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Abstract

The current study examines whether thematic music (e.g., battle music) can activate related concepts in memory (e.g., weapons, death) and whether the activated concepts are more likely to be included in a story generation task. Participants listened to one of two 90-sec excerpts of thematic music (Baby theme or War theme) either before or after engaging in a story generation task. Their stories were examined to determine the degree to which the thematic elements of the music were included in the stories. Across two experiments, there was evidence that listening to war or baby themed music before engaging in a generation task increased the likelihood that elements associated with that theme would be incorporated into the story. Evidence also existed that the music theme interacted with the story theme to influence the degree that thematic elements would be incorporated into the story.

Keywords: concepts; categories; knowledge representation; music; creativity; generation.

Introduction

We use music to celebrate events, entertain, motivate and inspire us. Hearing a song can bring back memories of a college romance. The musical score of a movie warns us when something unpleasant is about to happen. Given the pervasiveness of music in our lives, surprisingly little research has been directed at determining whether music is represented in semantic memory and how the musical associations stored in semantic memory affect performance on a variety of tasks

People's musical knowledge develops throughout their lives via exposure to such things as lullabies, music education, background music in television and film, and musical entertainment. Because people live in a musically rich environment, they become attune to the complexities of musical structure at an early age. Even three-year-old children demonstrate an understanding of the relationship between music in a major key being associated with a happy mood and music in a minor key being associated with a sad mood (Kastner & Crowder, 1990). This type of knowledge affects five to six-year-old children's interpretation of a story such that "happy" music playing in the background causes the children to form positive interpretations of a neutral story whereas "sad" music playing in the background causes them to form negative interpretations (Ziv & Goshen, 2006).

Exposure to certain types of music becomes associated with particular events throughout a lifetime of musical experiences (e.g., weddings, circuses). It stands to reasons that the link between music and event becomes strong enough that knowledge of the music will join object and event information in the concepts and schemas with which it is associated (e.g., "wedding music," "circus music"). Empirically demonstrating the existence of these associations is just beginning though.

Daltrozzo and Schön (2009) argued that music conveys concepts in the same way that images and words convey concepts. They supported this claim by demonstrating a larger N400 component of the event-related brain potentials to 1-second musical excerpt targets following a conceptually unrelated compared to a conceptually related linguistic context. Though this is fairly direct evidence of conceptual processing of musical information, it is left to other researchers to explain how such a short excerpt of music carries enough information to activate conceptual information in memory. Stronger (albeit indirect) evidence for the conceptual representation and processing of musical information is provided by North, Hargreaves, & McKendrick (1997) who demonstrated that ethnic background music can affect consumer decisions. When French music was playing in a wine shop, consumers were more likely to buy French wine than German wine. When German music was playing, the opposite was true, Boltz (2001) also demonstrated the effect of music on actions by demonstrating that musical soundtracks could activate a schematic framework thus affecting the interpretation of an ambiguous movie scene. Boltz (2001) had participants watch an ambiguous scene paired with either "positive" or "negative" music. She found that when a scene was paired with positive music it activated a positive schema resulting in positive interpretations of the events occurring in the scene (e.g., the man following the woman is a long lost lover) and subsequent memory for positive objects (e.g., flower bouquet) and events in the scene. When a scene was paired with negative music it activated a negative schema resulting in negative interpretations of the events occurring in the scene (e.g., the man following the woman is her brother and plans to kill her) and subsequent memory for

negative objects (e.g., human skull) and events in the scene. An interesting component of the paradigm Boltz (2001) used to demonstrate music acting as a schematic influence on the cognitive processing of film events is that she had participants extrapolate the film's ending as a means of examining the effect of schema activation by looking for elements of those schemas in the extrapolations. In demonstrating the influence of the schemas activated by the music via the events and objects described in participant's extrapolations of the film's ending, Boltz (2001) also demonstrated that music can activate conceptual knowledge which then affects performance in a generation task.

