer wieder« (»There are always miracles«) begins, the person with dementia asks: »Oh, should I listen to another one?«, which the project team confirms. Despite a perceptible lack of focus, her rhythmic response remains unchanged and her legs continue to move to the music. At the end of the song, she comments, »Silence.« The project team informs her that there will be two more songs, and the person with dementia responds with a smile and agreement, although she seems less enthusiastic today than she has been in the past [case study 3, behavioral sequence 26].*

With regard to the three temporal levels of musical experience, the leg movements of the person with dementia can be classified at the level of event fusion. This classification is based on the observation that the leg

movements can be attributed to the basic pulse, which is perceptible throughout the duration of the songs. In contrast, singing along is associated with the level of melodic and rhythmic grouping, wherein, in addition to the lyrics, the recognition and accurate reproduction of melodic and rhythmic structures are essential. In the second example of the person with dementia, this process is no longer possible. The fact that she is no longer able to sing the lyrics in full and at the correct tempo at this point is therefore less remarkable, as the synchronization of the leg movement remains unaffected. As the model of musical-temporal experience and the associated behavioral sequence shows, clear rhythmic structures can provide people with dementia with a sense of support and orientation. Even when larger units of time are no longer processible, orienting oneself to the basic pulse allows for a sustained connection with the music. Applying the three levels to the perception of music in people with dementia, it can be concluded that a clear, distinct and stable rhythmic structure helps to maintain a connection to the music, even when the cognitive impairment limits the capability to grasp larger contexts.

Rhythm is a constant parameter in the perception of music, activating auditory and motor regions of the brain. It is noteworthy that the motor regions play an integral role in the perception of beat in music, even when listeners are not moving or tapping to the music (Vanden Bosch der Nederlanden et al. 2019: 172). This awareness is of particular significance for individuals with limited mobility, as it can be assumed that activation is taking place even if it is not or only slightly visible from the outside. Rhythmic responses depend on physical ability and the severity of the dementia. Nevertheless, even subtle impulses may be signs of synchronization. The feeling of synchronizing with the rhythm serves as a source of orientation, which contrasts with the typical daily experiences of many people with dementia. It can provide a sense of stability by establishing a temporal order during the playtime. In this regard, music can contribute to relaxation and well-being for people with dementia who are disoriented in space or time.

## 4 LOOKING TO THE FUTURE

Despite improvements in healthcare and an increase in life expectancy, the ageing of the global population is leading to an increase in age-related diseases, including dementia. Currently, there is no cure for the disease. For this reason, maintaining and improving quality of life in old age are important goals in the treatment of those affected. Non-pharmacological ap-

proaches have been identified as particularly promising for improving the well-being of people with dementia.

As a key to wellbeing, meaningful activities are essential to improve their quality of life and reduce agitated behavior. Music has been demonstrated to be a powerful emotional and cognitive stimulus, and different types of musical activities may be used several times a day to positively influence the mood and behavior of people with dementia (Särkämö et al. 2012: 7). IML interventions are particularly low-threshold and cost-effective, and can be used regardless of an individual's level of education, previous musical experience, or the severity of the disease (Jakob et al. 2021: 56). They can provide an opportunity for social interaction or entertainment. Music has been shown to have a positive effect on people with dementia, as well as on their family members and caregivers. Incorporating music into daily care tasks is a simple and effective approach (McDermott et al. 2014: 712-713).

Nevertheless, the study of music and dementia is a young field of research. To ensure the adequate examination of the subject, which encompasses a range of disciplines in itself, it is essential to consider both the behavioral and musical aspects from an interdisciplinary perspective (Brotons et al. 1997: 235). This article synthesizes observations made during the research project *Individualized music for people with dementia—improvement of quality of life and social participation for people with dementia in institutional care*, which primarily focused on behavioral aspects from the discipline of psychology, and expands upon them through musical analyses by a musicologist. The musicological approach highlights the musical elements that elicit reactions from individuals with dementia during IML, with a particular emphasis on rhythmic synchronization in this article.

Dementia is often associated with a decline in verbal communication skills, which is also characterized by a decline in social interaction. The research project yielded evidence that rhythmic synchronization can serve as a means of nonverbal communication. In such cases, sharing musical experiences is a crucial factor in activating people with dementia. Similarly, there are cases of individuals with dementia who derive satisfaction from dancing or moving to music on their own, without a need to synchronize with others.

