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Rationale for the Effects of Familiar Music on Agitation and Orientation Levels of People in Posttraumatic Amnesia

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Summary

Observing highly agitated, disoriented and distressed young adults experiencing posttraumatic amnesia (PTA) is emotionally difficult for both the family and the staff caring for them. The author discusses the findings of a research project, reported elsewhere, which addressed the agitation and poor orientation of this client group. Firstly, the author outlines the phenomena of posttraumatic amnesia and illustrates the similarities in clinical presentation with those people in coma and those who have Alzheimer's Disease. Following this, the text examines the research findings in relation to music therapy work with these clinical groups. The Yerkes-Dodson theory of arousal (1908) and the Activation Theory of arousal (Morruzzi and Magoun, 1949) are adopted to explain the findings. Music's creation of a familiar and safe environment and its role in decreasing arousal is in depth.

Introduction

“Posttraumatic amnesia is perhaps the most dramatic behavioural consequence of severe traumatic brain injury” (Mysiw and Jackson, 1995, p.197).

The following text discusses the rationale for the effects of familiar music on the agitation and orientation levels of people in posttraumatic amnesia (PTA). The discussion is based on the results of previous research reported elsewhere¹. Briefly, the research, completed in 1999, compared the conditions of live music, pre-recorded music and no music in decreasing agitation and enhancing orientation of 22 people experiencing PTA. Participants were exposed to all three conditions presented in a randomised order, twice over six consecutive days. Three songs were used in the two music conditions and the songs were selected based on the participants' own preferred music. The degree of changes to agitation were pre and post-tested using the Agitation Behaviour Scale (Corrigan, 1989). This scale, developed especially for people with acquired brain injury, assesses changes to the different behaviours considered indicative of agitation. The participants' orientation to time, place and person was assessed pre and post conditions using the Westmead PTA Scale (Shores, Marosszeky, Sandanam, and Batchelor, 1986). The Westmead PTA scale also includes an assessment of the ability to recall 3 pictures shown to them. The participants' ability to recall these pictures was compared with their ability to recall the three music selections used from day to day.

The results indicate that the music conditions significantly reduced agitation ($p < 0.0001$) and enhanced orientation ($p < 0.001$) in the participants. However, the difference between the effects of live and taped music for both orientation and agitation was not significant

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($p=0.7$). For the comparison of the recall of pictures from the Westmead PTA scale and the recall of the songs included in the program, the differences were not significant ($p=0.7$), however, trends suggested that the mean number of music selections recalled was greater (1.22) than the mean number of pictures recalled (0.84).

The following paper discusses the reported effects of music on the orientation and agitation of people experiencing posttraumatic amnesia. The paper also compares these effects with the effects of music on patients in coma and patients with Alzheimer's Disease. In addition, a discussion on the involvement of music affecting arousal is presented as a possible explanation for the observed changes. The specific focus of this paper is on the effects of music on the participants' possible intrapersonal processes that may have occurred. Whilst the author acknowledges the influence of interpersonal processes and the development of the therapeutic relationship between the participants and researcher, this is not the focus of the current paper and is not discussed here. Please note that this text does not explore the comparisons between the effects of live and taped music, nor the findings regarding the recall of music selections and pictures.

Post-Traumatic Amnesia

PTA is a stage in recovery from head injury that immediately follows the period of coma, is characterised by poor orientation, agitation and an inability to learn (Ponsford, Sloan and Snow, 1995) and correlates with a period of spontaneous recovery in the brain (Zafonte, 1997). When patients are disoriented to time, place and person, they may become distressed, for example when the environment is misinterpreted as being a hotel, prison or a school (Ponsford et al., 1995) and their confusion may provoke attempts to abscond or wander in search of familiar surroundings. Watanabe, Black, Zafonte, Millis, and Mann (1998) propose that poor orientation is caused by a combination of disrupted functions including impaired alertness, selective inattention, impaired recent memory and by the disruption of specific brain pathways. People in PTA also display poor short-term memory, a poor ability to learn new information (Ponsford et al., 1995; Wilson, Baddeley, Shiel and Patton, 1992), and may be unable to remember events even minutes after they have occurred. This contributes to their poor orientation, as they are unable to recall the orienting information that hospital staff may give them. Approximately two-thirds of patients are unable to recall any events during the PTA period and one third of patients retain islands of fragmentary memories after the resolution of PTA (Daniel, Crovitz and Weiner, 1987).