Those studying creative cognition, frequently use generation tasks to examine the influences of concepts and categories on performance. In doing so, they gain knowledge about the contents and organization of conceptual knowledge and how this knowledge is applied when generating new ideas. For example, Marsh, Binks and Hicks (1999) demonstrated that participants shown examples sharing the conceptual feature of hostility (e.g., weapons, fangs) were more likely than those not experiencing the examples, to generate novel exemplars with hostile features. They also demonstrated that simply activating the concept of hostility was sufficient to influence performance on a generation task. Participants who unscrambled hostile sentences were more likely to generate novel exemplars with hostile features compared to participants who had unscrambled conceptually neutral sentences.

If people represent thematic music in memory and that representation is linked to the objects and activities with which it is associated, it should be possible to activate that representation and its associated concepts by having people listen to the music. For example, if the concept of "war" is associated with a certain type of music, then having people listen to "war music" should activate the war concept and the elements associated with war such as "marching" and "weapons." Once those concepts are activated, they should affect performance in a subsequent generation task by increasing the likelihood that conceptual elements will be incorporated into the novel product.

Experiment 1

As discussed, music experienced during goal-directed activity (shopping, watching a movie) has the ability to affect purchasing decisions as well as story interpretation and generation in what appears to be a conceptually congruent fashion. What is less clear is whether our representation of thematic music is rich enough that listening to such music in the absence of other stimuli is sufficient to activate more complex concepts such "fighting in a war" and "tucking a baby into bed" much less instantiate those concepts in a generation task. The current experiment seeks to demonstrate the ability of music to activate complex concepts in memory and affect the content incorporated into stories generated in a story generation task.

Participants will listen to one of two types of thematic music ("tucking a baby into bed" (baby) theme, "going off to war" (war) theme) either before or after a story generation task. The stories generated by participants will be examined for the presence of elements associated with either one of the two music themes.

We hypothesize that participants who listen to the war themed music prior to engaging in the generation task will include more war themed concepts than baby themed concepts in their stories than people who listened to the war themed music after engaging in the generation task. Participants who listen to the baby themed music prior to engaging in the generation task will include more baby themed concepts than war themed concepts in their stories than people who listened to the war themed music after engaging in the generation task.

Methods

Pilot Testing

Participants, Stimuli and Procedure. Thirty-one Oakland University students participated in exchange for experimental credit in the song-rating task.

Participants wearing headphones were seated at a computer and interacted with a Flash program that provided instructions, randomized song presentation and collected participants' responses to the songs. The 14 songs presented to participants during pilot testing satisfied the criteria of 1) being strongly thematic and containing at least 90 seconds of music devoid of 2) environmental sounds (e.g., barking dog, crying baby) or 3) lyrics.

On each trial, participants listened to a 90 sec. song clip, then listed the "first three things the song made them think of" and rated the familiarity, pleasantness, and liking of the song on a 7 point Likert scale (7 = most familiar, pleasant, liked) (See Table 1).

Responses to each song were content analyzed to identify the three most salient concepts (listed by > 30% of sample) that each song brought to mind (MusicConcepts).

The two songs chosen for use (DeLaTerra and Carousel) were selected because they 1) both elicited consistent thematic responses from participants ("war" and "baby" respectively), 2) the themes were extremely different from each other and 3) the songs were equally unfamiliar.

It was thought that the activation of a concept by listening to the music might spread to associated concepts and affect performance on the generation task. Consequently, a different group of 18 students enrolled in a Cognitive Psychology course engaged in a feature listing task, listing features for the three Carousel and three DeLaTerra MusicConcepts. Nine conceptually related features (MusicAssociates) were listed by at least 33% of the students in response to the Carousel MusicConcepts and seven features were listed by at least 33% of the students in response to the DeLaTerra MusicConcepts.

