Using Innovative Technologies to Analyze for Similarity between Musical Works in Copyright Infringement Disputes

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USING INNOVATIVE TECHNOLOGIES TO ANALYZE FOR SIMILARITY BETWEEN MUSICAL WORKS IN COPYRIGHT INFRINGEMENT DISPUTES

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I. INTRODUCTION

Copyright law has long relied on the distinction between an idea and the expression of that idea to define the scope of protection for creative works.¹ Through this “idea-expression dichotomy,”² copyright protection “extends only to the particular expression of the idea and never to the idea itself.”³ Accordingly, courts base assessments in infringement cases using Learned Hand’s idea-expression analysis from Nichols v. Universal Pictures Corp.,⁴ under which the patterns in a copyrightable work may be seen at many levels of increasing generality. “[T]here is a point in this series of abstractions where they are no longer protected, since otherwise the [author] could prevent the use of his ‘ideas,’ to which, apart from their expression, his property is never extended.”⁵ The finder of fact must determine “whether there has been copying of the expression of an idea rather than just the idea itself. . . . The difficulty comes in attempting to distill the unprotected idea from the protected expression.”⁶

Because all writings, including musical compositions, can be dissected to the point of becoming uncopyrightable ideas, when courts try to eliminate the uncopyrightable elements they risk over-dissecting the work, after which they might never find infringement.⁷ In Apple Computer, the district court analogized the visual image displays at issue to a musical composition and overturned the dismissal of the copyright suit on rehearing.⁸ The court reasoned that unprotectable elements of a copyrighted work should nevertheless be analyzed under the substantial similarity of expression standard because the unprotectable

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¹ See, e.g., Sid & Marty Krofft Television Prods., Inc. v. McDonald’s Corp., 562 F.2d 1157, 1163, 196 U.S.P.Q. (BNA) 97, 101 (9th Cir. 1977).

² Id. at 1163 n.6, 196 U.S.P.Q. (BNA) at 103 n.6.


⁴ 45 F.2d 119, 7 U.S.P.Q. (BNA) 84 (2d Cir. 1930).

⁵ Id. at 121, 7 U.S.P.Q. (BNA) at 86.

⁶ Krofft, 562 F.2d at 1163, 196 U.S.P.Q. (BNA) at 101 (internal citations and quotations omitted).


⁸ Id.
elements may be combined in an original, copyrightable expression. If all unprotectable elements were removed, individual musical notes, which are unprotectable as not original, would all be eliminated from analysis for substantial similarity of expression, precluding the court from ever finding infringement of a musical composition. The court in *Apple Computer* recognized the difficulties faced by "even the most thoughtful judges" in trying to eliminate the unprotectable elements when drawing the line between idea and expression.

Judge Hand’s guidance provides an adequate guideline for literature, plays, and other written works, but not musical compositions. Textual copying has long been adequately adjudicated using the "substantial similarity" standard. Courts analyze the specificity of the expression, and thus copyright

\[9\] *Id.* at 136, 20 U.S.P.Q.2d (BNA) at 1237 ("If . . . the works are deemed substantially similar, then copyright infringement will be established even though the copyrighted work is composed of unprotectible [sic] elements. There is simply no other logical way of protecting an innovative arrangement or 'look and feel' of certain works.").

\[10\] *Id.* at 135, 20 U.S.P.Q.2d (BNA) at 1237 ("The problem with analytic dissection of copyrighted works is that carried to an extreme, it can preclude copyright protection for works which deserve protection in that they represent creative effort which the copyright laws seek to foster."). Alternatively, the court noted that because a musical note is both the idea and expression of a specific sound and cannot be expressed any other way, it would be forced to find that the merger doctrine applied. *Id.*

\[11\] *Id.*


\[13\] *See, e.g., Nichols v. Universal Pictures Corp.,* 45 F.2d 119, 7 U.S.P.Q. (BNA) 84 (2d Cir. 1930) (comparing the movie *The Cohens and the Kellys* and the play *Abie's Irish Rose* and creating the current standard for establishing copyright protection depending on the level of specificity); *Warner Bros.,* 654 F.2d at 207-09, 211 U.S.P.Q. (BNA) at 99-101 (involving the owners of the copyright to the comic book character Superman and its allegedly infringed use in a television show called *Hero*). "[I]t is well settled that copying may be inferred where a plaintiff establishes that the defendant had access to the copyrighted work and that the two works are substantially similar." *Warner Bros.,* 654 F.2d at 207, 211 U.S.P.Q. (BNA) at 99; Berkic v. Crichton, 761 F.2d
protection, in layers. Moving from specific to general, at some point the level of character development, themes, and dialogue would no longer be protected expression, but would reach the level of being an unprotectable idea. As Judge Hand stated, "the less developed the characters, the less they can be copyrighted; that is the penalty an author must bear for marking them too indistinctly."14

With regard to music compositions, it is more difficult to apply this analysis due to its inherent limitations, namely the limited number of combinations that produce pleasing musical sounds.15 As a result, courts continue to struggle with discerning the level of substantial similarity between musical compositions in infringement analyses.16 This makes it difficult to determine the portion that is available for the public to use and where that permission stops.17

This article argues that courts should consider using new tools to help determine the level of similarity between two musical works in infringement suits. With regard to musical works, the current method relies too heavily on

1289, 1291-92, 226 U.S.P.Q. (BNA) 787, 788 (9th Cir. 1985) (evaluating the scripts for the movies Reincarnation and Coma for infringement). "To establish a successful copyright claim, a plaintiff must show: (1) his ownership of the copyright; (2) the defendant's access to his work; and (3) 'substantial similarity' between the defendant's work and his own." Berfic, 761 F.2d at 1291-92, 226 U.S.P.Q. (BNA) at 788 (citing Sid & Marty Krofft Television Prods., Inc. v. McDonald's Corp., 562 F.2d 1157, 1162, 196 U.S.P.Q. (BNA) 97, 101 (9th Cir. 1977)); Williams v. Crichton, 84 F.3d 581, 588, 38 U.S.P.Q.2d (BNA) 1810, 1817 (2d Cir. 1996) (evaluating infringement involving literary works by examining similarities in "such aspects as the total concept and feel, theme, characters, plot, sequence, pace, and setting" of the two works in question); cf. CBS Broad., Inc. v. ABC, Inc., 2003 U.S. Dist. LEXIS 20258 (S.D.N.Y. Jan. 13, 2003); Daley v. Granada U.S. Prods., 2003 WL 21294986, at *1 (E.D. Pa. Jan. 29, 2003).

14 Nichols, 45 F.2d at 121, 7 U.S.P.Q. (BNA) at 87.

15 "[W]hile there are an enormous number of possible permutations of the musical notes of the scale, only a few are pleasing; and much fewer still suit the infantile demands of the popular ear." Darrell v. Joe Morris Music Co., 113 F.2d 80, 80, 46 U.S.P.Q. (BNA) 167, 167 (2d Cir. 1940).


each judge’s subjective value judgment or the jury acting as a proxy for the intended audience of the music.\textsuperscript{18} Some questions raised are how should courts test for similarity in musical works without removing the uncopyrightable elements, and whether it is possible to test for substantial similarity in a more objective manner. This article considers two possibilities: (1) objectively mapping a song’s many artistic elements; and (2) using the link between the wave motion theory of physics and music to mathematically model a song.

