Animation and Music: Principles for Effective Combination

http://www.accad.ohio-state.edu/~efarrar/thesis/

Introduction

Music and film are both emotionally rich mediums. Individually, each art-form is capable of conveying a seemingly limitless range of human emotion. In combination however, the impact of each can become even more powerful. In addition to adding to the aesthetic of a film, music can serve a number of functions that create a deeper, more emotionally rich experience. Among these functions are providing continuity between shots, directing attention to important features on the screen, establishing mood, furthering narrative, enabling the symbolization of past and future events through the use of reoccurring themes, and heightening the sense of reality or absorption in a film [1]. Countless animation examples exist which support the fact that careful consideration of sound and music can help to create a final piece that is far more powerful than either the visual or musical elements are on their own. All too often, however, sound and music are almost treated as an afterthought, particularly by students of animation who may be more versed in the visual elements of animation than with the aural [2]. This may be due in part to a lack of understanding of the basic elements of music and the principles by which music and animation can be combined. The intent of this paper is to provide some insight into these principles and to present them in a way that can be easily understood by students of the visual arts.

History

Ever since the earliest animated films of the 1920s and 30s, music has served as an integral element in creating emotionally rich pieces. Even the first "silent films" were not really silent when they were viewed in theaters. They were invariably accompanied by some form of live music performance, usually piano or organ. In addition to covering the distraction of the noise from the movie projector the music aided in conveying the emotion and meaning of the scenes in the film. There are countless examples of animators using music as both the driving force for an animated film as well as a means of aiding in the understanding of the action. Early examples range from literal visual representations of the music to more abstract, and from motion that is highly synchronous with the music to that which seems to move in opposition to the music. In addition to the cartoons that were produced by the studios of Disney and Warner Brothers during those early years, in which the music and motion was highly, there were other less commercial animators such as Norman McLaren, Oskar Fischinger, Jaques Drowin and John and Faith Hubley who were also experimenting with the connections between music and animation.

Disney's technique of synchronizing every single animated movement to the beat or pulse of the music became so popular and recognizable that it was known in the industry as "Mickey Mousing" [3]. The processes that the Disney studios developed called for a

very close working relationship between the director of a film and the musician composing the music. Many hours were dedicated to the planning of the animation in tandem with the writing of the music before any actual production work was done on a film.

Animation sequences were planned out in strict adherence to the number of beats in the music. Often, if the motion called for more time than the music would allow, additional beats would be added to the music to give the animator time to fit in all the necessary frames of animation. The process would go back and forth between the animator and the