Stimuli and Procedure

Participants were seated at a computer with headphones on and interacted with a Flash program in the browser that provided instructions, presented stimuli and recorded participants' responses. All participants spent four minutes engaged in a nine-item Remote Associates Task (included to disguise the study's purpose), listened to 90 seconds of music, and spent 15 minutes writing a story with the theme "My Adventure on an Alien Planet." Conditions different only in terms of which of the two songs participants experienced and whether the songs were presented immediately before or immediately after the story generation task.

Coding

Raters blind to condition coded the stories generated by the participants for the presence of the MusicConcepts and MusicAssociates associated with the two songs. This resulted in four dependent variables: the proportion of Baby MusicConcepts, the proportion of Baby MusicAssociates, the proportion of War MusicConcepts, and the proportion of War MusicAssociates included in the story written by the participant.

Results

Four 2 X 2 ANOVAs were conducted examining the effects of music theme (Baby, War) and position (Before, After) on the proportion of MusicConcepts and MusicAssociates included in the stories.

The analyses revealed no main effects or interactions on the tendency for participants to include the Baby MusicConcepts or MusicAssociates in their stories, $p > .05$. The same was also true for the tendency to include War MusicConcepts in their stories. However, there was a significant main effect of position on the proportion of War MusicAssociates incorporated into the story, $F(1, 137) = 4.34$, $p < .05$, $eta^2 = .032$. This main effect was moderated by a non-reliable interaction, $F(1, 137) = 3.15$, $p < .10$, $eta^2 = .023$. Participants exposed to the War theme music before the story generation task included a greater proportion of War MusicAssociates into their stories ($M = .04$, $SE = .01$) than those who were exposed to War music after the generation task ($M = .00$, $SE = .01$) or those who were exposed to the Baby music either before ($M = .02$, $SE = .01$) or after ($M = .02$, $SE = .01$) the generation task.

Table 1: Characteristics of 90-second Song Samples and Evoked Concepts (Concepts)

Theme	Music		Music Primes	Familiarity		Pleasantness		Liking	
	Song	Artist		M	SD	M	SD	M	SD
Church	Dante's Prayer	Loreena McKinnett	Church, Sadness, Peace	3.4	1.77	4.75	2.01	4.34	1.81
Evil	Toccatta and Fugue in D Minor	Bach	Church, Organ, Horror	4.91	1.85	3.91	1.72	3.89	1.86
	Carmina Burana Introduction	Orff	Choir, Movies, Marching Band	6.00	1.60	4.53	1.56	4.26	1.89
Indian	Ahini-Lalita	Ravi Shankar	Middle East, India, Desert	3.51	2.09	4.29	1.53	3.89	1.60
Arabia	Lawrence of Arabia	Henry Mancini	Movies, Broadway	4.18	1.95	5.15	1.48	4.53	1.50
	Marco Polo	Loreena McKinnett	Desert, India, Egypt	3.80	1.73	4.91	1.63	4.57	1/60
Latin	Latin Quarter	Big Lazy	Spanish, Salsa, Tango	3.60	2.04	4.97	1.46	4.37	1.54
Asian	Asian-Thai-Classic Chinese Folk Music	Chinese Folk Music	China, Asia, Oriental	3.60	2.16	5.03	1.54	4.40	1.42
Circus	Cirque De La Mort	Vernian Process	Circus, Carnival, Scary	2.88	1.92	2.97	1.57	2.74	1.66
	Death of a Doll Maker	Creature Feature	Video game	2.69	2.34	3.57	1.82	3.4	2.02
War	De La Terre a La Lune	Vernian Process	Marching, Marching band, War	3.06	2.10	3.5	1.24	3.0	1.37
	Your Betrayal	Bullet for My Valentine	Rock, Rock Concerts	3.67	2.04	3.74	1.83	4.24	1.89
Hostile	Agitated Screams of Maggots	Dir en Grey	Anger, Rock, Screamo	2.69	2.08	2.06	1.63	2.09	1.67
Baby	Se Lest	Sigur Ros	Baby, Sleep, Music Box	2.32	1.97	4.15	1.69	3.38	1.48
	Carousel on a Slide Projector	Lullatone	Sleeping, Baby, Lullaby	3.09	2.15	5.00	2.15	4.09	1.88