Part II reviews the development of the current test for infringement of musical works. It examines cases and scholarly writings that illustrate the difficulties in how the current test for musical works is implemented. It also explains how relying on music experts and the jury leads to subjective and inconsistent results. Part III discusses two possibilities for a new method to analyze song similarity by describing how songs may be (1) deconstructed into their basic musical elements and (2) dissected into mathematical models based on their underlying physics. It then describes how similarity tests using each of these methods would work. Part IV analyzes hurdles that must be overcome before either of these methods can be used as a test in music copyright infringement disputes. The article concludes with a short discussion as to whether either proposed test method would be an improvement to the current test.

II. THE CURRENT TEST FOR INFRINGEMENT

The current test for copyright infringement holds that “a plaintiff with a valid copyright must demonstrate that: (1) the defendant has actually copied the plaintiff’s work; and (2) the copying is illegal because a substantial similarity exists between the defendant’s work and the protectible [sic] elements of [the] plaintiff’s.”\textsuperscript{19} Both prongs are questions of fact,\textsuperscript{20} although the first prong can be decided as a matter of law.\textsuperscript{21}

\textsuperscript{18} See Arnstein v. Porter, 154 F.2d 464, 469, 68 U.S.P.Q. (BNA) 288, 293 (2d Cir. 1946).

To establish whether actual copying of an original work has occurred, courts require that the plaintiff prove either (1) access plus substantial similarity of expression between the works or (2) "striking" similarity between the works.\footnote{22} "Access plus substantial similarity" means the plaintiff must establish "that the defendant had access to the copyrighted work and that substantial similarities exist as to protectible [sic] material in the two works."\footnote{23} Alternatively, if the litigation of copyrighted musical works"); \textit{Arnstein}, 154 F.2d at 468, 68 U.S.P.Q. (BNA) at 293; \textit{cf.} Castle Rock Entm't v. Carol Publ'g Group, Inc., 150 F.3d 132, 137, 47 U.S.P.Q.2d (BNA) 1321, 1324 (2d Cir. 1998) ("There are two main components of [a] \textit{prima facie} case of infringement: 'a plaintiff must first show that his work was actually copied . . . [and] then must show that the copying amounts to an improper or unlawful appropriation.").

\textit{Arnstein}, 154 F.2d at 469, 68 U.S.P.Q. (BNA) at 294.

\textit{Sid & Marty Krofft Television Prods., Inc. v. McDonald's Corp.}, 562 F.2d 1157, 1164, 196 U.S.P.Q. (BNA) 97, 102 (9th Cir. 1977); \textit{see also} \textit{Ringgold v. Black Entm't Tel., Inc.}, 126 F.3d 70, 74, 44 U.S.P.Q.2d (BNA) 1001, 1004-05 (2d Cir. 1997).

[C]lare must be taken to recognize that the concept of "substantial similarity" itself has unfortunately been used to mean two different things. On the one hand, it has been used as the threshold to determine the degree of similarity that suffices, once access has been shown, as indirect proof of copying; on the other hand, "substantial similarity" is more properly used, after the fact of copying has been established, as the threshold for determining that the degree of similarity suffices to demonstrate actionable infringement.

\textit{Ringgold}, 126 F.3d at 74, 44 U.S.P.Q.2d (BNA) at 1004-05; \textit{cf.} \textit{Arnstein}, 154 F.2d at 468, 68 U.S.P.Q. (BNA) at 292-93 ("it is important to avoid confusing two separate elements essential to a plaintiff's case in [a] copyright infringement suit"); \textit{Autry}, \textit{supra} note 19, at 116 ("While \textit{Kroff}t did not involve an alleged infringement of a copyrighted musical work, its implications for all subjects covered under copyright law, including musical works, are clear.").

\footnote{22} \textit{See Autry}, \textit{supra} note 19, at 113. The defendant can also admit to copying. \textit{See} \textit{Arnstein}, 154 F.2d at 468, 68 U.S.P.Q. (BNA) at 293.

\footnote{23} \textit{Tisi}, 97 F. Supp. 2d at 546-47, 55 U.S.P.Q.2d (BNA) at 1122 (citing \textit{Walker v. Time Life Films, Inc.}, 784 F.2d 44, 48, 228 U.S.P.Q. 505, 508 (2d Cir. 1986) (internal quotations and citations omitted)); \textit{see also} \textit{Cavalier v. Random...
plaintiff cannot directly prove that the defendant had access to the allegedly infringed work, "then an inference of access may still be established circumstantially by proof of similarity which is so striking that the possibilities of independent creation, coincidence and prior common source are, as a practical matter, precluded."24 When ascertaining actual copying, courts have allowed expert testimony of musicologists,25 often highly trained musicians on the faculty at well-known universities.26 Musicologists form their opinions on the similarities and differences between the allegedly infringing and infringed songs by analyzing and comparing their musical scores.27


24 Selle v. Gibb, 741 F.2d 896, 901, 223 U.S.P.Q. (BNA) 195, 198 (7th Cir. 1984); Tisi, 97 F. Supp. 2d at 548, 55 U.S.P.Q.2d (BNA) at 1123 (citing Cox v. Abrams, 1997 WL 251532, at *5 (S.D.N.Y. May 14, 1997) ("[S]triking similarity exists when two works are so nearly alike that the only reasonable explanation for such a great degree of similarity is that the latter . . . was copied from the first.")); see also Gaste v. Kaiserman, 863 F.2d 1061, 1067, 9 U.S.P.Q.2d (BNA) 1300, 1305-06 (2d Cir. 1988).

Of course, if there are no similarities, no amount of evidence of access will suffice to prove copying. If there is evidence of access and similarities exist, then the trier of the facts must determine whether the similarities are sufficient to prove copying. On this issue, analysis ("dissection") is relevant, and the testimony of experts may be received to aid the trier of the facts. If evidence of access is absent, the similarities must be so striking as to preclude the possibility that plaintiff and defendant independently arrived at the same result.

Arnstein, 154 F.2d at 468, 68 U.S.P.Q. (BNA) at 293.


26 See, e.g., Tisi, 97 F. Supp. 2d at 543, 55 U.S.P.Q.2d (BNA) at 1119 (experts for the plaintiff and defendant were from the Juilliard School and the Department of Music and Performing Arts at New York University, respectively).