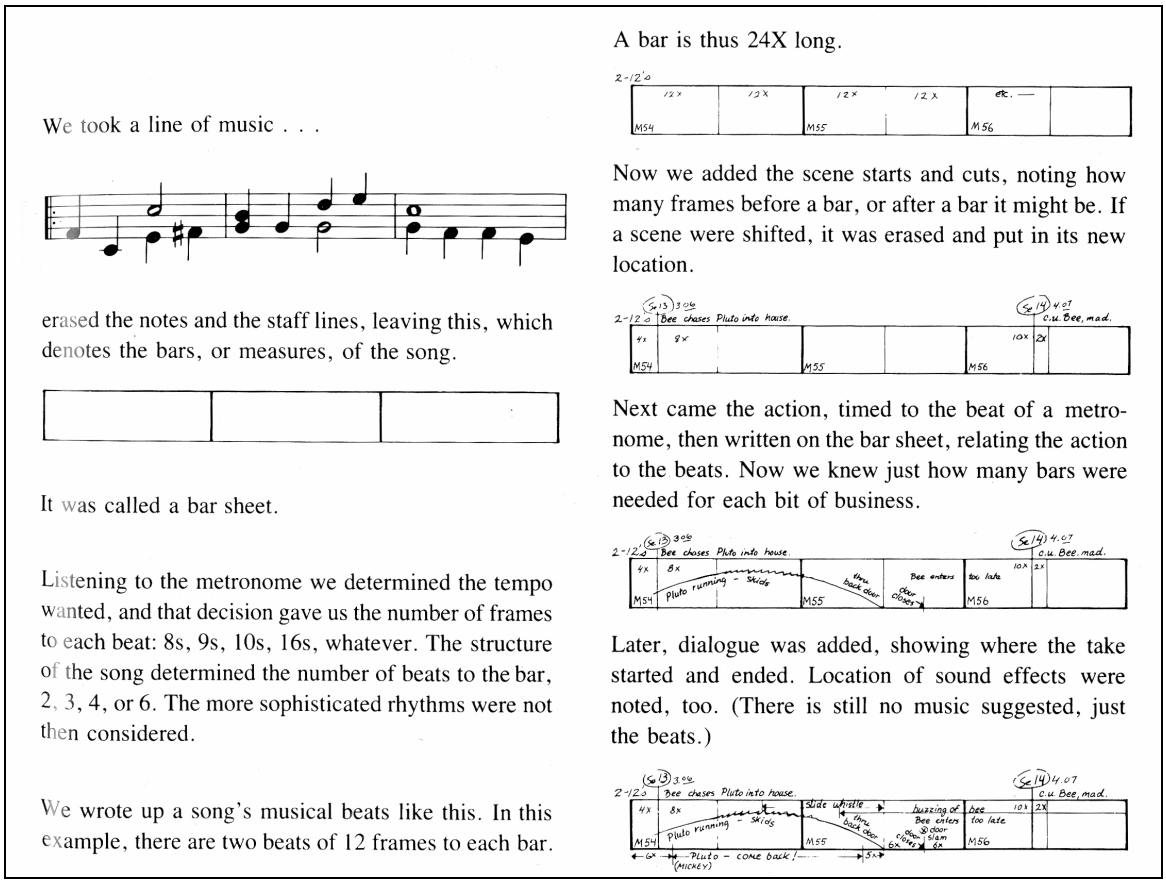


fig. 1. From *The Illusion of Life* by Frank Thomas and Ollie Johnston

composer until the desired result was achieved. Out of this process came a new form of music and animation notation called a bar sheet, also referred to as a dope sheet (fig. 1) [4]. In other films by Disney, most notably in the film *Fantasia*, the music was pre-scored so that adding additional beats to the music was not an option. In those cases animators were forced to fit their movements and storytelling techniques to the confines of the music. Disney animator Frank Thomas said of this technique, "There is a special feeling in work that is done this way that is not found in other methods, but it is more expensive because of the demands it makes in all the creative departments" [5]. There is very little give and take between the animation and the music in this type of animation, no adding a beat here and there to help the music fit with the motion. Instead, animators were challenged to limit their expressions of motion to the absolute minimum. They

were forced to find the most efficient way of communicating their message and doing it so that it all fit into the 24 frames within a bar of music, for example. As a result, Disney's animation displays the purest essence of an idea with each and every movement. Every single movement communicates its message exactly, without extraneous clutter. Arguably, animation that is built around a musical soundtrack creates the strongest form of audio/visual combination. By considering music as an integral element in animation production and introducing it early in the production process, the integration of music and motion can be much more dramatic and emotional than by simply adding music to already completed animation.

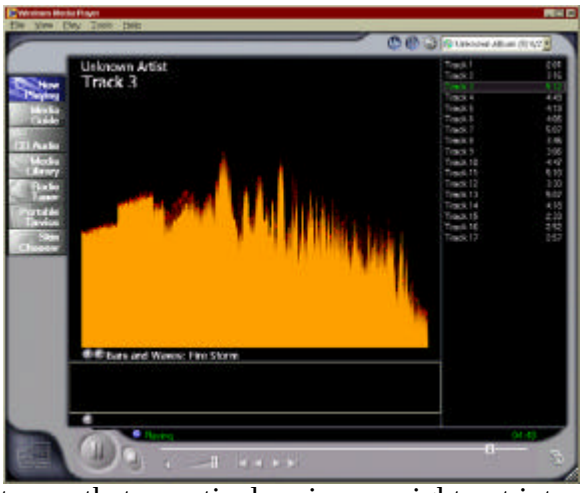
The process of animating to the music is extremely laborious and involves highly detailed analysis of the music before creating a single animation drawing. In the case of highly synchronous animation it can involve mapping the music on a frame-by-frame basis as shown earlier in fig. 1.