Discussion

The hypothesis that thematic music experienced prior to engaging in a story generation task increases the likelihood thematic elements associated with that music will be incorporated into the story is partially supported. Participants exposed to music that brings to mind concepts associated with fighting in a war are more likely to incorporate concepts such as weapons, death and blood into the stories they write immediately after listening to the music. However, exposure to war themed music did not increase their tendency to incorporate the specific terms brought to mind by the music (as revealed in pilot testing) into their stories. Exposure to baby themed music did not appear to affect whether or not concepts associated with tucking a baby into bed were included in the stories either.

So why did exposure to war themed music affect performance and exposure to baby themed music did not? Perhaps because baby themed elements were incorporated into the stories at higher rates than war themed elements across all conditions. Specifically, baby themed elements related to sleeping and dreaming were commonly included in the stories generated by participants.

We believe participants faced with the task of describing their "adventure on an alien planet" seemed compelled to explain how they ended up on that alien planet. A common solution was to say they fell asleep in bed and dreamt that they were on an alien planet. If this is a valid explanation for the lack of influence of baby themed music on performance in a generation task, then perhaps a more plausible setting will decrease the use of literary devices such as sleeping and dreaming in the story generation task.

Experiment 2

Experiment 2 tests the proposal that the story generation task scenario given to participants in Experiment 1 hid the influence of baby themed music by causing them to incorporate items associated with that theme (sleeping, dreaming, bed) into their stories to rationalize being on an alien planet.

We predict that providing a more "down-to-earth" scenario will allow the effects of the baby themed music to be manifested in the story generation tasks by decreasing the inclusion of the specific baby-themed concepts of sleeping and dreaming across all conditions as a literary device. We maintain the hypotheses that experiencing war themed music prior to engaging in a story generation task will increase the proportion of war themed items included in the story compared to when the music is experienced after the generation task. Similarly, experiencing baby themed music prior to the generation task will increase the proportion of baby themed items included in the story compared to when the music is experienced after the generation task or compared to when war themed music is experienced prior to the generation task.

Methods

Participants

One-hundred and seventeen Oakland University students participated in exchange for experimental credit and were randomly assigned to one of four conditions: 29 listened to Carousel before generation (Baby Before), 33 after generation (Baby After), 28 participants listened to DeLaTerra before generation (War Before) and 27 after generation (War After). None of the participants provided data for Experiment 1.

Stimuli and Procedure

The stimuli and procedure were identical to Experiment 1 with the exception that participants were now asked to spend spent 15 minutes writing a story with the theme "An Adventure to a Foreign, Undiscovered, yet Inhabited Land."

Results

Four 2 X 2 ANOVAs were conducted examining the effects of music theme (Baby, War) and position (Before, After) on the proportion of MusicConcepts and MusicAssociates included in the stories.

Analyses revealed a significant music theme X position interaction on the incorporation of Baby MusicConcepts incorporated into the story in the generation task, $F(1, 117) = 5.41$, $p < .05$, $eta^2 = .05$. Participants exposed to the baby themed music prior to the generation task ($M = .10$. $SE = .02$) were more likely to incorporate Baby MusicConcepts items into their stories than people who were exposed to the music after the generation task ($M = .03$, $SE = .02$) or people who were exposed to the war themed music before the task ($M = .02$, $SE = .02$). In fact, those exposed to the war themed music before the generation task were actually less likely to incorporate Baby MusicConcepts into their stories than those exposed to the war themed music after the generation task ($M = .06$, $SE = .03$).

Further analyses revealed no main effects or interactions on the tendency for participants to include the Baby MusicAssociates, War MusicConcepts, or War MusicAssociates in their stories, $p > .05$. This suggests the effects of thematic music on incorporating thematic elements into the story is more complicated than simply being the effect of whether or not thematic music is heard prior to the generation task. It appears as if incorporating thematic concepts into a story depends on the types of concepts activated by the music AND the context of the story generation task. The disappearance of the effect of War themed music on the incorporation of War MusicAssociates suggests that those War MusicAssociates are more compatible with people's understanding of the types of adventures that are possible on an alien planet then they are with adventures to an unexplored, yet inhibited foreign land.