Only if actual copying is established do courts look at the second issue, illicit copying, also called improper or illegal appropriation.28 Improper appropriation is found when there is substantial similarity between the two works, which, in some circuits, is determined by a two-part test.29 The first part, the extrinsic component, "considers whether two works share a similarity of ideas and expression as measured by external, objective criteria."30 Like the actual copying test, the extrinsic test requires the establishment of substantial similarity to protected elements of the copyrighted work. "[I]t is essential to distinguish between the protected and unprotected material in a plaintiff's work," and thus the test also uses "analytical dissection of a work and expert testimony."31 The second part "is subjective and asks whether the ordinary, reasonable person would find the total concept and feel of the works to be substantially similar."32 This intrinsic component must be ascertained by the jury.33 Its goal is to answer the question of "whether defendant took from plaintiff's works so much of what is pleasing to the ears of lay listeners, who comprise the audience for whom such popular music is composed, that defendant wrongfully appropriated something which belongs to the plaintiff."34

28 Arnstein, 154 F.2d at 468, 68 U.S.P.Q. (BNA) at 293.

29 A "jury may not find substantial similarity without evidence on both the extrinsic and intrinsic tests." Swirsky v. Carey, 376 F.3d 841, 845, 71 U.S.P.Q.2d (BNA) 1491, 1495 (9th Cir. 2004) (quoting Rice v. Fox Broad. Co., 330 F.3d 1170, 1174, 66 U.S.P.Q.2d (BNA) 1829, 1831 (9th Cir. 2003)).

30 Swirsky, 376 F.3d at 845, 71 U.S.P.Q.2d (BNA) at 1495.

31 Id., 71 U.S.P.Q.2d (BNA) at 1494-95 (quoting Three Boys Music Corp. v. Bolton, 212 F.3d 477, 485, 54 U.S.P.Q.2d (BNA) 1720, 1726 (9th Cir. 2000)). On summary judgment, a trier of fact may find that there is insufficient evidence to show that the extrinsic test has been proven. Id.

32 Three Boys, 212 F.3d at 485, 54 U.S.P.Q.2d (BNA) at 1729 (internal quotations omitted); see also Cavalier v. Random House, 297 F.3d 815, 822, 62 U.S.P.Q.2d (BNA) 1946, 1950 (9th Cir. 2002). As noted, supra, this test has been used for dramas, books, plays, and other literary works without the same difficulties as when implemented in music copyright infringement disputes.

33 Swirsky, 376 F.3d at 845, 71 U.S.P.Q.2d (BNA) at 1494.

34 Arnstein v. Porter, 154 F.2d 464, 473, 68 U.S.P.Q.2d (BNA) 288, 297 (2d Cir. 1946). In a footnote, Judge Frank remarks that "[i]t would, accordingly, be proper to exclude tone-deaf persons from the jury." Id. at 473 n.22, 68 U.S.P.Q.2d (BNA) at 297 n.22.
In other circuits, only this second part of the improper appropriation test, the ordinary observer's analysis, is used.\textsuperscript{35}

Several scholars have criticized how the \textit{Arnstein} test is implemented and its poor fit for determining infringement of musical compositions. One commentator, John Autry,\textsuperscript{36} discusses the use of expert testimony; Paul Grinvalsky\textsuperscript{37} concentrates on lay observer issues.

\textbf{A. Basic Music Characteristics and Expert Testimony}

Autry seeks to develop a way to distinguish between the "substantially similar" and "strikingly similar" standards when proving actual copying by dissecting the basic components of music. He argues that the body of case law shows a great deal of variety among courts' analyses of the musical elements of a song, which often has incongruous results.\textsuperscript{38} He describes in detail the four characteristics that are often used by courts when assessing similarity: melody, harmony, rhythm, and structure.\textsuperscript{39} The first, melody, is "the tune or theme around which a piece of music is constructed."\textsuperscript{40} It can be considered the character of the composition and breaks into melodic content, symmetry, and

\textsuperscript{35} See, e.g., Boisson v. Banian, Ltd., 273 F.3d 262, 272, 60 U.S.P.Q.2d (BNA) 1974, 1980 (2d Cir. 2001) (explaining that for the improper appropriation prong in an infringement analysis the Second Circuit only requires that an ordinary observer compare the two works in question to determine whether the allegedly infringing work is substantially similar to the allegedly infringed work).

\textsuperscript{36} Autry, \textit{supra} note 19.

\textsuperscript{37} Grinvalsky, \textit{supra} note 17.

\textsuperscript{38} Autry, \textit{supra} note 19, at 124-32.

\textsuperscript{39} \textit{Id.} at 121. Autry acknowledges the follow critical reviews as discussing the inadequacies of these categories of infringement analysis of musical compositions: Grinvalsky, \textit{supra} note 17; Paul J. Heald, \textit{Reviving the Rhetoric of the Public Interest: Choir Directors, Copy Machines, and New Arrangements of Public Domain Music}, 46 DUKE L.J. 241 (1996); Aaron Keyt, Comment, \textit{An Improved Framework for Music Plagiarism Litigation}, 76 CAL. L. REV. 421, 431 (1988) (discussing the problems of oversimplification in an analysis using only these broad elements); Michael Der Manuelian, Note, \textit{The Role of the Expert Witness in Music Copyright Infringement Cases}, 57 FORDHAM L. REV. 127 (1988).

\textsuperscript{40} Autry, \textit{supra} note 19, at 121.
character components. Autry claims that melody is “potentially [the] most dispositive of the four elements.”

The second characteristic, harmony, “is the relationship of each pitch included in a composition to the other pitch choices made by the composer.” It is “the essence of how one chord . . . relates to the next, and how the chords progress from the first chord in a phrase of music to the last.” Autry argues that “[i]n assessing striking similarity, the number of common chords must inevitably be greater.” He stresses the importance of chord progression uniqueness and cites Gaste v. Kaiserman, a music copyright infringement case involving the song “Feelings,” where the court stressed the evidence of a “unique musical fingerprint” in a finding of actual copying and infringement.

The third characteristic, rhythm, “is determined by the time value of notes and silences. The important components of rhythm are tempo, note value

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41 ld. For an in-depth analysis of melody, see Keyt, supra note 39.

42 Autry, supra note 19, at 125. Autry suggests that courts have routinely implied that the melodic themes must be nearly identical for a finding of striking similarity. ld. at 124-32.

43 Various others have discussed problems associated with the musical copyright infringement cases. Keyt, supra note 39, asserts that the originality of the melodic content of a song is highly persuasive in determining infringement, especially when compared with popular musical expressions. Although there appears to be a consensus that there is a great deal of difficulty applying the current infringement test to copyrightable musical compositions, there is no clear-cut way to resolve this.

44 ld. supra note 19, at 122.

45 ld. at 132 (internal citations omitted).

46 ld. at 133.

46 863 F.2d 1061, 9 U.S.P.Q.2d (BNA) 1300 (2d Cir. 1988).


48 Autry, supra note 19, at 134-35.
and silence, and symmetry." Rhythmic similarity is assessed by comparing these elements and is like hearing the song played on a drum, where only the thumping of the beat is considered.

The final characteristic, the structure of the work, is the number of measures or chord changes in a song or theme. It usually involves an empirical analysis and comparison of the number of measures contained in the allegedly infringing and infringed works.

Auyry's analysis exposes problems facing courts without directly addressing them. Some of these problems include conflicting expert testimony that relies on the limited breakdown and mapping of songs by musicologists and misplaced reliance on that testimony, which seems to lead to random results. At most, twenty-five to thirty elements are used to compare the two songs, which may be too small a number to truly quantify the differences and similarities between them. In addition, courts view some elements, such as those for

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49  *Id.* at 137 (internal citation omitted).