A clear perception of the pulse structure and its metric hierarchy facilitates synchronization with the music. For people with dementia who experience difficulty orienting themselves in time and space, a clearly discernible pulse structure can be helpful in synchronizing with the music and reinforcing their sense of orientation. The sense of direction provided by rhythm can be a contrast to the everyday lives of people with dementia, and continuous pulse structures can contribute to a sense of stability and well-being. Even

in the case of poor mental condition, rhythmic responses are often maintained.

The observations from the case studies show that rhythmic synchronization can contribute substantially to the well-being of people with dementia. However, there is still a lack of systematic investigations into the process of selecting music that is sensitive to the needs of those with dementia, particularly with regard to rhythm. The observations presented in this article serve as a reference point for further studies focusing on the potential of rhythmic synchronization to increase the well-being of people with dementia.

In the process of creating individualized playlists for IML, it is crucial to prioritize the exploration of autobiographical information. It is essential to consider the life experiences of a person with dementia and the potential impact on their behavior, which may undergo changes over the course of the disease. Autobiographical memory can serve as a point of reference, and music can evoke these memories, thereby providing a source of joy. However, the selection of individualized music also requires consideration of the musical parameters, which have been the focus of this article. Rhythm, in particular, has been identified as an important inherent factor, facilitating synchronization with the music and facilitating synchronization with others. Consequently, future musical selections for IML should not only prioritize the individual's most preferred songs, which often evoke special life events, but also consider the impact of specific musical parameters, such as rhythm, on individuals with dementia. This approach could enhance their responsiveness to musical stimuli.

In conclusion, the research project has demonstrated that many people with dementia continue to move accurately to their preferred music. This indicates that they continue to perceive and respond to the music, that it continues to affect them emotionally, and that they still got the groove.

## REFERENCES

Bernatzky, Günther / Grebosz-Haring, Katarzyna / Wendtner, Franz / Kreutz, Gunter (2015). »Musikhören bei Depression und Demenz: von der Hirnforschung zur klinischen Anwendung.« In: *Musik und Medizin: Chancen für Therapie, Prävention und Bildung*. Ed. by Günther Bernatzky and Gunter Kreutz. Wien: Springer, pp. 85-97.

Brotons, Melissa / Koger, Susan / Pickett-Cooper, Patty (1997). »Music and Dementias: A Review of Literature.« In: *Journal of Music Therapy* 34 (4), pp. 204-245.

Cason, Nia / Schiaratura, Loris / Samson, Séverine (2017). »Synchronization to Music as a Tool for Enhancing Non-Verbal Communication in People with Neurological Diseases.« In: *The Routledge Companion to Embodied Music Interaction*. Ed. by Micheline Lesaffre, Pieter-Jan Maes and Marc Leman. New York: Routledge, pp. 304-312.

Chang, Yu-Shiun / Chu, Hsin / Yang, Chyn-Yng / Tsai, Jui-Chen / Chung, Min-Huey / Liao, Yuan-Mei / Chi, Mei-ju / Liu, Megan F. / Chou, Kuei-Ru (2015). »The efficacy of music therapy for people with dementia: A meta-analysis of randomised controlled trials.« In: *Journal of Clinical Nursing* 24 (24), pp. 3425-3440.

Clements-Cortés, Amy (2019). »Understanding the Continuum of Musical Experiences for People With Dementia.« In: *Music and Dementia: From Cognition to Therapy*. Ed. by Amee Baird, Sandra Garrido and Jeanette Tamplin. New York: Oxford University Press, pp. 3-23.

Deutsche Alzheimer Gesellschaft (2022). *Informationsblatt 1: Die Häufigkeit von Demenzerkrankungen*. Berlin.

Ferreri, Laura / Moussard, Aline / Bigand, Emmanuel / Tillmann Barbara (2019). »Music and the Aging Brain.« In: *The Oxford Handbook of Music and the Brain*. Ed. by Michael H. Thaut and Donald A. Hodges. Oxford: Oxford University Press, pp. 623-644.

Fraisse, Paul (1982). »Rhythm and Tempo.« In: *The Psychology of Music*. Ed. by Diana Deutsch. New York und London: Academic Press, pp. 149-180.

Gabrielsson, Alf (1982). »Perception and Performance of Musical Rhythm.« In: *Music, Mind, and Brain: The Neuropsychology of Music*. Ed. by Manfred Clynes. Boston: Springer US, pp. 159-169.