To statistically examine the effects of story scenario on the tendency to include Baby or War themed elements in a

story generation task, we conducted post-hoc analyses comparing Experiments 2 results to those in Experiment 1. We believe this is a valid comparison because the two experiments differed only in terms of the theme participants were asked to write a story about. Also, participants were drawn from the same subject pool during the same year for both experiments.

Because we are interested in how the story theme interacts with the placement and the theme of the music to affect the tendency to incorporate Baby themed or War themed items into the story, we combined the Baby MusicConcepts and Baby MusicAssociates variables into a single variable (BabyAll) that measures the proportion of both Baby MusicConcepts and Baby MusicAssociates (12 items total) included in the story. The same was done for the War MusicConcepts and War MusicAssociates, resulting in WarAll (10 items total).

Table 2. Effects of Music Theme, Position and Story Theme on Proportion of Total Baby and War Items in Stories

			Story Theme			
			Alien		Foreign	
	Music	Position	M	SE	M	SE
BabyAll	Baby	Before	.07	.01	.06	.01
		After	.07	.01	.03	.01
	War	Before	.07	.01	.04	.01
		After	.06	.01	.04	.02
WarAll	Baby	Before	.02	.01	.01	.01
		After	.02	.01	.02	.01
	War	Before	.04	.01	.01	.01
		After	.02	.00	.00	.00

A 2 X 2 X 2 ANOVA examined the effect of music theme (Baby, War), position (Before, After) and story theme (Alien, Foreign) on the inclusion of baby themed items and war themed items in the story generation task.

The analyses revealed a significant main effect of story theme on the inclusion of baby themed elements (BabyAll) in the story, $F(1, 254) = 5.91$, $p < .05$, $eta^2 = .02$. Participants are more likely to include BabyAll items when writing a story with an alien theme ($M = .07$, $SE = .01$) than when writing a story with a foreign land theme ($M = .04$, $SE = .01$).

Analysis of the tendency to incorporate War themed elements (WarAll) in the generation task also revealed a significant main effect of story theme, $F(1, 254) = 4.09$, $p < .05$, $eta^2 = .02$. Participants are more likely to include the WarAll items when writing a story with an alien theme ($M = .02$, $SE = .00$) than when writing a story with a foreign land theme ($M = .01$, $SE = .00$).

There was also a non-reliable Music Theme X Position interaction $F(1,254) = 2.87$, $p < .10$, $eta^2 = .01$. Participants are more likely to incorporate WarAll items into their stories when they hear war themed music before engaging in the generation task ($M = .03$, $SE = .01$) compared to hearing it after the task ($M = .01$, $SE = .01$) or hearing baby themed music before ($M = .02$, $SE = .01$) or after ($M = .01$, $SE = .01$) the task.

Discussion

The hypothesis that a story scenario set on Earth would allow the effect of listening to baby themed music on the inclusion of baby themed items in the generation task to be visible was supported. Participants who listened to baby themed music prior to engaging in a generation task, were more likely than those who listened to the music after writing their story to include items that pilot testing indicated were specifically activated by the baby themed music into their stories. The effect of listening to war themed music on performance in a generation task was weak enough that it was not visible in the Experiment 2 data. However, combining the Experiment 1 and 2 data provided enough power to demonstrate listening to war themed music rather than baby themed music before engaging in a generation task does increase the number of war themed components that are included in the generation task.

To explain the results of the Experiments 1 and 2, we would like to propose that the story scenario that participants were writing about interacts with the type of concept activated by the music to influence the degree to which participants incorporate thematic elements of the music into the story. For both story themes it was demonstrated that whether or not music concepts were incorporated into the story was influenced by the scenario for which they were writing the story with both baby themed music elements and war themed music elements being more likely to be incorporated into the novel stories when writing stories set on an alien planet. Interestingly, the reason why each set of elements was more likely to be incorporated differs between the two scenarios and themes.