Current Developments

In recent years with the advent of the computer there have been numerous investigations, both scientific and artistic, into the relationships between sound and motion. Examples range from using physical motion to generate sound or music to using prerecorded music to animate computer generated objects. David Rokeby is a performance artist who created a space in which movements of the body are captured by video cameras and then translated into computer-generated sounds. In his piece he studies relationships between human movement and sound, and human/machine interfaces [6]. Though this technique applies to a real time performance as opposed to pre-recorded film, the connections between human emotion and the generated sounds are definitely present. Slow flowing movements, for example, might produce sounds that are similar or reflective of the motion while fast, vigorous movements would create sounds with a much higher energy level. Other studies of a more scientific nature have been conducted at George Washington University in which computer animated objects are used to drive synthesized sound production. Researchers are, in a sense, creating virtual objects that can programmatically generate their own sounds when they collide with other objects. One example from these studies is a set of virtual wind chimes in which each piece of 3d geometry used to represent the wind chimes creates its own synchronized sound when it collides with another piece of geometry [7]. This type of example shows a physics based approach to sound generation. It attempts to create a sense of realism in virtual environment by having objects appear to create realistic and believable sounds. Emotional considerations do not seem to be considered. Still others are working on techniques to use music to systematically drive computer-generated animation. There have been several computer programs written that create visualizations of music such as Microsoft's Media Player, Nullsoft's Winamp and RealNetwork's RealOne Player. These programs use audio waveforms from the music to create abstract shapes and color combinations. The colors and shapes can change with changes in the intensity and frequency (low sounds verses high sounds) of the music. Microsoft's Media Player is a popular music-playing program that includes an option for displaying such music visualization (fig. 2). In this type of example, we see visually a

direct relationship between two elements of music, pitch and loudness, which are integral factors in music's ability to express emotion. There is however, no apparent connection between the emotion of the music and the visuals represented. Music that is somewhat soft and played in a low frequency range could express either sadness or majesty, but the visualization has no way of really differentiating between these two emotions. The final result is a visualization that is sometimes interesting to look at and can very often create a relaxing, almost hypnotic effect for the viewer. What these visualizations lack, however is any deeper meaning or connotative implications that are derived from emotional elements of the music. That is not to say that a particular viewer might not interpret a visualization generated by sad music as appearing "sad" for example, but this emotional connection between the visual and audio would be purely coincidental.

fig.2. Music visualization in Windows Media Player



In the early 1980s, a new electronic protocol was developed for communicating between music synthesizers. This protocol is known as MIDI (Musical Instrument Digital Interface) and it records information about a particular musical performance played on an electronic MIDI instrument such as a keyboard synthesizer. There are two very successful examples of using MIDI data and using it to drive computer-generated animation. The first, titled "Butterflies in the Rain", was developed at Ohio State University as part of a graduate thesis. In the project the students took old player piano rolls, converted them to MIDI data and then mapped that data to the animation of a 3d animated piano. The MIDI information for each note of music was used to drive the animation of the individual piano keys. Every time a specific note was indicated in the data, the corresponding key on the piano would be animated at the appropriate time and for the appropriate duration.

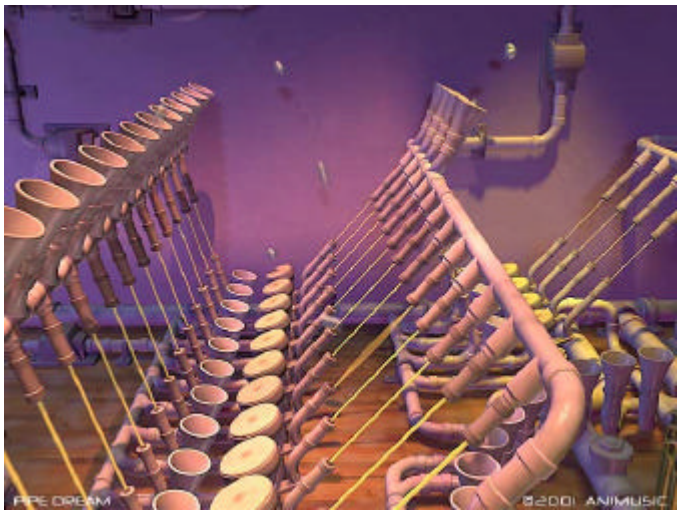


fig. 3. An example from an Animusic animation called Pipe Dream. Animated spheres bounce off of various virtual percussion instruments in perfect synchronization with the pre-recorded MIDI soundtrack.

The second example comes from a company called Animusic that produces little mini "music-videos" based on pre-composed MIDI music (fig. 3) [8]. With this technique technical elements of the musical piece called MIDI events, that include things like what note is played, when it is played, how hard it is played and for how long, are mapped directly to some technical element of the animation. For example, every time the note "A-flat" is listed in the MIDI data, an animation object directly related to that note gets "moved" or "played". This results in animation that appears to be "playing" the music. This is great for the animator because key-framing all of the individual objects in close synchronization with the music would be prohibitively time consuming. As a result of the direct one-to-one relationship between MIDI note and animated "note" however, examples of this technique tend to be very mechanical and devoid of any real emotional content.