Agitation, the constant display of uninhibited movement, is often the first symptom exhibited at the commencement of the PTA phase of recovery (Malkmus, Booth and Kodimer, 1989). Agitation manifests itself in communication (constant, excessive and inappropriate talking), behaviour (aggression, disinhibitive behaviours, poor tolerance to pain or frustration, impatience, uncooperative behaviour, disturbed sleep, and violence), physical functioning (tension, wandering, excessive movement, restlessness, self-stimulation) and cognitive functioning (short attention span, distractibility, impulsivity) (Fugate, Levy, Johnson and Mysiw, 1997). When patients are agitated they may place themselves in danger of self-injury

in their attempts to abscond, removal of bandages and intravenous tubes, aggression towards others and resistance to medical intervention and nursing care.

There is now a consensus that pharmacological interventions can delay the cognitive and functional improvement of patients, thereby prolonging PTA resolution (for example: Ellenberg, Levin, and Saydjari, 1996; Zafonte, 1997). Consequently behavioural management is employed by providing a structured routine and including the presence of family, familiar photos and possessions, to create a familiar environment and prevent anxiety caused by experiencing unfamiliar situations (Ponsford et al., 1995). However, these techniques have not resulted in totally managing PTA symptoms, and it was for this reason, that the impetus for the prior research evolved.

To understand the source of changes in orientation and agitation that occurred for the participants' in PTA, a comparison has been made with music therapy research with people who are in coma and people who have Alzheimer's Disease (AD). The rationale for linking this research with people in PTA is as follows:

- (1) People in coma are also poorly oriented to the environment although this disorientation is at a lower level than people in PTA (such as merely being aware of sounds, sights and smells in the room). Further, people in coma may also display agitation (Kennelley and Edwards, 1997).
- (2) People with AD also display poor orientation to time, place and person and are frequently reported to display either constant or episodic periods of agitation (Clair, 1996).
- (3) The clinical presentation of a person in late stage dementia can be likened with that of a person in coma (little or no response to aspects or events in their environment), and a person in middle stage dementia shares a similar clinical presentation with that of a person in PTA, (poor orientation to time, place and person, presence of agitation and poor short term memory) (Clair, 1996).

Music's Role in the Orienting Process

Aldridge (1996), Aldridge, Gustorff and Hannich (1990), Ansdell (1995), Bright and Signorelli (1999), Kennelly and Edwards (1997) and Rosenfeld and Dun (1999) reported the positive effects of music on orientation of people in coma. Observed orienting responses included making eye contact with the music therapist and head turning, spontaneous eye opening and increased movement in the patients' limbs. Similarly, for people in late stage dementia, familiar music facilitated orienting responses such as rotating the head to localise sound, opening eyes and fixing on the music therapist, moving limbs, vocalising, and changing their tense facial expressions to neutral expressions (Clair, 1996). For people in the middle stages of AD, familiar music employed in a range of different music therapy interventions, was found to improve orientation to time, place and person (Shively and Henkin, 1986; Clair and Ebberts, 1997; Olderog-Millard and Smith, 1989).

It is possible that music achieves this response for people with AD and people in coma because people's memory for music may remain intact following neurological damage or

degenerative neurological diseases (O'Callaghan, 1999). Music has been considered as a "relative island of preservation in a sea of impairments" (Balch and Bathory-Kitsz, 1993, p. 418). This implies that although people in coma or with AD have cognitive deficits, they may retain the ability to recognise and recall familiar musical material (Ansdell, 1995). This recognition of familiar music may have encouraged the patients to take more notice of the environment that they were in. With respect to people in PTA, anecdotal observations of the responses given by the participants' in the study clearly indicated that the music was well recognised by them (Baker, 1999). These common responses included singing the words of the songs and/or briefly verbalising the participants' opinion on the song and/or artist.

