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Review of W.B. Hewlett & E. Selfridge-Field, eds., *Melodic Similarity: Concepts, Procedures, and Applications* (Cambridge, Massachusetts: MIT Press, 1999)

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[1] Volume 11 of *Computing in Musicology* comprises 13 contributions by 18 authors. While the spectrum of topics is broad, reaching from melodic similarity in music-copyright infringement suits (C. Cronin) to web-based melodic search tools (A. Kornstadt), a clear emphasis is given to the conceptional approach to melodic similarity

[2] The main article within the group of essays on *Concepts and Procedures* is written by E. Selfridge-Field and focuses on data representations of music and search strategies for melodic material as stored in data banks. In her contribution, Selfridge-Field remarks that the representation of musical data crucially influences the choice of the search strategies and the results of data base searches. She suggests classifying musical components into three classes: (a) "representable components" such as pitch and duration, (b) "derivable components" such as intervallic motion and accent and (c) "non-derivable components" such as articulation and dynamic indications. Melodies, for example, which are represented only in the form of pitch sequences may misidentify musical material as "similar" which might have been identified as being "different" had the rhythm been considered. Thus, as Selfridge-Field maintains, such data representations are often inadequate. Why, however, she classifies dynamics into the class of non-derivable components remains unclear to this reviewer, especially if we consider its highly developed notation in 20th century music. 20th-century avant-garde music seems frequently slighted as, for instance, when Selfridge-Field critiques the base-12 system (the representation of the chromatic scale by twelve values) as not being applicable to the "conventions of written tonality." Inspired by music ethnologists (e.g. Seeger 1960) and supported by the findings of music psychologists (e.g. Dowling 1971), contour has often been regarded as a major factor in melodic similarity. Thus it does not surprise when Selfridge-Field confirms that contour is a "common approach to melodic comparison." How melodic similarity—including rhythmic representation—might be implemented in an algorithm, however, remains an unanswered question. Thus neither a definitive working solution nor a definite approach is offered.

[3] D. O. Maidin's article, "A Geometrical Algorithm for Melodic Difference," offers a specific algorithm which is based on some interesting principles. First, O Maidin proposes to compare a given pair of melodies by forming the difference between the pitch sequences of both melodies. For instance, melody A given as C–E–G–E and melody B given as E–D–E–G will

produce the differences in semitones: C – E = 4, E – D = 2, G – E = 3 and E – G = 3. Overall we obtain the sum of the differences of 12 semitones. Further, O Maidin maintains that notes of longer durations will have to be weighted more than notes of shorter durations. This seems a plausible assumption. Had we transposed the first melody up by a fifth, we would have obtained: g–b–d–b. Comparing this with the second melody, we obtained the overall difference of 26 semitones. Thus, the proposed algorithm is transpositionally sensitive. Although this is in accordance with experimental findings by R. Egmond, D. Povel & E. Maris (1996), O Maidin seems uncomfortable with this aspect of the algorithm. He suggests the following procedure for the calculation of the pitch difference between the melodies A and B: (a) transpose melody B into various keys, (b) calculate the pitch differences between these various transpositions of melody B and the melody A and (c) determine which transposition of B yields the minimal pitch difference. This is a tedious procedure which could have been avoided by calculating the differences between the intervals rather than between the pitches. In fact L. Hofmann-Engl & R. Parncutt (1998) found in two experiments that a model based on interval difference is a major predictor for melodic similarity ($r > 0.8$, $p < 0.01$).

[4] Admittedly, experimental investigations into melodic similarity are still scarce. This might explain why neither the two articles reviewed above nor the other four contributions in the section on “Concepts and Procedures” endeavor to approach the issue from a more cognitive point of view. However, there seems altogether a certain amount of confusion prevailing over the issue of melodic similarity. This becomes apparent, when for instance T. Crawford, C. S. Iliopoulos, and R. Raman formulate in their article, “String-Matching Techniques for Musical Similarity and Melodic Recognition,” the objective that an important part of their research is directed towards a “formal definition of musical similarity.” This seems like yet another trial to develop a formal theory and then to hope for it to have some cognitive relevance (as happened with the “generative theory of tonal music” by F. Lerdahl & R. Jackendoff (1983) and more recently E. Narmour’s “implication realization model” (1992)).