50  *Id.*; see also McRae v. Smith, 968 F. Supp. 559, 562 (D. Colo. 1997) (analyzing both rhythm and structure in its infringement determination).


52  *Id.* at 139. However, this factor is traditionally given less weight than melodic, harmonic, and rhythmic content.

53  *Id.* *passim.* Under "melody and melodic content," nine comparisons were named covering both broad and narrow themes for melodic symmetry:

1. the uniqueness of the particular succession of notes;
2. the shape and line of the musical phrase the notes represent;
3. when and how often they recur in each piece;
4. the melodic character, i.e., whether one melody evokes the same emotion or "mood" as the other;
5. the succession of notes in the melodic line;
6. the relationship of those notes to each other and the intervals between each note;
7. how many notes are included in each theme;
8. how many pitches in each are the same; and
9. at what points in the melodic line do those similar pitches fall, and whether the pitches ascend or descend.

*Id.* at 122-25. With harmonic content, or the compositional sophistication, Auyry lists four comparisons that can be made between the two songs: "duplication of chords, chord progressions, key signature, and mode." *Id.* at
melody, as more dispositive than others. The subjective and limited breakdown and analyses of the songs often lead to conflicting interpretations by the musical experts called to testify, and result in a credibility contest between these experts rather than an actual similarity comparison between the songs. In addition, "[t]he witnesses called to present testimony regarding musicological and theoretical comparisons are uniformly classically trained and educated. This remains true, even when the compositions being compared are 'pop' songs and the expert has little knowledge of the specific genre." 

B. The Intended Audience and the Lay Observer

With respect to the lay observer portion of the infringement analysis, Grinvalsky argues for a literal application of the intended audience test. This application serves as a solution for the weakness of using the jury as a proxy for the intended audience. He argues that a finding of substantial similarity for improper appropriation depends on the ordinary lay person's exposure to a musical genre, and therefore the jury should be more discerning and familiar with that genre. For example, if the music genre in question is jazz, then jazz aficionados are the intended audience and should comprise the jury. Since the test was first formulated in Arnstein in 1946, there has been an explosion of musical genres, such as rock-and-roll, disco, rap, and hip-hop. With this

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136. He lists three components for rhythm: tempo, note value and silence, and symmetry. Id. at 137. For structural similarity, four comparisons are generally made when measuring the empirical boundaries of each: "the number of measures contained in each work, the number of measures contained in the themes of each work . . . , the percentage of the overall composition . . . represented by each theme . . . [and] repetition." Id. at 139.

Based on this data, approximately twenty comparisons are made. However, to err on the side of caution and account for measurements that may not have been discussed by Autry, twenty-five to thirty is a reasonable estimate of the number of elements usually compared by music experts in infringement cases.

54 Id. at 124.
55 Id. at 120.
56 Id. at 121 n.64.
57 Grinvalsky, supra note 17; see also Michael Sitzer, Copyright Infringement Actions: The Proper Role for Audience Reactions in Determining Substantial Similarity, 54 S. Cal. L. Rev. 385 (1981).
58 Grinvalsky, supra note 17.
expansion, the probability that a trier of fact would be familiar enough with the form of music at issue to make a valid improper appropriation judgment becomes more remote.  

Grinvalsky supports his argument by citing the dissent in *Arnstein*, which argues that "artistic repugnance or boredom, or mere distance . . . causes all sounds to merge." Grinvalsky notes: "distance to music skews the substantial similarity plane and affects the ultimate findings of fact. An unintended audience may find that the two works sound substantially alike where an intended audience may find the two works fall short of substantial similarity." Grinvalsky also cites *Dawson v. Hinshaw Music*, where the allegedly infringing musical work was sheet music. The trier of fact viewed the two pieces of sheet music in question, which he did not know how to read, and therefore "was incapable of detecting, much less appreciating, their similarity or dissimilarity. He was simply not part of the audience for whom such . . . music [was] composed," and could not determine whether the works were substantially similar. Thus, Grinvalsky concludes, only the literal intended audience can recognize the difference between the works; the unintended

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59 *Id.*


61 Grinvalsky, *supra* note 17, at 423.

Where the styles are similar, for example, an unintended audience creates a risk of a lower substantial similarity plane. On the other hand, where the styles are different, the risk shifts in the other direction. The result may be a finding of no infringement where there perhaps should be, where the unintended audience simply could not believe that the works contained similarity of expression because, based on a mechanical change of tempo or instrumentation, the works did not sound alike. . . . Having an unaided, uninformed, disinterested or distanced finder of fact creates a potential risk of error that should not be there.

63 *Dawson*, 905 F.2d at 737, 15 U.S.P.Q.2d (BNA) at 1137.
audience may neither understand nor comprehend the material upon which they are to make a factual determination concerning infringement.\footnote{Grinvalsky, \textit{supra} note 17, at 427-28.}

Grinvalsky’s solution for the problems associated with the lay observer jury is not feasible due to the difficulty of finding a jury that is representative of the intended audience. In addition, Grinvalsky’s solution does not help resolve the issues involving the objective similarity tests for actual copying or improper appropriation. In order for the \textit{Arnstein} test to be reliable, better tools to assess the similarity of songs are needed.

\section{Two Paths to Substantial Similarity}

This section discusses proposed paths for the development of new substantial similarity tests that rely on (1) the art of music\footnote{\textit{See} \textit{John S. Rigden, Physics and the Sound of Music} (2d ed. 1985).} and (2) the science of music.\footnote{The definition of science, a particular way of knowing about the world, was very significant in a recent, high-profile court case refuting the teaching of Intelligent Design as a science:} In science, explanations are restricted to those that can be inferred from the confirmable data—the results obtained through observations and experiments that can be substantiated by other scientists. Anything that can be observed or measured is amenable to scientific investigation. Explanations that cannot be based upon empirical evidence are not part of science.}

\begin{quote}
\end{quote}

\footnote{\textit{Rigden}, \textit{supra} note 66, at 2.}

\footnote{\textit{John Redfield, Music: A Science and an Art} 138-52 (Tudor Publishing 1928).}
appropriation standard can find its roots. However, by relying on classically trained experts, who analyze music from a single viewpoint, courts are implicitly discounting the range and sophistication of both the musical genres in our culture and the elements that are dissected. A classically trained musician could listen to a rap or jazz song without fully appreciating rhythmic nuances or subtle melodic changes in the singer's voice. This objective information would be lost to the trier of fact and the jury that relies on expert testimony.

Courts currently ignore the physical science behind the creation of music. Physical scientists are not called upon to be expert witnesses in musical copyright cases, and the current analyses for similarity do not rely on the physical principles that underlie the unique mathematical expression of a song.

Both the artistic and scientific aspects of music must be taken more seriously by courts if there is to be an adequate solution to the problems plaguing the current musical copyright infringement test. Two potential solutions, using each of these concepts, are outlined below.