Music's potential to create a structured, safe and more familiar environment has been argued as one possibility for understanding why music is able to enhance orientation of people in coma and people with AD as observed in these studies. This structured environment may have been less threatening and confusing for both people in coma and people with AD, than the often unfamiliar and noisy environment of the hospital and nursing home ward (Kennelly and Edwards, 1997; Ansdell, 1995; O'Callaghan, 1999). In creating this structured environment, the patients' stress attributed by the unfamiliar environment was reduced, thereby encouraging them to become and remain oriented and connected with their environment. Aldridge (1996) suggests that the predictable features of music, including the rhythmic pulse, cadences, familiar melody, harmonic frameworks and timbres, provide these structure and orienting cues. Similarly, creating a structured and familiar environment for the patient in PTA is recommended by clinicians experienced in PTA management. By providing familiar photos, possessions and the presence of family members, there is a greater chance that the patients in PTA may recognise the environment and feel safer to make contact with it. Similarly, the familiarity with the environment may reduce the patients' distress and anxiety (Howard, 1988; Malkmus et al., 1989; Ponsford et al., 1995). Given this, and the evidence that music orients people in coma and people with AD, it seems reasonable to argue that music functions in the same way for people in PTA, that is, greatly increasing the familiarity of the environment by filling the patients' rooms with music that they recognise, thereby inviting them to be part of it.

Music's Role in Reducing Agitation

Although there has been no study examining the effect of music on agitation of patients experiencing PTA, Kennelly and Edwards (1997) found that agitation reduces when familiar music is played to children in a semi-conscious state. Similarly, the inclusion of familiar music in music therapy programs has assisted people with AD to become less agitated with the specific symptoms of aggression, hiding/hoarding, wandering, repetitive vocalisations, excessive psychomotor movement, distress, tension and restlessness being amongst those symptoms whose severity was reduced (Brotons and Pickett-Cooper, 1996; Casby and Holm, 1994; Hanser and Clair, 1995; Thomas, Heitman, Alexander, 1997; Whitcomb, 1994). It has been the inclusion of familiar music that has been implicated as the primary reason for the reduction of agitation in the patients with AD and for the children in a semi-conscious state. The similarity in the effect of music in people experiencing PTA, would suggest that familiar

music affects these people in much the same way.

Dietsche and Pollman (1982) and Whitcomb (1994) observed that when agitation reduced following the music therapy programs with people who have AD, a corresponding improvement in orientation occurred. Although this link was not established, a similar observation was implied in Kennelly and Edward's (1997) music therapy work with children in coma. In a study concerning the relationship between agitation, cognition and attention of people in PTA, Corrigan et al. (1992) reported the same relationship between orientation and agitation. The observations from the author's own research align with and further support these observations that music can facilitate an increase in orientation and a corresponding decrease in agitation, however, the author's study had insufficient data to statistically establish a relationship.

In people who are cognitively intact, behaviours such as sudden changes of mood, threats of violence, anger, aggression, and uncooperative behaviour are often provoked by either events or other peoples' actions. People with middle stage AD display agitation such as aggression and anger, possibly in response to events or people's actions that they are unable to comprehend (Mace and Rabins, 1991). In people experiencing PTA, it is also likely that they display agitation in response to being in an environment that they do not understand. Perhaps the reduction in agitation in both studies of people with AD and the author's own study of people experiencing PTA, indicates further, the role of familiar music in enhancing orientation. The observation that the patients' agitation decreased may suggest that they were able to understand the environment and the actions of others, thereby limiting the opportunities for these reactive responses. This tentative assumption supports the previously described argument that music facilitates a corresponding increase in orientation.

In the author's study, prior to the presentation of music, many of the participants displayed excessive psychomotor activity that was both inappropriate and lacked purpose (for example: wandering around the room, self-stimulatory behaviour or continuously hitting the wall). Whilst the music was being played to the participants, these various behaviours transformed, becoming more appropriate and intentional. For example, unnecessary movements of upper or lower limbs were replaced with appropriate foot tapping or hand clapping. Some participants altered their continuous pacing around the room to assimilate with the rhythm of the music. One participant imitated the movements of playing a guitar as he paced around the room. These modifications of behaviour illustrate that the participants were processing the music stimuli accurately and in turn, altering their behaviour to match the pace of the music. Participants discontinued the appropriate movements (such as hand clapping) and did not resume the inappropriate movements at the completion of the music program. This implies that music provided a structural framework for the automatic but appropriate expression of agitation, thereby releasing their agitated energy appropriately. The end of the music seemed to cue the patients to cease these appropriate movements. To continue the movements would have been inappropriate without the presence of music. Again this supports the assumption that their understanding of the environment was enhanced, further illustrating the relationship between orientation and agitation levels (Corrigan et al., 1992) and music's role in altering it.

