APPRECIATION OF JAZZ AND OTHER GROOVE-BASED MUSIC AS A FUNCTION OF TEMPO

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ABSTRACT

Background. Musicians' intuitions are sometimes that only one specific tempo is acceptable for a given piece of music, while listeners' preferences are little affected by tempo changes way beyond what can be perceived, according to empirical results. Recognising that a primary goal of groove-based music is to induce body movement, the present study explores whether the experience of groove and movement characters in music might reflect an optimal tempo for certain music examples, and whether this might be dissociated from general preference.

Aims. To show how music experience is affected by altering the tempo determined by the artist or producer.

Method. Stimuli were original recordings of instrumental ensemble music and versions of these in which the tempo was altered by –20%, –10%, +10%, or +20% by means of DSP software. Listeners rated 14 adjectives in response to each music example.

Results. As a function of tempo ratings of *rapid* and *intensive* increased while ratings of *calm* decreased. Ratings associated with aesthetic or musical evaluation, such as *good*, *groovy*, and *swinging* were lower for decreased tempi but insignificantly in- or decreased for increased tempi.

Conclusions. The notion of optimal tempo found some support by the fact that although tempo was linearly related to adjectives associated with speed, ratings of evaluative adjectives were not systematically higher for any altered tempo. The question remains whether optimal tempo is determined by the melody or other structural properties of the composition, the musical arrangement, or a specific pattern of performance variability.

1. INTRODUCTION

Different views have been expressed on the role of tempo in the perception and experience of music. Some musicians demonstrate a very keen sense for which tempo they want to perform in, as reflected in replicability of tempo for given pieces separated by months or years (Clynes & Walker, 1986). Also, listeners can reproduce a familiar song from long-term memory typically within 8 percent of the original tempo (Levitin & Cook, 1996), while the discriminability of tempo for two simple sound sequences presented in succession is between 2.5 and 6 percent (Drake & Botte, 1993; Ellis, 1991). In contradiction to musicians' concern with optimal or 'correct' tempo and listeners' acuity, LeBlanc et al. (1988) reviewed a number of studies which do not support an optimal tempo, but which suggest a small, general increase in listener preference as a function of tempo. Behne (1972), using both music examples that were recorded in different tempi, and examples whose tempo was 'mechanically' altered, concluded that tempo had little effect so long as it did not vary more than 20 percent or lead a different structural interpretation.

There may be several explanations why listeners appear to attribute less importance to tempo than musicians do. For one thing, methodological factors may have exaggerated the difference between musicians and non-musicians, for example as a consequence of having listeners judge very short and unfamiliar music examples. For another, musicians attitudes to tempo are likely to be influenced more by a variety of factors related to performance, notably motoric ones, compared to purely perceptual ones. Against this background, the present study explores the way in which tempo may affect the experience of groove and movement characters in music, and whether this may be dissociated from preference in general.

A further assumption is that the arrangement and performance of ensemble music intended to engage movement and a sense of groove does indeed employ devices that are related to tempo. The goal of such devices might be to structurally fill the temporal space given by perceptually optimal limits, while at the same time avoiding distraction by events outside these limits. Even a moderate tempo change could under these conditions affect the perceived movement character, swing, or 'groove-ness'.

2. METHODS

Five music examples were selected from commercially available CDs; two jazz (125 and 224 BPM), one percussion piece in a Moroccan style (145 BPM), and two other "ethnic" pieces influenced by Indian (104 BPM) and African (216 BPM) traditional music, respectively. The MM values were obtained with an electronic metronome independently by the author and another musician, whose judgements agreed within ±1 BPM. All recordings were made between 1990 and 1999 and have good acoustic quality. Instrumental and purposely unfamiliar music was selected so as to minimise possible associations to the human voice, a certain time, context, or values that previous exposure to the music might represent.

The tempo of each example was manipulated by means of DSP software to produce five alternate versions, each preserving the original pitch. The 5 examples and their 5 tempi - presented in table 1 - were independently rotated to yield 14 different presentation orders, one of which were given to each listener.