A. The Musical Elements of a Song

Although analyzing a song under the broad, artistic categories of harmony, melody, structure, and rhythm may be a good starting point for determining the level of similarity between songs, it should be expanded. As noted in Part II, the current breakdown leads to contradictory results and conflicting expert testimony. One solution is to further subdivide each of these categories into a large number of artistic elements for a detailed dissection of the songs in question. I will refer to this proposed test as Mega-Element Analysis (MEA).

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70 See Autry, supra note 19, at 121 n.64.

71 If the artist fixed the musical copyright through a recording rather than a written musical score, a musicologist would have no foundation for comparing the written notes of two songs without performing the task herself, which could lead to two obvious problems: (1) one not trained in the genre may miss some of the subtleties in the transposition; and (2) some of the sounds may not easily lend themselves to being written on a standard musical scale.

72 A search on Westlaw's Federal Intellectual Property Cases database in November 2005 returned no decisions in which a physicist has been employed as an expert witness in a music infringement copyright case.

73 See, e.g., Autry, supra note 19.
Music archivist Alan Lomax\(^{74}\) made an early attempt at such a systematic breakdown and dubbed it The Global Jukebox.\(^{75}\) His "army of rigorously trained research assistants"\(^{76}\) analyzed roughly 4400 songs based on "36 parameters that could be used to compare musical performance styles across cultures."\(^{77}\) The goal was to create "a multimedia interactive database that surveys the relationship among dance, song, and human history."\(^{78}\) He was only able to have a small portion of his intended body of work analyzed and included in the Global Jukebox and did not get the Jukebox past the prototype stage before his death in 2002.\(^{79}\)

More recently, Pandora Media, Inc. has created a database containing the breakdown of songs into a multitude of musical elements.\(^{80}\) Its Music Genome Project is a complex database—much more detailed than the Global Jukebox—containing quantitative, objective analyses of songs from over 10,000

\(^{74}\) In the 1930s and early 1940s, Alan Lomax and his father, folklorist John Avery Lomax, helped develop the Library of Congress' Archive of American Folk Song as a national resource, recording thousands of songs and oral histories in their original settings. See The American Folklife Center, *Alan Lomax Collection*, http://www.loc.gov/folklife/lomax/lomax.html (last visited Aug. 21, 2007).


\(^{76}\) Edlund, *supra* note 75.

\(^{77}\) *Id.* The songs spanned "400 cultures, everything from Pygmy recordings to American Pop Tunes." *Id.*

\(^{78}\) The American Folklife Center, *supra* note 74. "[T]he Jukebox [allows the listener to] compare and relate individual songs or entire musical cultures and trace traits across the globe. [The 'Correlations' function lets the listener] compare song structure with social structure. . . . Lomax had come to view music as a kind of code that carried fundamental information about the culture that produced it." Edlund, *supra* note 75.


artists. Each song is analyzed by a trained musical expert for up to 400 distinct musical characteristics and grouped into larger categories such as harmony, rhythm, structure, melody, vocals, and lyrics. For example, the harmony aspect of a song is analyzed for about twenty attributes, including keys, modality, and general harmonic structure; vocals is broken down into approximately thirty-five attributes, such as vibrato, range, and gender. This information is stored in a computer database where a proprietary software program mathematically calculates a correlation among songs.

The database is currently used commercially to allow listeners to find music they like and to suggest songs that are similar to previously selected music. When listeners interact with the program by choosing songs they like, the program becomes educated to their tastes. Then, based on correlations to other songs in the database, the program directs listeners to songs and artists that they might like.

The concept behind the MEA test is to objectively analyze both the allegedly infringing song and the allegedly infringed song independently based upon objective criteria, such as the system used in the Global Jukebox or the Music Genome Project. The songs would be stored in the computer database of song analyses and compared against each other and other music in that genre to determine their degree of similarity.

The MEA test offers several benefits over the current objective tests for actual copying and improper infringement. First, the MEA test provides a larger number of comparison points than the current test. Most musicologists use anywhere from twenty to thirty musical elements in their comparisons. This

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81 E-mail from Tim Westergren, Chief Strategy Officer & Founder of Pandora Music, Inc., to Author (Nov. 5, 2005) (on file with author).

82 Telephone Interview with Tim Westergren, Chief Strategy Officer & Founder of Pandora Music, Inc. (Nov. 7, 2005) [hereinafter Interview with Westergren]. It takes a musician who is trained in the Music Genome Project system twenty to thirty minutes to analyze a song. Pandora currently has twenty musicians working full-time analyzing songs for input into the database. Each characteristic is scored on a sliding scale, and the scale used for an element is dependant on the nature of the characteristic. Id.

83 Id.

84 Id.

85 See supra note 53 and accompanying text.
could lead to problems of both over- and under-inclusiveness. One may falsely find similarities based on the big picture when a more detailed analysis would show substantial differences, or an overall dissimilarity when there are a substantial number of small-scale similarities.

To illustrate this, one can compare the number of points of analysis for a song to the number of points used when graphing a mathematical equation. Suppose one was trying to graph the equation for the simple sine wave, \( y = \sin(x) \). If we compare the graphs charting the result every 150 degrees (Figure 1), versus every 30 degrees (Figure 2), there are obvious differences.

**Figure 1. Wavelength Generated from \( y = \sin(x) \) when Sampled Every 150 Degrees**

![Figure 1](image1.png)

**Figure 2. Wavelength Generated from \( y = \sin(x) \) when Sampled Every 30 Degrees**

![Figure 2](image2.png)

The more points of comparison there are, the better one can determine points of similarity between two works and thus achieve a better objective description of a song with fewer chances of over- or under-inclusiveness. In other words, using more points (or musical elements) in a comparison provides more opportunity for finding both differences and similarities.

Second, unlike current infringement analysis where the musical elements of two songs are compared directly, in an MEA dissection, the subject elements for each song are independently scored on an objective scale without regard to infringement by or on other songs. Only after the song is analyzed and the results are stored in the database will there be a comparison to the independent
analysis of the other work. This would remove any potential bias on the part of the musicologist when comparing the songs.

A problem with the MEA is the use of trained musicians whose analyses contain some level of subjectivity. Some musicians may have preferences toward certain media genre that skew their analyses. However, skewing may also be overcome if each song is evaluated by several musicians and then each score is averaged and outliers removed.

The MEA test is a reasonable and viable expansion of the current musical copyright infringement test and should be developed for use by courts. The Music Genome Project demonstrates the feasibility of an objective MEA test to determine both actual copying and improper appropriation.86

B. The Physics of a Song

As an alternative to the MEA, one might adopt a completely new approach to a striking or substantial similarity test based on mathematical modeling of the physical attributes of a song. How sound is carried is itself an expression, not merely the expression of emotion and ideas that we attempt to convey through it. It is an expression of the science behind how sound propagates. At its most fundamental level, music is sound. Sound is the movement of a wave by compression of molecules in the air resonating on an eardrum. This sound is subsequently interpreted by the brain.87 Music is the expression of physics—harmonics and oscillations.