Demonstrating an effect of listening to baby themed music on the tendency to include baby themed items into the story in Experiment 2 but not in Experiment 1 is probably due to participants feeling a need to rationalize the visit to the alien planet in Experiment 1 causing them to rely on the plot device of falling asleep and dreaming that they visited an alien land. This was evident in the fairly high rates of baby themed items across all four conditions in Experiment 1. Because sleep, dreams, and bed were all "tucking a baby into bed" themed items, the plot device washed out any effects that hearing the baby themed music might have had on the stories participants generated. The plot device was not necessary for stories about an adventure in an undiscovered foreign land so only the participants exposed to baby themed music prior to the generation task included baby themed elements into their story.

In contrast, the greater tendency to include war themed elements in the stories in Experiment 1 compared to Experiment 2 probably was due to the concept of war being more congruent or plausible with a visit to an alien planet than a visit to a foreign land. This suggests participants' knowledge of alien planets and foreign lands is influencing

which thematic elements activated by the music get incorporated into the story or whether they are incorporated at all.

The proposal that the thematic elements activated by listening to thematic music interacts with the knowledge of the story scenario to affect performance in a generation task is consistent with some of the previous work on conceptual expansion and concept activation. Sifonis (1995) (as discussed in Ward, Smith & Finke, 1999) demonstrated that participants asked to describe a restaurant for a race of bird-like aliens integrate their category knowledge of birds with their schema of restaurants to generate a novel exemplar of "restaurants for bird-like aliens." These novel restaurants retained some of the salient features of restaurants on Earth (e.g., having tables and serving food). However, in the process of replacing the human customer in the restaurant schema with birds in the context of an alien planet, the novel restaurants incorporated features of all three types of knowledge: restaurants, birds, alien planet (i.e., the customers sat on perches at tables and were served worm burgers but didn't have to pay for their meals because the civilization had advanced beyond the need to exchange money for services). Perhaps the themes activated by the music are, in fact, activating a complex schema rather than just the individual concepts and their associates that participants reported during pilot testing. If this is the case, then the effects of the music on story generation might be more evident when looking for schematic elements associated with the theme (e.g., baby theme activating schema elements associated with children and parents and school).

Another explanation for a process underlying performance in the story generation task is that the specific scenario participants asked to generate stories for activates a specific form of the thematic element. Solomon and Barsalou (2001) have argued that properties associated with a concept are represented differently in different concepts. For example, the property of "red" is represented differently for "hair" and "wine" and "blood." The dominant representation of the property at the time of retrieval varies on the basis of context as well as other factors. Consequently, the specific conceptual properties that are activated by the thematic music and incorporated into the generation task might depend on the story context/scenario of the generation task. If this is the case, then coding the stories for the features associated with the specific combination of music theme and story scenario (e.g., features of an "undiscovered foreign land in which there are a lot of babies"), should increase the ability to observe the effects of the thematic music on performance in the generation task.

Additional directions for future experiments include finding music that more strongly activates a particular theme. Using familiar rather than unfamiliar music should increase the effect of that music on the performance in the generation task over the low levels observed in the current study. Alternately, perhaps music associated with a particular geographical region (e.g., Arabia, China) would be more likely to result in those features being included in a story about a visit to a distant land than music with a theme that is not geographical in nature.

In summary, the research described in this paper provides preliminary data suggesting that music can be associated with concepts and that listening to the music can activate those concepts and affect performance in a generation task. Because of the pervasiveness of music in our lives and its use to help enhance our performance, moods or thoughts, developing a greater understanding of the influence music has on those thoughts and behaviors will allow us to increase the manner in which music benefits us. It will also increase our understanding of how music is represented in memory and how that representation is manifested in performance,

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