[5] L. A. Smith, R. J. McNab, and I. H. Witten approach the issue of melodic similarity in their essay, “Sequence-Based Melodic Comparison: A Dynamic Programming Approach,” from a transformational angle, based on the work of M. Dillon & M. Hunter (1991). The underlying hypothesis is: “The more steps required to transform a given melody A into a melody B the smaller the similarity.” Although interesting and possibly valuable, the reviewer is of the opinion that an experimental approach to the issue might be more promising. Useful examples of such an experimental approach can be found in the wider spectrum of cognitive psychology for instance within the works of S. Shepard (1987) and A. Tversky (1977). Until there is more experimental evidence supporting a theoretical approach, it will remain purely speculative.

[6] The issue of melodic similarity is considered from a more practical point in J. Howard’s article, “Strategies for Sorting Melodic Incipits.” As he points out in his introduction, the collection of musical materials in libraries and the need for systematic classification pose direct questions. The most pressing question might be the attribution of pieces of unknown origin. Howard reports that while ten years ago there was still a trend to trace the origin of a source in order to determine authorship, there has recently been a shift towards comparing musical material directly. In a first attempt, the RISM database in Frankfurt was used to determine the origin of 144 unknown pieces by comparing pitch and interval profiles of melodic incipits. As this did not produce the desired results other factors were included (e.g., staccati, pauses). The results obtained confirmed that when several factors are included in a search, the search becomes far more effective. In a similar approach, Howard devised a series of search criteria. Although a search based on those criteria reproduced similar effects as had the team in Frankfurt, he also found that over-specification can be misleading, placing highly similar material into different classes. Howard concludes that search strategies have to be somewhat flexible and adaptable in order to be most effective. It also appears to the reviewer that more sophisticated statistical tools would enhance such search processes.

[7] The concepts of musical “signatures” as referred to by D. Cope in his essay, “Signatures and Earmarks: Computer Recognition of Patterns in Music,” has been popular since J. S. Bach, who “signed” many of his compositions (the sequence B♭–A–C–B translates into German B–A–C–H). Cope proposes to broaden this concept of musical signature to any characteristic which is unique to a composer’s style, referring to some examples of typical Mozartian cadences and to some excerpts of Chopin’s Mazurkas. The question of what makes a specific style is as old as musicology itself. True, the given examples of Mozart are somewhat typical for his piano music, but they can also be found in compositions of other composers (e.g., Haydn and Clementi). Thus without some more detailed investigation, it seems difficult to say whether the

quoted type of cadence is more typical for Mozart than, for instance, Clementi. The question remains: "Who's signature really is it?" Maybe more crucial is the question whether the style of a composer like Mozart or Chopin can be captured by referring to a signature. From a musicological point of view, we are tempted to say "no." It seems a multiplicity of features creates Mozart's piano style including the extensive use of Alberti basses, chromaticisms, thin layered harmony (mostly within the understanding of the functional tonal system) and extensive use of the classic sonata form. Stanley's (1983) entry in "The New Grove" might serve as a suitable starting point. Investigations of the kind proposed by Cope's conclusion will need further substantiation.

[8] The essay, "A Multi-scale Neural-Network Model for Learning and Reproducing Choral Variations," by D. Hornel is one of the three articles in the group on "Tools and Applications." The underlying concept of his presentation is to test whether neural-networks will perform a compositional task better when the task is divided between two neural-networks. While one of the neural-networks is implemented to make decisions about the use of motivic material depending on the more global structure, the second neural-network is designed to decide on the exact pitches according to counterpoint rules and melodic coherence. The test case is the artificial composition of a melodic variation in the style of Pachelbel where quarter and half notes are replaced by a flowing line of sixteenth notes. After the initial training of this neural-network system by imputing examples of original Pachelbel excerpts, the system artificially composed several variations (two of them are given in the article). The results are impressive and seem to confirm that more complex neural-network systems, taking into account global structuring, are more likely to be successful. The composition composed by this system falls short, however, when compared to a typical Pachelbel variation. Several counterpoint rules are violated throughout both examples (e.g., improper resolution and preparation of dissonances). Additionally, much of the melodic line does not flow smoothly, which makes it hard to mistake these examples for compositions in Pachelbel's style. While the counterpoint violations can be avoided by algorithmic adaptation of the neural-network, the smoothness of the melodic line could be, as Hornel suggests, improved by using a third neural-network controlling the overall structure of motive distribution. The reviewer feels, however, that the application of neural-networks will be far more instructive if the network system is fed with different styles and used for the artificial composition of new works.