The author found that the participants' incidence or severity of rapid, loud or excessive talking decreased following listening to familiar music. Casby and Holm (1994) have already reported the correlation between a reduction in the number of vocalisations and the playing of music in people with AD. The findings of Casby and Holm's and the author's study imply that music affects the verbal components of agitation of people with brain injury and AD in similar ways. The author also observed that the participants' conversations became more appropriate following the music conditions. They began to discuss their thoughts on the songs being played and the researcher's live replication of the songs. Many of the conversations became less tangential and more organised, indicating that the verbal components of agitation reduced and the quality of the verbal interactions was enhanced.

Role of Arousal in Posttraumatic Amnesia

The phenomenon of environmental awareness and orientation depends directly on cortical arousal (Whyte, 1992). Arousal refers to a state of alertness and high responsiveness to stimuli, reflecting the "underlying energetic state of the individual" (Cohen, 1993, p.116). It represents the neuronal activity within the brain, describing the moment when the brain is ready to receive sensory information and act in accordance (Hodges, 1996).

The Yerkes-Dodson Law (1908) attempts to explain the connection between arousal and optimal task performance (here, orientation). It states that performance becomes optimal at medium levels of arousal and decreases as arousal increases or decreases (cited Glass and Holyoak, 1986, p.102; Prigatano, 1999). More specifically, when arousal levels are low (hypo-arousal), the person becomes unable to distinguish between relevant and irrelevant information, and in the brain's attempt to process all stimuli, becomes overloaded and then fails to respond altogether. This theory has been applied to explain why people in coma do not respond (Cohen, 1993). Similarly, when arousal is at a moderate level, the person's sensitivity also increases. The person becomes able to filter noise, ignore irrelevant stimuli and focus only on the necessary aspects of a task. When arousal is too high (hyper-arousal), the person becomes over-sensitised, disregarding the relevant stimuli as well as the irrelevant and leading to performance deterioration. Disorganised behaviour such as mania, agitation and hyper-activity results, as the person is unable to utilise information and act accordingly (Cohen, 1993). The clinical presentation of a person in PTA suggests that people in PTA are in a state of hyper-arousal when they are agitated and disoriented (Sandel, Zwil, Fugate, 1995). Because the author noted that the participants' agitation decreased and their orientation to the environment was enhanced following the listening of familiar music, it suggests that music facilitated a change in their arousal (that is, arousal decreased towards optimal levels) according to the Yerkes-Dodson theory (1908).

Glass and Holyoak (1986) further developed the Yerkes-Dodson theory, stating that arousal levels required for optimal performance vary according to the task's level of difficulty. They postulated that completion of difficult tasks require medium levels of arousal and easier tasks require higher levels of arousal. Glass and Holyoak (1986) also found that the novelty of unfamiliar stimuli requires more extensive cortical processing in comparison to familiar

stimuli and that the processing of information that is not familiar is likely to raise arousal levels to a greater degree than unfamiliar stimuli.

This theoretical framework can be applied to explain the possible effects of the familiar music. When working with people in this study, I noticed that when asking orientation questions following the music listening experiences, the patients tended to respond with more speed and confidence than they did when questioned prior to the music listening experience. Given this, it would appear that prior to experiencing the music listening program, the patients' arousal levels were too high, and they were unable to answer the orientation questions correctly and quickly. However following the music listening sessions, improvements in orientation and increased response times to questions suggest that the music experiences facilitated a change in arousal levels that were more appropriate to the orientation test's level of difficulty. Perhaps if the music was unfamiliar, it would have been more difficult to process and perhaps not resulted in the changes in arousal that were illustrated by the increase in orientation and decrease in agitation.