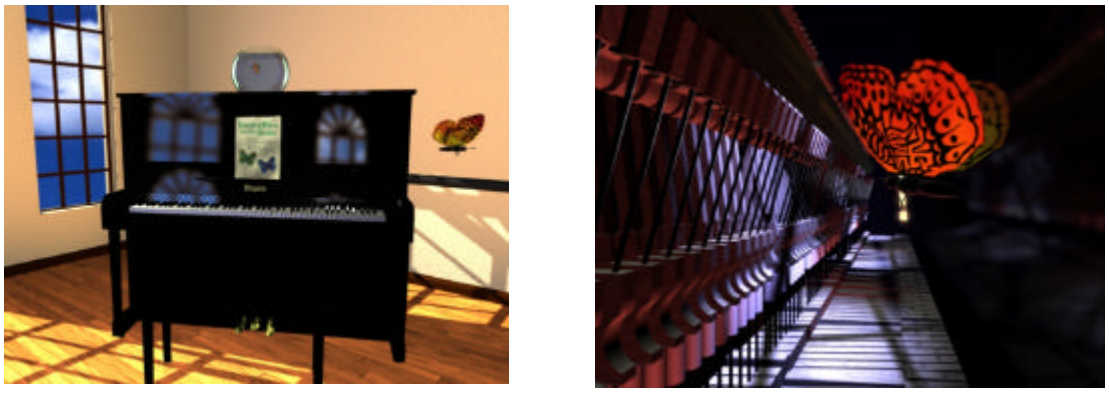


fig. 4 The brightly lit room corresponds with the major key and active melody of the music while the bridge of the song, in a minor key and with long descending melodic notes is better complimented by the dark colors and closed space of the interior of the piano.

The computer animation examples presented do utilize elements of emotion in their visual presentation that correspond with emotional content in the music. In the "Butterflies in the Rain" example, color and light are used very effectively to enhance the contrasting section, or bridge, of the music (fig 4). In this section of music, the key changes from major to minor (happy to sad) and the melody changes from a rhythmically active ascending line to longer notes with a descending melody (again, happy to sad). Visually, this is the section where the main character of the piece, a butterfly, moves from the brightly lit wide open spaces of the room to the dark, foreboding interior of the piano. This effect created is one of heightened emotion in the short film. In the Animusic example, colored lights and camera angles are used to match the mood of the music. In both examples however, the musical mood and the visual mood are not what is being driven automatically. The animated motion is complex and synchronized very closely with the music, but the qualities of music that help to enhance the level of emotion expressed in the films appear to be created manually by the animator. This is not necessarily a problem when the animator has an understanding of the factors in music and in visual composition that help to create a sense of emotion. However, when these factors are overlooked, or used in ways that are not congruent with the desired message, music can actually detract from the overall presentation. The relationship between music and animation has the potential to be so much more than just motion with sound. Walt Disney knew this and knew how to use the two together to create incredible works of emotional content. Disney animators Frank Thomas and Ollie Johnston wrote, "Music is undoubtedly the most important addition that will be made to the picture. It can do more to bring a production to life, to give it integrity, style, emphasis, meaning, and unity than any other single ingredient" [9].

The Language of Music

Functions of Music

Music in combination with film can take two forms, diagetic or nondiagetic. Diagetic music is that which is literally connected to an element within the film. An example would be a scene with a musician playing his or her instrument, or a jukebox in the back of a diner. The sound is directly connected to the source and both characters within in the

scene as well as the audience are aware of it. Nondiagetic music refers to the music that does not emanate from within the environment of the film [10]. Nondiagetic music serves a number of very important functions when combined with the moving images of film or animation. In her book *Unheard Melodies: Narrative Film Music*, Claudia Gorbman presents seven principles of nondiagetic music [11].

I. *Invisibility*: The technical apparatus of nondiagetic music mus not be visible.
II. *"Inaudibility":* Music is not meant to be heard consciously. As such it should subordinate itself to dialogue, to visuals—i.e., to the primary vehicles of the narrative.
III. *Signifier of emotion:* Soundtrack music may set specific moods and emphasize particular emotions suggested in the narrative, but first and formost, it is a signifier of emotion itself.
IV. *Narrative cueing:*
    referential/narrative: Music gives referential and narrative cues, e.g., indicating point of view, supplying formal demarcations, and establishing setting and characters.
    connotative: Music "interprets" and "illustrates" narrative events.
V. *Continuity:* Music provides formal and rhythmic continuty—between shots, in transitions between scenes, by filling "gaps."
VI. *Unity:* Via repetition and variation of musical material and instrumentation, music aids in the construction of formal and narrative unity.
VII. A given film score may violate any of the principles above, providing that violation is at the service of the other principles. (p.73)