Gabrielsson, Alf (1993). »The Complexities of Rhythm.« In: *Psychology and Music. The Understanding of Melody and Rhythm*. Ed. by Thomas J. Thighe and W. Jay Dowling. New York: Psychology Press, pp. 93-120.

Gabrielsson, Alf / Lindström, Erik (2010). »The Role of Structure in the Musical Expression of Emotions. « In: *Handbook of Music and Emotion: Theory, Research, Applications*. Ed. by Patrik N. Juslin and John Sloboda. Oxford: Oxford University Press, pp. 367-400.

Garrido, Sandra / Dunne, Laura / Chang, Esther / Perz, Janette / Stevens, Catherine J. / Haertsch, Maggie (2017). »The Use of Music Playlists for People with Dementia: A Critical Synthesis.« In: *Journal of Alzheimer's Disease* 60 (3), pp. 1129-1142.

Garrido, Sandra / Stevens, Catherine J. / Chang, Esther / Dunne, Laura/ Perz, Janette (2019). »Musical Features and Affective Responses to Personalized Playlists in People With Probable Dementia.« In: *American Journal of Alzheimer's Disease & Other Dementias* 34 (4), pp. 247-253.

Gaviola, Minah Amor / Inder, Kerry J. / Dilworth, Sophie / Holliday, Elizabeth G. / Higgins Isabel (2020). »Impact of individualised music listening intervention on persons with dementia: A systematic review of randomised controlled trials.« In: *Australasian Journal on Ageing* 39 (1), pp. 10-20.

Ghilain, Matthieu / Schiaratura, Loris / Singh, Ashmita / Lesaffre, Micheline / Samson Séverine (2019). »Is Music Special for People With Dementia?« In: *Music and Dementia: From Cognition to Therapy*. Ed. by Amee Baird, Sandra Garrido and Jeanette Tamplin. New York: Oxford University Press, pp. 24-40.

Gold, Christian / Eickholt, Jasmin / Assmus, Jörg / Stige, Brynjulf / Dugstad Wake, Jo / Baker, Felicity Anne / Tamplin, Jeanette / Clark, Imogen / Lee, Young-Eun Claire / Lindahl Jacobsen, Stine / Ochsner Ridder, Hanne Mette / Kreutz, Gunter / Muthesius, Dorothea / Wosch, Thomas / Ceccato, Enrico / Raglio, Alfredo

/ Ruggeri, Mirella / Vink, Annemiek / Zuidema, Sytse / Odell-Miller, Helen / Orrell, Martin / Schneider, Justine / Kubiak, Christine / Romeo, Renee / Geretsegger, Monika (2019). »Music Interventions for Dementia and Depression in ELderly care (MIDDEL): protocol and statistical analysis plan for a multinational cluster-randomised trial.« In: *BMJ Open* 9 (3), pp. 1-14.

Hillebrand, Mareike C. / Weise, Lisette / Itz, Marlena L. / Jakob, Elisabeth / Wilz, Gabriele (2024). »Music Matters, but so Does the Outcome Measure: A Randomized Controlled Trial for an Individualized Music Intervention for People Living with Dementia.« In: *Clinical Gerontologist*, pp. 1-13.

Hillebrand, Mareike C. / Weise, Lisette / Wilz, Gabriele (2023). »Immediate effects of individualized music listening on behavioral and psychological symptoms of dementia: A randomized controlled trial.« In: *International Journal of Geriatric Psychiatry* 38 (3), pp. 1-9.

Jacobsen, Jörn-Henrik / Stelzer, Johannes / Fritz, Thomas Hans / Chételat, Gael / La Joie, Renaud / Turner, Robert (2015). »Why musical memory can be preserved in advanced Alzheimer's disease.« In: *Brain* 138 (8), pp. 2438-2450.

Jakob, Elisabeth / Weise, Lisette / Wilz, Gabriele (2021). »Das Hören von Lieblingsmusik. Erste Erkenntnisse zur Studie Individualisierte Musik für Menschen mit Demenz.« In: *pflegen: Demenz* 58, pp. 53-56.

Kales, Helen C. / Gitlin, Laura N. / Lyketsos, Constantine G. (2015). »Assessment and management of behavioral and psychological symptoms of dementia.« In: *British Medical Journal* 350, pp. 1-16.