Example	-20%	-10%	±0	+10%	+20%
Indian	83	94	104	114	125
Jazz medium	100	112	125	137	150
Moroccan	116	130	145	160	174
African	173	194	216	238	259
Jazz fast	179	202	224	246	269

Table 1: Tempi of the five music examples, including the four tempo-altered versions of each example.

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Fourteen adjectives were chosen in order to tap groove and movement characters (Gabrielsson, 1973), as well as preference and qualities typically found by means of dimensional analysis for music. These words were presented in Swedish and their translations are *bouncing* (studsande), *calm* (lugn), *driving* (drivande), *flowing* (flytande), *happy* (glad), *intensive* (intensiv), *movement-inducing* (rörelseskapande), *rapid* (snabb), *rocking* (gungande), *simple* (enkel), *solemn* (högtidlig), *good* (bra), *swinging* (svängig), and *walking* (gående). *Movement-inducing* (abbreviated to *Movement* in the following) was defined as "makes me want to move some part of my body", and G*ood* was defined as "I like it". The number of rating scales was minimised in order to avoid fatigue, with the criteria that previously found dimensions should be represented with at least one pole in the case of bi-directional dimensions (e.g. sad [vs. happy], simple [vs. complex], slow [vs. rapid], solemn [with no opposite pole], intensive [vs. relaxed]).

The experiment was administered by a computer program which played the sound files through the computer's sound card and collected the responses. Each listener sat alone with headphones by the computer and rated all 14 words after each stimulus presentation. The listener prompted the following stimulus and could therefore rest at any time, conducting the session at an individual, leisurely pace. The listeners were asked to note if they recognised any example, or if they had any comments pertaining to difficulties in rating it. For each example, each of the 14 descriptive words was rated from 0 (not at all appropriate) to 10 (entirely appropriate). The order of the words' appearance on the screen was individually randomised for each stimulus. A session lasted between 45 and 60 minutes. The listeners were asked a number of questions after the final session concerning how they had experienced the task.

Forty-nine listeners with normal hearing and a wide range of musical experience served as listeners. There were approximately equal numbers of women and men, they were between 15 and 45 years of age, and were paid for their participation.

3. RESULTS

Large individual differences were apparent, both in terms of mean ratings, in the range of ratings, and in response to the music examples. The range of these differences was larger for *Good* and *Solemn* than for *Rapid* and *Calm*, for example. Ratings in response to the tempo alteration were more consistent, however, and revealed highly similar patterns for *Driving* and *Rapid* (r = .50), *Rapid* and *Intense* (r = .58), and *Intense* and *Driving* (r = .53). These correlation coefficients are most likely substantially attenuated by the large individual differences, as are those for *Swinging* and *Movement* (r = .29) and *Swinging* and *Happy* (r = .38). The interactions between music example and tempo change were minor and will not be considered here.

As some rating scales seem to overlap, only one from each cluster is depicted in Figure 1, together with general preference (*Good*). It is clear that listeners perceive each level of tempo change, in terms of *Rapid* and *Calm*, while they do not let this affect their preference for the music examples. However, a small but statistically significant decrease in the ratings of *Movement inducing* occurs for decreased tempi, while there is no difference between the original and increased tempi.

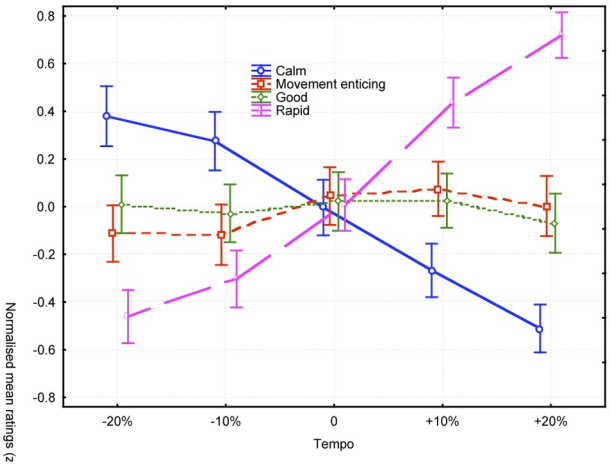

Figure 1: Normalised mean ratings of *Calm*, *Movement*, *Good*, and *Rapid* as a function of tempo alteration, with .95 confidence intervals (N = 245).