Basic Elements of Music

In order to better understand how music functions in combination with film and animation, it is necessary to first understand the basic elements of music. Many parallels can be drawn between these building blocks of music and similar structural elements of the visual field. One example of this is looking at what Herbert Zettle calls "visual vectors." In his book *Sight Sound Motion: Applied Media Aesthetics* he defines these as forces that are leading the viewer's eye from one point to another. Vectors are created by graphical elements in the frame directing the viewer's eye in a certain direction, index elements such as arrows or characters looking in a certain direction, and by motion [12]. Similarly, "…even if you don't read music, you can look at musical notation simply as another type of vector structure. When translated into graphic, index, and motion vectors, musical notation can describe a line, a direction, a movement, and horizontal and vertical vectors." [13]

Much in the way that any language has different levels of structure, i.e. letters that form words, words that form sentences, sentences that form paragraphs, etc., music has multiple levels upon which it is built. The most basic elements of music are pitch, timbre (pronounced "tamber"), duration, loudness and attack/decay.

Pitch –
Timbre –

Duration –
Loudness –
Attack/Decay –

Structures of Music
The next level of structure in music can be thought of as the "words" and "sentences" of music. While there are many structures that can be identified, these are probably the most important to gain a basic understanding: melody, rhythm, harmony, homophony, polyphony.

Melody –
series of musical tones grouped in succession
It is the leading part of a piece of music or the part that you would be inclined to sing if asked to recall a particular song.
forms a horizontal vector [Zettle]
All melodies are based on scales
examples of western scales and melody are available at
http://www.accad.ohio-state.edu/~efarrar/thesis/music/

Rhythm –
formed by varying the duration of notes
based on a "felt" pulse or beat

Harmony –
Major, minor
similar to visual texture
very important in establishing mood
examples of common western harmonies are available at
http://www.accad.ohio-state.edu/~efarrar/thesis/music/

Homophony –
Polyphony –

Combination Principles

[currently pouring over the following texts and trying to synthesize some basic principles for music/visual combination. Some high level points from each author are listed below.]

Herbert Zettle – Sight Sound Motion
-Homophonic vs. Polyphonic music
-Visual vector fields and auditory vectors
-Structural comparisons between visual and musical structures
-Leitmotif
-"hearing" an images, "seeing" music

James Buhler – Analytical and Interpretive Approaches to Film Music: Analysing Interactions of Music and Film

-Synchronization versus Counterpoint

-Narratological issues of music

Kassabian – Hearing Film: How Music Works in Film

-Meaning of music and how it impacts the meaning of film

Furniss – Art in Motion – General Concepts: Sound and Structural Design

-Functions of music

-More history – Norman McLaren, Carl Stalling

Kalinak – Settling the Score – Ch4. The Classical Hollywood Film Score

-Structural unity

-narrative action

-emotion

-mood

-music placement

-Leitmotif

Principles in Practice: Analysis of Suburbia

Conclusion

---

1. Cohen, Annabel J. "Music as a Source of Emotion in Film." Music and Emotion Theory and Research. ed. Patrik N. Juslin and John A. Sloboda. New York: Oxford University Press. (2001):258.

2. Furniss, Maureen. *Art in Motion: Animation Aesthetics.* Sydney: John Libbey & Company Ltd. (1988):85.

3. Thomas, Frank, and Ollie Johnston. *Disney Animation: The Illusion of Life.* ed. Walton Rawls. New York: Abbeyville Press. (1981):288.

4. Thomas [3]:289.

5. Thomas [3]:289.

6. For more information see <http://prixars.aec.at/history/interactive/1991/E91azI-nervous.html> Very Nervous System by David Rokeby.

7. Mishra, Suneil and James K. Hahn. "Mapping Motion to Sound and Music in Computer Animation and VE." *Computer Graphics and Applications: Proceedings of the Third Pacific Conference on Computer Graphics and Applications, Pacific Graphics '95*. World Scientific Publishing Co. Pte. Ltd. (1995):83-98.

8. *Pipe Dream.* Animusic (2001).

9. Thomas [3]:289.

10. Kalinak, Kathryn Marie. *Settling the Score: Music and the Classical Hollywood Film.* Madison: University of Wisconsin Press. (1992):xiv.

11. Kassabian, Anahid. *Hearing Film: Tracking Identifications in Contemporary Hollywood Film Music.* New York: Routledge. (2001):40.

12. Zettle, Herbert. *Sight, Sound, Motion: Applied Media Aesthetics.* 3rd Ed. Belmont, CA: Wadsworth Publishing Company. (1999):106.

13. Zettle [12]:327.