[9] The concept of database search has been shown to provide useful information for the classification of musical material (e.g., Schlichte 1990). Computer-aided music analysis might be just as useful, however, for the analysis of stylistic characteristics of individual composers. This is the main argument put forward by N. Nettheim in "Melodic Pattern-Detection Using MuSearch in Schubert's 'Die schöne Müllerin'." As the title suggests, Nettheim uses the song cycle, "Die schöne Müllerin," by Schubert as an example. The melodic material, together with the text, was entered into a database. A text/melody search then can, for instance, list all data entries which contain the letter sequence "lieb" (love). Nettheim does not, however, draw any conclusions from his search results. Although the reviewer agrees with Nettheim that the use of databases could be a helpful tool for the analyst, he also feels that Nettheim's argument would have been much more convincing if he had shown that the text/melody search helped to reveal a new and interesting aspect of Schubert's music.

[10] It certainly is true that a closer interdisciplinary cooperation between the various branches of musicology is still insufficiently explored. Ethnomusicology is no exception. Thus the article, "Rhythmic Elements of Melodic Process in Nagauta Shamisen Music," by M. Yako could have been a valuable contribution to the publication. As it stands, however, Yako's article draws conclusions which seem little justified by the research details given in the text. Initially, Yako sets out to analyze ten nagauta compositions, based on transcriptions from 1918. Although aware that traditional Japanese notation identifies finger positions and movements rather than pitches and durations, Yako seems to accept the accuracy of the transcriptions (transcriptions which usually ignore tempo deviations by grouping durations into simple duple or quadruple time). Following some vaguely described criteria Yako then isolates 700 rhythmical patterns within these 10 pieces. Although one of the tables in the text endeavors to list a selection of these patterns, we are given letters (representing patterns) without explanation what these letters stand for. Further, the letters given in the table do not coincide with the letters in the musical examples, thus rendering both the table and the examples useless. Finally, the conclusion that patterns overlap is trivial and more a consequence of allowing 700 patterns for the search and likely of no cognitive relevance. This is all the more disappointing as the understanding of time in Shamisen music, which might be described as breathing, is certainly worth a thorough investigation.

[11] The section on "human melodic judgment" contains two articles. Disappointingly, neither article addresses cognitive questions, and any expectation to find an answer for the question "What is melodic similarity?" remains unfulfilled. Although E. Dahlig & H. Schaffrath present an experiment in their essay, the standards of psychological experimentation are not met. The authors set out to investigate the effects of real folk songs in comparison to artificial folk songs. The stimuli of the real folk songs are authentic, but the construction of the artificial folk songs seems problematic, as they consist of phrases taken from original folk songs. The construction according to algorithmic strategies would have been more appropriate, for instance by using Markov chains (Cambouropoulos 1994). The records of the participants of the experiment are also insufficient (for instance musical skill is simply measured by whether a participant plays an instrument or not). We are also not informed how many people participated in the experiment. The questionnaire itself gives the participant a three-point scale for "pleasure" and a five-point scale for "authorship." The inclusion of other dimensions such as "coherence" and "completion" instead of "authorship" would have enabled the researchers to measure responses more accurately. Finally, in the result section we learn that subjects were from socially diverse groups. Groups of participants are listed as "Hauptschüler" (students classified by the German education system as unsuitable for regular secondary education and not, as claimed by the authors, students at the beginning of secondary education), statisticians, music-conservatory teachers, computer science students and others. Yet none of these groups form social groups per se and the formation of testable social groups would require much more detailed information about the participants. Finally, the evaluation as reported by the authors does not satisfy statistical requirements (e.g., correlations are stated without the value for "r" or with significance levels). The sum of all these deficiencies renders the text of questionable value.

[12] C. Cornin's contribution, "Concepts of Melodic Similarity in Music-Copyright Infringement Suits," is funny to read. It shows how courts struggle to prove the unprovable: That two melodic fragments which are highly similar are either truly the same or truly different. The fact that this quest is mostly driven by monetary interests can, as Cornin points out, produce highly controversial court decisions. Two on-line tools allow the Internet user to access a databank containing American/British, German, Chinese and Irish folk songs (http://www.nzdl.org/meldex), and a databank containing themes from compositions from the Baroque to the romantic period (http://musedata.stanford.edu/databases/themefinder).

[13] Overall, the book is interesting and contains some new research. Nevertheless, some of the articles fail to approach the topic with methodologies sufficient for the considerable difficulties entailed by the subject matter. It also would have been beneficial to include at least one article dealing with cognitive aspects of melodic similarity.

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