Leman, Marc / Buhmann, Jeska / Dyck, Edith (2017). »The empowering effects of being locked into the beat of the music.« In: *Body, Sound and Space in Music and Beyond: Multimodal Explorations*. Ed. by Clemens Wöllner. London: Routledge, pp. 13-28.

McDermott, Orii / Orrell, Martin / Ridder, Hanne Mette (2014). »The importance of music for people with dementia: the perspectives of people with dementia, family carers, staff and music therapists.« In: *Aging & Mental Health* 18 (6), pp. 706-716.

Pfleiderer, Martin (2006). *Rhythmus. Psychologische, theoretische und stilanalytische Aspekte populärer Musik*. Bielefeld: transcript.

Przyborski, Aglaja / Wohlrab-Sahr, Monika (2014). *Qualitative Sozialforschung. Ein Arbeitsbuch*. 4. Aufl. München: Oldenbourg.

Raglio, Alfredo / Oasi, Osmano (2015). »Music and health: what interventions for what results?« In: *Frontiers in Psychology* 6 (230), pp. 1-3.

Rossato-Bennett, Michael (2014). *Alive Inside*. United States: Projector Media.

Samson, Séverine / Clément, Sylvain / Narme, Pauline / Schiaratura, Loris / Ehrlé, Nathalie (2015). »Efficacy of musical interventions in dementia: methodological requirements of nonpharmacological trials.« In: *Annals of the New York Academy of Sciences* 1337 (1), pp. 249-255.

Särkämö, Teppo / Laitinen, Sari / Tervaniemi, Mari / Numminen, Ava / Kurki, Merja / Rantanen, Pekka (2012). »Music, Emotion, and Dementia: Insight From Neuroscientific and Clinical Research.« In: *Music and Medicine* 4, pp. 153-162.

Savaskan, Egemen / Bopp, Irene / Buerge, Markus / Fischlin, Regina / Georgescu, Dan / Giardini, Umberto / Hatzinger, Martin / Hemmeter, Ulrich / Justiniano, Isabella / Kressig, Reto / Monsch, Andreas / Mosimann, Urs / Müri, René / Munk, Anna / Popp, Julius / Schmid, Ruth / Wollmer, Marc (2014). »Empfehlungen zur Diagnostik und Therapie der behavioralen und psychologischen Symptome der Demenz (BPSD).« In: *Praxis* 103 (3), pp. 135-148.

Schmüdderich, Kathrin / Holle, Daniela / Ströbel, Armin / Holle, Bernhard / Palm, Rebecca (2021). »Relationship between the severity of agitation and quality of life in residents with dementia living in German nursing homes – a secondary data analysis.« In: *BMC Psychiatry* 21 (1), pp. 1-12.

Schön, Lisa (2025). *Musikhören für Menschen mit Demenz. Fallstudien – Wirkungen – Anwendungen*. Bielefeld: transcript.

Snyder, Bob (2001). *Music and Memory. An Introduction*. Cambridge: MIT Press.

Töpfer, Nils F. / Schön, Lisa / Jakob, Elisabeth / Hillebrand, Mareike C. / Reichertz, Jo / Rother, Doreen / Weise, Lisette /Wilz, Gabriele (2024). »Sounds of Difference: A Typology of Reactions of People with Dementia to Individualized Music in the Presence of a Monitoring Person.« In: *The Gerontologist* 64 (6), pp. 1-12.

Vanden Bosch der Nederlanden, Christina / Taylor, J. Eric T. / Grahn, Jessica A. (2019). »Neural Basis of Rhythm Perception.« In: *The Oxford Handbook of Music and the Brain*. Ed. by Michael H. Thaut and Donald A. Hodges. Oxford: Oxford University Press, pp. 165-186.

Weise, Lisette / Jakob, Elisabeth / Töpfer, Nils Frithjof / Wilz,Gabriele (2018). »Study protocol: individualized music for people with dementia—improvement of quality of life and social participation for people with dementia in institutional care.« In: *BMC Geriatrics* 18 (313), pp. 1-8.

Wilz, Gabriele (2024). *Psychotherapeutic Support for Family Caregivers of People With Dementia. The Tele.TAnDem Manual*. Göttingen: Hogrefe.

World Health Organization (2021). *Global status report on the public health response to dementia*. Geneva.