The Greek mathematician Pythagoras is credited with discovering harmonic motion. About 2500 years ago, he surmised that the pitch of a sound depends on the length of the string that produces it, and by changing the length of the string in set increments (e.g., doubling or tripling it), the tone is the same

86 The founder of Pandora, Tim Westergren, thought that for use in copyright infringement determination, an MEA test might require analyzing approximately 10,000 musical attributes rather than 400, but he had an obvious vested interest in not using his system for such an analysis. Use in an infringement analysis would most likely require divulging his software code to the public, destroying any trade secret protection. A few years ago, Pandora was approached by attorneys interested in using the database for copyright infringement analysis, but the founders did not believe that this was the function they had in mind for the Music Genome Project, and had no desire to pursue it. Interview with Westergren, supra note 82.

87 See generally RIGDEN, supra note 66.
but resonates at a different octave. Sound occurs when the molecules in air are displaced and compressed rapidly causing a change in pressure. These inequalities in pressure generate gas motion, thus propagating a wave.

However, musical tones are different than ordinary noise propagation. "Noise corresponds to a sort of irregular vibration of the eardrum that is produced by the irregular vibration [of some nearby object,]" whereas a musical sound has sustained tones or notes. It has periodicity, meaning the shape of the propagation corresponding to "the variation of the air pressure with time . . . repeats itself over and over." This consistent oscillating motion is known as harmonic motion or periodic motion. Regular noise—the sounds of everyday life such as the screeching of car brakes and the crash of two cars colliding, the drone of traffic on a freeway, or the rustling of leaves on a tree—would have no discernible repeating pattern. Musical sound, on the other hand, has a discernible pattern. "Simple harmonic motion is the origin of musical sounds . . . an object such as a tuning fork, oscillating with [simple harmonic motion], gives rise to the simplest of all musical sounds—a pure tone."

Sound waves travel through the air the same way water waves travel through the ocean. If we consider sound as a wave passing through water, as illustrated below in Figure 3, the molecule does not travel in the horizontal direction of the wave, but the wave's motion changes where it is vertically located.

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88 *Id.* at v.
89 RICHARD P. FEYNMAN ET AL., 1 THE FEYNMAN LECTURES ON PHYSICS 47-3 (1963).
90 *Id.* at 50-1.
91 *Id.*
92 *Id.*
93 *Id.* at 50-1 to 50-2.
94 RIGDEN, *supra* note 66, at 18.
Figure 3. Diagram of Wave Propagation Through Water\textsuperscript{95}

When a simple harmonic wave is graphed, as shown in Figure 4, it is usually shown as a function of time rather than as a function of distance; that is, it is a graph showing how the individual molecule changes its vertical position over time as the wave passes through that point in the ocean or the air.\textsuperscript{96}

Figure 4. Diagram of Simple Harmonic Motion\textsuperscript{97}

For musical sound, the height or amplitude is the change in air pressure corresponding to the change in the height of the wave.\textsuperscript{98} If this simple harmonic

\textsuperscript{95} THOMAS GARRISON, OCEANOGRAPHY: AN INVITATION TO MARINE SCIENCE 229 (2d ed. 1996).

\textsuperscript{96} Without going into detail about wave formation, for the purposes of this discussion, it is assumed that the wave is traveling at a constant speed.

\textsuperscript{97} Adapted from JUAN G. ROEDERER, THE PHYSICS AND PSYCHOPHYSICS OF MUSIC: AN INTRODUCTION 19 (3d ed. 1995).
motion were a musical sound, a listener would hear a single sustained tone. Plucking the string of a piano produces a sound through the harmonic motion of the string. 99 As physicist Richard Feynman explained:

If we pluck the string, by pulling it to one side and releasing it, the subsequent motion will be determined by the motions of the waves we have produced. We know that these waves will travel in both directions, and will be reflected at the ends. They will slosh back and forth for a long time. No matter how complicated the wave is, however, it will repeat itself. . . . Each point on the string will . . . return to its starting position after one period, and again one period later, etc. The sound wave produced must also have the same repetition. We see why a plucked string produces a musical tone. 100

Every musical sound can be broken down into its basic physical elements, a set of pure tones. 101 Pure tones are superimposed to form chords and arranged sequentially to form musical compositions. 102 Where the waves are both positive or both negative, they create a bigger signal. Where they are opposite, they create a smaller signal. If they are completely opposite, they cancel each other out. 103 For example, in Figure 5, the thick black line represents the combined signal of the two light gray lines.

98 F E Y N M A N E T A L., supra note 89, at 50-1.

99 R I G D E N, supra note 66, at 12.

100 F E Y N M A N E T A L., supra note 89, at 50-2.


102 Id. at 57.

103 David Worrall, Course Notes for The Physics and Psychophysics of Sound & Music: Superimposition of Two Sine Tones of Equal Frequency and Equal Phase, available at http://www.avatar.com.au/courses/PPofM/psychohearing/psycho3.html. This is essentially how noise reduction headphones work. A tiny microphone in the earpiece detects the annoying noise, such as the engine of an airplane, and before the sound reaches your ears, it inverts the signal, i.e., it turns the noise's sound wave upside down, creating the opposite sound wave. These two waves cancel each other out. CNET, The Sound of Silence, CNET REVIEWS, July 19, 2005, http://reviews.cnet.com/4520-3000_7-1017728-1.html (last visited Aug. 21, 2007).
A song is composed of many sound waves that are both superimposed and arranged temporally, and while the physics becomes more complicated, it may be summarized as follows: Musical sounds can be broken down to their most elemental musical tones and represented through mathematical equations.\textsuperscript{105} They can also be plotted on a graph to see their different physical characteristics.\textsuperscript{106} This footprint of a musical sound could then be compared with that of other sounds to determine the correlation, or similarity, between them.

Using the physics of music, a math and physics-based copyright infringement test, which I call the Mathematical Modeling Analysis (MMA) test, could be developed to analyze the distinct characteristics of a musical tune. The MMA test could be used for both the actual copying and improper appropriation analyses. The concept behind the test is the creation of mathematical models of the allegedly infringed and allegedly infringing songs by dissecting them into mathematical formulas representing their physical components. The mathematical expressions of the two songs could be compared through a

\textsuperscript{104} \textsc{Edward A. Lee} \& \textsc{Pravin Varaiya}, \textit{Structure and Interpretation of Signals and Systems} 7 (Addison-Wesley 2003).

\textsuperscript{105} For a detailed exploration of the physics of music, see \textsc{Rigden}, \textit{supra} note 66.

\textsuperscript{106} Often an oscilloscope is used to create a visual image of a sound wave. By converting pressure into electronic impulses, the oscilloscope shows the relationship between the pressure change created by the sound over time on a computer screen. An example of the output seen would be the simple harmonic motions shown in Figure 4, \textit{supra}. 
correlation analysis. One could then determine how similar the songs are relative to each other and to other songs in the genre.\textsuperscript{107}

The MMA test offers several benefits over the current similarity analysis. First, like the MEA test, the MMA test can be used to demonstrate that a certain level of similarity is always present within a given genre. It would act as a filtering mechanism similar to removing the uncopyrightable components prior to analysis for similarity. For example, if there were an infringement dispute regarding two country-western songs, one could mathematically compare the two songs as well as other country-western tunes. One might learn that all country-western tunes are at least 60% alike,\textsuperscript{108} yet there is a 95% correlation between the two songs in question with no other song greater than 70% similar. Figure 6 below provides a hypothetical scale, expressed as percentage of similarity, for using the MMA test.