Moruzzi and Magoun's (1949) Activation Theory includes the functioning of the reticular activating system (RAS) as essential in the state of arousal. The RAS functions to activate and deactivate selected nervous circuits; and to monitor sensory signals, filtering and ignoring the unimportant aspects of an experience, and redirecting the relevant sensory signals to the corresponding areas of the cortex for further processing (Cohen, 1993). People with damage to the RAS fail to react effectively to stimuli. For example, during periods of coma, the RAS is unable to activate sufficient arousal to energise the patient, so regardless of the type and intensity of stimulation presented, the patient is unable to respond. Rosenfeld and Dun (1999) conceived that music enhances the orientation of people in coma by activating the reticular activating system (RAS), which in turn activates parts of the cortex. In this way, the music has stimulated the RAS to become active and functional, so that it can then in turn, activate other neuronal circuits ultimately changing the level of functioning of the individual. With respect to the participants in the author's study, because they enhanced their orientation and decreased their agitation, this indicates that the functioning of the RAS was also enhanced as a consequence of the music listening experience.

Taylor (1997) reported that musical stimulation has the ability to activate and sensitise the RAS, thereby increasing arousal. This seems appropriate and important for people who are in a hypo-aroused state (people in a coma). However, for people in PTA, further increasing arousal would be detrimental and may place them at greater risk of increasing agitation. However, the author's findings demonstrate that music can also play a role in reducing arousal for people who are hyper-aroused. This raises many questions regarding why and how music can play opposing roles for people with coma and people experiencing PTA.

Complex music can be considered music with many melodic lines, instrumental timbres, and changes to harmony, dynamics and tempo. Scartelli (1991) suggests that complex music is more difficult to process cognitively than simple music, implying that listening to complex music may increase arousal (Konecni and Sargent-Pollock, 1976). Therefore, it is logical to assume that simple music would be preferable to play for people in PTA when a decrease in

arousal is desired. Supporting this idea, Ansdell (1995) stated that music should be simplified to the cognitive capacity of people with brain injury. Similarly, music that is structurally repetitious decreases arousal because it brings familiarity to the listener and does not require the listener to give the music any additional attention (Gardner, 1993). This idea concurs with the points raised by Glass and Holyoak (1986), which state that the less novel the stimuli, the greater the decrease in arousal.

For the people who were included in the author's study, the proposed reduction in arousal may have occurred during music listening because the participants were participating in an activity that matched their cognitive abilities. Because they were able to recognise, sing-along with and discuss the songs with the author, it was clear that they understood the music and that the music selections suited their cognitive abilities. Most of the music selections included in the study, were popular songs, which were familiar, predictable and simply structured as reflected by predictable rhythms, melodies, harmonies, and the presence of repetitive sections (chorus alternating with verses) and an instrumentation of up to six instruments. The combination of the predictable and simplistic components of the music selections increase the likelihood of the brain predicting what musical phrase (and its length), lyric, chord, instrument, harmonic sequence and tempo will follow. Predictability ensures that minimal arousal is required to interpret the music and may be one reason why music was so effective in reducing arousal and agitation and enhancing orientation.

Conclusions and Final Thoughts

In working with people experiencing PTA, the author argues that the playing of *familiar, predictable and stylistically simple* reduces their agitation and enhances their orientation. Possible processes and sources facilitating such outcomes include a reduction in people's cortical arousal. These decreased arousal levels enable them to more accurately cognitively process the information they receive from the environment. Similarly, the familiar music creates a more familiar, which subsequently encourages people to interact with it more, thereby enhancing their awareness of it. With regard to agitation, in some cases the rhythmic elements of the music can facilitate an appropriate expression of agitation. In others, the familiarity of the music is calming. In addition, the feelings of safety, which occur with enhancement orientation to the environment, may result in reduced agitation also.

Similarities in the responses to listening to familiar music with people who are in coma, people who have Alzheimer's Disease and people experiencing PTA, suggest that similar processes are occurring with regard to the reduction of agitation and enhancement of orientation. What remains unclear is how and in what ways are these processes the same in these differing populations? The author hopes that music therapy researchers' increasing interest in the field of agitation and orientation, particularly with people who have dementia, will further fuel the development of knowledge in this area.

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