Ratings of the remaining five words representing movement characters are depicted in Figure 2, where it can be seen that *Rocking*, *Solemn*, and *Walking* decrease with increased tempo whereas *Swinging* and *Bouncing* increase.

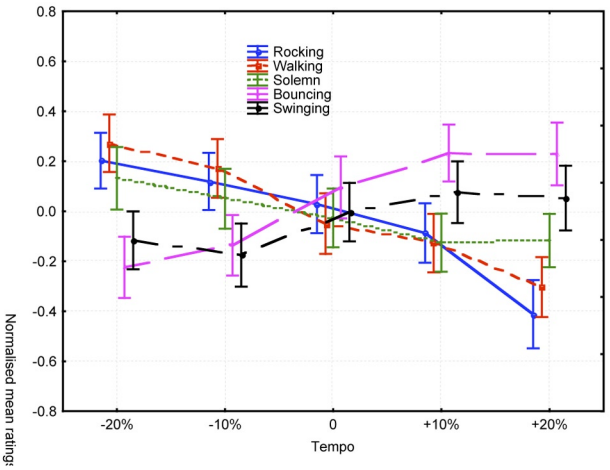

Figure 2: Normalised mean ratings of *Rocking*, *Walking*, *Solemn*, *Bouncing*, and *Swinging* as a function of tempo alteration, with .95 confidence intervals (N = 245).

4. CONCLUSIONS

The present results are in perfect agreement with previous studies that failed to find any effect of tempo change within 20 percent up or down on music preference. However, the other adjectives employed, representing groove and movement characters, revealed consistent effects of both 10 and 20 percent changes.

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It is remarkable that these effects were so consistent across the wide range of musical style and absolute tempo (104-224 BPM). It should be noted, however, that the two fastest examples may have been perceived closer to half their measured tempo, as suggested by Figure 3. This phenomenon may be typical for what musicians refer to as "up-tempo" music.

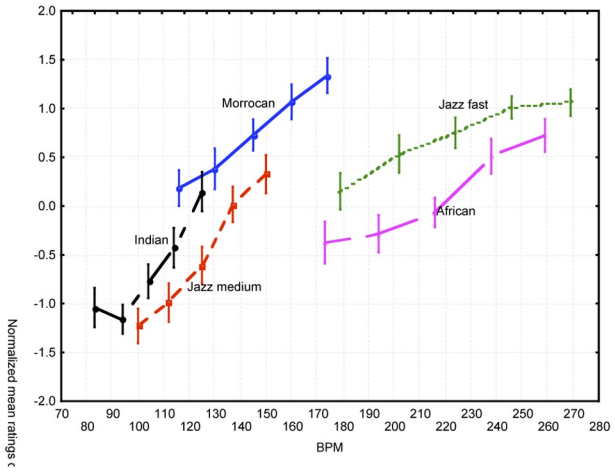

Figure 3: Normalised mean rating of *Rapid* as a function of music example and absolute tempo, with .95 confidence intervals ($N = 49$).

It can be seen that halving the Jazz fast and African examples to 123 and 112 BPM, respectively, would place them in much better accord with the *Rapid* ratings of the other three examples. The awkwardness of tempi far from the optimal range 500-800 ms between pulse beats (van Noorden & Moelants, 1999) may be sufficient to scale their perceived rate down by a temporal octave, even in the absence of performance characteristics suggesting the listener to do so.

Since both *Good* and *Movement* display a similar drop for the fastest tempo, I suggest that this may reflect a trend consistent with an optimal tempo. If this interpretation is confirmed by other research, the larger effect of decreased tempo than of increased tempo may be explained by the goal to structurally fill the temporal space given by perceptually optimal limits, corresponding to approximately 200-1,800 ms between events (Fraisse, 1982). The explanation is that for a given tempo the fastest events can not be separated by much less than 200 ms, if not for other reasons than motor constraints, which means that a decrease in tempo will lead to a wake of events in the fast perceptual range. In contrast, musical structure contains inherently still lower subdivisions of temporal intervals in terms of halfbeats, metre, phrases, and so forth. Increased tempo will therefore fill the lower end of the perceptual range with event intervals that were previously outside this range.

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