Alternatively, rather than have an overall similarity score, several algorithms could compare the similarity of recognized characteristics of the two songs, such as harmony, melody, and structure. The determination of substantial (or striking) similarity would then be based on the evaluation of all of these MMAs. The songs might have a high correlation with regard to melody, but a low one for harmony.

If the plaintiff is to attempt to prove actual copying, a very high correlation to the allegedly infringed work could be viewed as meeting the strikingly similar standard. Alternatively, if the plaintiff is able to prove access to the allegedly infringed work, a reasonably high correlation above the baseline level could lead the trier of fact to find substantial similarity between the songs, and thus actual copying and improper appropriation. However, a strong correlation of either or both songs to every other song in the country-western music database could be viewed as favorable to the defendant.

\textsuperscript{107} A simplified explanation of the procedure is as follows: one can plot two equations against each other to see how similar they are and determine a correlation value. In mathematics, this is represented by $\chi^2$ and has a value between zero and one. Zero means no correlation; one means a perfect correlation between the two equations.

\textsuperscript{108} This is pure speculation, as this analysis has not been performed. The author calls on musically inclined math or physics students to create this test and determine the overall correlation of country-western songs.
Figure 6. Hypothetical Scale for Using the MMA Test

<table>
<thead>
<tr>
<th>&lt; 60%</th>
<th>&gt; 80%</th>
<th>&gt; 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline for country-western music ('actual copying' and 'unlawful appropriation' analyses)</td>
<td>Substantial Similarity ('actual copying' and 'unlawful appropriation' analyses)</td>
<td>Striking Similarity ('actual copying' analysis)</td>
</tr>
<tr>
<td>Expert testimony can go to the jury.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With the proposed MMA test, no filtering of non-copyrightable material would be necessary.\(^\text{109}\) Rather, it could be assumed that any similarity below a certain percentage is that of non-copyrightable material. It is only when the similarity would rise above a determined percentage, either overall or from the separate components, that the work would be considered substantially similar enough to the allegedly infringed work to be considered infringing. Thus, information from the MMA test could answer questions for both striking similarity in the actual copying test and substantial similarity in the improper appropriation test.\(^\text{110}\)

The MMA test could also compare an allegedly infringed song's harmonics to works in the public domain. One defense available would be a showing that both the allegedly infringed work and the allegedly infringing work had a high correlation to a work in the public domain. Because both were demonstrated to be copied from that uncopyrightable work, there would be a finding of no infringement notwithstanding how similar the harmonics might be.

Because the MMA test has not yet been put to practice, there is no way to prove that mathematically modeling songs to create a correlation algorithm for copyright infringement similarity analyses would work.\(^\text{111}\) However, a great deal

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\(^{110}\) The Second Circuit in Arnstein v. Porter noted that “[i]n some cases, the similarities between the plaintiff’s and defendant’s work are so extensive and striking as, without more, both to justify an inference of copying and to prove improper appropriation.” 154 F.2d 464, 468-69, 68 U.S.P.Q. (BNA) 288, 293 (2d Cir. 1946).

\(^{111}\) Various library and internet searches of scholarly literature in physics did not reveal any mathematical models of the physics of particular musical competitions that could be used for infringement analysis.
of research has been done in the field of mathematical modeling of music.112 There is a journal devoted to computer music113 and scores of articles have been written regarding computer programs that analyze music through the use of mathematical algorithms.114 Computer languages and programs have been created to write music.115 Yet no one has specifically dealt with the use of these tools in the copyright infringement analysis. However, in theory, with a sufficiently sophisticated computer system, it should be possible for an enterprising and musically inclined mathematician, physicist, or computer scientist to create a program that would capture a song in a computer model suitable for a correlation analysis.

IV. **LEGAL OBSTACLES TO IMPLEMENTING A NEW TEST**

In order for either the MEA or MMA test to be accepted and used, there are two hurdles in the legal realm that must be overcome: (1) the test must meet the Federal Rules of Evidence standard for admissibility116 and (2) juries must be


113 Computer Music Journal has been in publication for twenty-nine years.


115 MIDI, an acronym for Musical Instrument Digital Interface, is "a standard adopted by the electronic music industry for controlling devices, such as synthesizers and sound cards, that emit music. At minimum, a MIDI representation of a sound includes values for the note's pitch, length, and volume. It can also include additional characteristics, such as attack and delay time." Webopedia, MIDI, http://www.webopedia.com/TERM/M/MIDI.htm (last visited Aug. 21, 2007).

sufficiently comfortable with the test to rely on the results and testimony offered when deciding the issues of actual copying and improper appropriation.

A. Scientific Evidence, Expert Testimony, and the Daubert Standard

_Daubert v. Merrell Dow Pharmaceuticals, Inc._117 laid the foundation for Rule 702 of The Federal Rules of Evidence,118 "which was designed to ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable."119 Under Rule 702:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.120

In addition, the four non-exclusive factors identified by the Supreme Court in _Daubert_ continue to be applied by courts to determine the reliability of expert testimony in accordance with Rule 702.121 These are:

(1) whether the theory or technique can be and has been tested; (2) whether the technique has been subject to peer review and publication; (3) the technique’s known or potential rate of error and the existence and maintenance of standards controlling its


118 RULE 702.

119 United States v. Parra, 402 F.3d 752, 758 (7th Cir. 2005) (quoting Smith v. Ford Motor Co., 245 F.3d 713, 718 (7th Cir. 2000) (internal quotations omitted)).

120 RULE 702.

operation; and (4) the level of the theory or technique's acceptance within the relevant discipline.\textsuperscript{122}

In music infringement cases, courts have generally accepted the expert testimony of musicologists and their limited dissection and comparison of songs as reliable expert testimony despite the fact that this testimony arguably might not satisfy the first and third \textit{Daubert} factors. The experts testify to the similarity (or dissimilarity) of the musical elements of the songs, and it is left to the trier of fact to determine which of the two experts, and their competing conclusions, is more credible.\textsuperscript{123} The \textit{Daubert} standard and Rule 702 were formulated for medical and scientific testimony,\textsuperscript{124} and, although determinative in those fields, may not always be easily applied to other disciplines such as musical copyright infringement.\textsuperscript{125}

\begin{quote}
\textsuperscript{123} \textit{See} Tisi v. Patrick, 97 F. Supp. 2d 539, 543, 55 U.S.P.Q.2d (BNA) 1117, 1119 (S.D.N.Y. 2000) (finding that the conclusions of the expert for the defendant "were sounder and more credible, and his analysis more convincing once the examination moved beyond the initial audible overall dissimilarity of the two songs"). "[L]itigators should be keenly aware that, as in other litigation, many of the copyright determinations will turn on the credibility of the expert witnesses employed by the plaintiff." Autry, \textit{supra} note 19, at 120; \textit{see also} Bright Tunes Music Corp. v. Harrisons Music, Ltd., 420 F. Supp. 177, 178 (S.D.N.Y. 1976) (relying on expert witness testimony regarding the unusualness and uniqueness of the note sequences in two songs, "He's So Fine" and "My Sweet Lord," even though the motifs themselves were in the public domain).
\textsuperscript{124} "The inquiry envisioned . . . is . . . a flexible one. Its overarching subject is the scientific validity—and thus the evidentiary relevance and reliability—of the principles that underlie a proposed submission. The focus, of course, must be solely on principles and methodology, not on the conclusions that they generate." \textit{Daubert}, 509 U.S. at 594-95, 27 U.S.P.Q.2d (BNA) at 1206-07.
\textsuperscript{125} For example, \textit{Daubert} involved the likelihood of birth defects resulting from the use of a drug, and the statistical analyses and expert testimony revolved around that issue. \textit{Id.} at 582, 27 U.S.P.Q.2d (BNA) at 1200. However, the \textit{Daubert} standard "applies not only to testimony based on scientific knowledge, but also to testimony based on technical and other specialized knowledge." \textit{Kumho Tire Co.}, 526 U.S. at 141, 50 U.S.P.Q.2d (BNA) at 1180 (internal quotations omitted).
\end{quote}
Using a more complex and objective breakdown in the MEA test could be considered a reasonable expansion of the technical evidence currently allowed. However, the use of musicians rather than the classically trained musicologists that are currently used has both benefits and disadvantages. Using musicians trained in a variety of fields would eliminate some of the problems associated with the limited knowledge base of classically trained musicologists. However, musicians whose training is limited to evaluating songs based on an objective scale may not have a sufficient knowledge base in music to (1) perform the job in an adequate manner or (2) be accepted by courts as experts with reliable “scientific, technical or other specialized knowledge.”126 Because courts already judge the Daubert factors in copyright and find the limited training of musicologists acceptable under its standard, it would be no worse to use musicians as experts with the MEA test and would most likely be an improvement.

For the MMA test, there is no acceptance by courts of a similar form from which the MMA test may be extrapolated and thus aid in its acceptance. However, the expert testimony of highly educated physicists and mathematicians who are trained in mathematic modeling of music could eventually meet the requirements of Rule 702 and be considered qualified as experts. First, the generation of a mathematical model or models could be shown to be based on sufficient data to form a reliable opinion. Second, the MMA test would be based on the reliable and accepted principles of physics and methods of mathematical modeling. The third factor, reliable application of the MMA test to the facts of a case, is a subjective matter. It would be difficult to say that it is more or less reliable than the current test. However, the use of objective scientific principles that result in empirical data could go a long way toward convincing courts that it is more reliable than the subjective comparisons of musicologists who may not even be trained in the relevant musical genre.

With regard to the Daubert factors, a mathematical model can be tested and is already subject to peer review and publication. The statistical errors regarding the MMA test, that is, the mapping error between the physics of the song to its mathematical algorithm, could eventually be determined, and over time decreased. Thus, there is a strong possibility that the MMA test could eventually be accepted as a method for comparing songs for the purposes of determining similarity in an infringement action.

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126 Rule 702. See generally Autry, supra note 19, at 120.
B. The Role of the Jury

No matter how sophisticated or accurate the MEA or MMA tests appear to be, they cannot supplant the role of the jury.127 The Supreme Court has affirmed that, under the Seventh Amendment, parties to an infringement suit have the right to have their case tried by a jury.128 Juries may be uncomfortable using an unfamiliar standard to determine actual copying or improper appropriation. The party using the test has the task of making the jury comfortable with the test and its results for it to be of any use. If a new test is not understood by the lay members of the jury, they may ignore the testimony regardless of what information is presented by experts. It is well settled law that "the testimony of experts is only advisory, and . . . the jury is not required to surrender their judgment or to give a controlling influence to the opinion of expert witnesses, but may exercise an independent judgment from their own knowledge and experience."129

For the product of either test to be of any use, the party wishing to support its position with such evidence must overcome any reluctance on the part of the jury. An explanation of the method that is too complex could confuse the jury, yet an insufficient explanation may cause the finders of fact to discount it. An advantage of the MMA method is that the resulting data does not have to be in numeric form. Two or more songs' harmonics could be plotted on graphs and compared in that manner, which would benefit jurors who prefer visual representations.

V. Final Thoughts

Either the MEA or the MMA test could supplant the current dueling expert head-to-head analysis for actual copying. Both proposed methods rely on sophisticated computer technology and have the potential of being as central to infringement cases as DNA technology is to criminal proceedings. In the short term, the MEA test has a better chance of initial acceptance by courts and of being understood by the jury. Music, as with any sound, requires creation,

127 Assuming that the case cannot be decided as a matter of law.
129 Brownrigg v. Massengale, 70 S.W. 1103, 1104 (Mo. Ct. App. 1902); see also Weaver v. Scripture, 211 N.Y.S. 593, 599 (Sup. Ct. 1925).
transmission, and perception. There is art in music that evokes emotion, stirs
the intellect, and holds other intangibles that a mathematical model is incapable
of capturing. However, the MMA test could lead to the presentation of more
objective testimony with which a jury may be more comfortable—they may want
to rely less on emotions and more on facts.

When Arnstein was decided in 1946, neither of the two tests proposed in
this article could have been used. The computer technology necessary for either
music genomic analysis or mathematical modeling was in its infancy and
incapable of performing the complex computations for correlating the similarity
between two songs. Today, it could be possible. The Music Genome Project is
well on its way to creating a usable database for the MMA test proposed in this
article. Even if it were unavailable, it could be independently replicated. The
development of a computer program that mathematically models and compares
two songs is not as far along. But musicians with backgrounds in physics,
mathematics, or computer science may have the tools to develop the algorithms
and mathematical models required to analyze songs and correlate their similarity
for use in copyright infringement determinations.

Creating a less subjective similarity test for musical copyright
infringement is not a futile endeavor. Even if neither of the tests proposed herein
is found to be a reasonable alternative, we must continue to challenge the current
method and work to improve it. As long the current policies regarding

See RIGDEN, supra note 66, Part I, at 4.

In the most general terms, [listening to music] involves
three systems. First, there is the source of the sound. The
source emits the sound. Second, there is the air that
propagates the sound. A medium is necessary to carry the
sound from the source; the medium, air, transmits the
sound. Third, there is your auditory system that detects
the sound. A detection system receives information from
the source via the medium and registers that information.
Origination, transmission, and detection together form a
crucial part of the listening experience.

Id.

Computers still used vacuum tubes, required large rooms, and had very
limited memory. The transistor was not developed until the 1960s, and it
was only in the 1970s that the modern microprocessor was developed. See
Myles White, The ‘Chip’ at 25: Processor Credited with Kick-Starting the
copyright protection and unauthorized copying remain, it is unacceptable to allow a substandard test to continue to affect the ability of authors and composers to protect the product of their creative talents.
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