Articulation strategies in expressive piano performance

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Presented by Shih-Jer Lin

Outline:

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  - Legato articulation
  - Staccato articulation
  - Repeated tones articulation
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Authors

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  PhD in Music Acoustics, Dept. of Speech Music Hearing,KTH, Stockholm

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- **Italian pianist who has performed concerts and recitals throughout the world, including London, Stockholm, Athens, Ankara, Tokyo and several cities in the United States.**
- **http://www.conseve.it/sitidocenti/battel/**

Introduction

- AIM: Relation between Piano players' finger motions & resulting expressive performance character
- KTH performance rules: (Bresin & Friberg)

1.articulation of repetition:

introduce a fix micro-pause between two notes of the same pitch

2.duration contrast rule (empirical)

insert long micro-pause after short notes

amplified->staccato

inverted ->legato

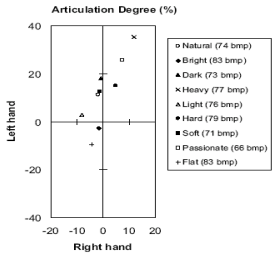
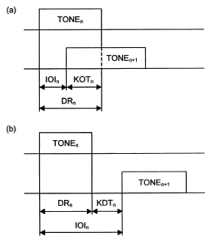


Fig. 1. Overall articulation degree in the right and left hand observed in different performances of the same piece, expressed as % of inter-onset-interval. The data points show averages across pianists. Negative values represent detached articulation and positive values overlapped articulation. For each performance category the tempo in beats per minute (bpm) averaged across pianists is reported (Battel and Fimbianti, 1998).

- Battel & Fimbianti:

Passionate (slowest): legato with both hands

bright and flat (fastest): non-legato with both hands



- Repp:

Key Overlap time (KOT):

the time interval between the onset of key depression for one tone and the key release for the preceding one

he found clear increase of staccato note durations with increasing IOI

Method

- 5 pianists(2 female and 3 male)
- First 16 bars of the Andante movement of W.A. Mozart's Piano Sonata in G major K-545
- 9 adjectives: natural, bright-dark, heavy-light, hard-soft, passionate-flat
- Played on Yamaha Disklavior II, C3 model

- Pianist were asked to exaggerate the expressive intentions

  1.help the performer, cause it psychologically unusual to play Mozart dark, hard, heavy or flat

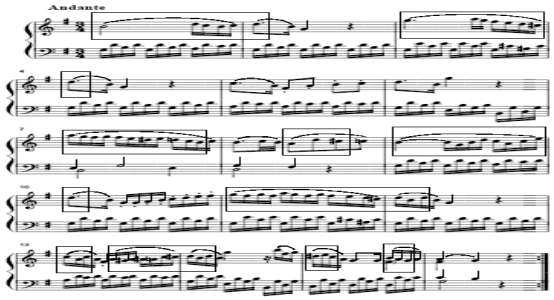
  2.need a larger contrast between performances so the analysis is easier

Legato articulation

- Aim: how the KOR varied in the 5X9 performances
- Key Overlap Ratio (KOR):

  KOT represented as a percentage of the IOI

1.material: piano sonata G major, k545



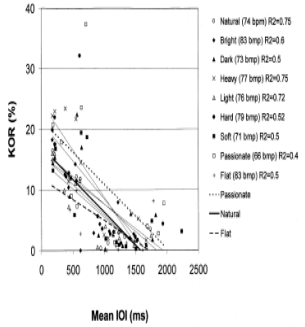
Analyze method

- ANCOVA:
  http://carbon.cudenver.edu/~lsherry/rem/ancova.html

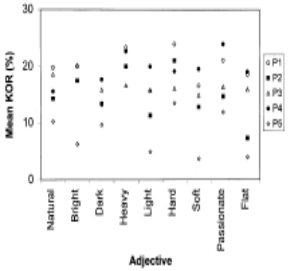
  http://www.socialresearchmethods.net/tutorial/Lee/LEE1.HTM

- Analyzed by 3 factor ANCOVA

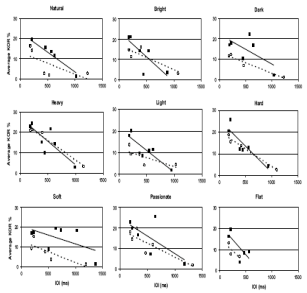
Results and Discussion



- All the line shows negative slope: the longer the IOI, the shorter the KOR
- Extremes: passionate & flat
- Intermediate position: natural



- All pianist tended to change their performance in similar ways when switching from one adjective to its opposite



- KORs for “Down notes” are generally greater than KORs for “Up notes”
- Gap between 2 lines
  1. constant for flat
  2. narrower for larger IOIs for other versions

- They played faster in ascending than in descending melodic patterns
- Compare with previous studies

  same:

  1.key overlap times increase as tempo decreased in production (Repp)

  2.down notes were played with a lager KOT than up notes (Sloboda)

  3.KOT decrease as tempo increased (Mackenzie & Van Eerd)

difference:

overlap time decrease with increasing duration of the preceding note (Palmer)

parallel:

largest degree of legato: heavy

smallest degree of legato: bright (De poli, Roda , & Vidolin)

(but bright receive medium degree in Bresin's study)

Staccato articulation

- Key Detached Time (KDT):
  time between the release of the key and the instant when the key of following note is fully depressed
- Key Detached Ration (KDR):
  ration between KDT and IOI of the preceding tone

Result and Discussion

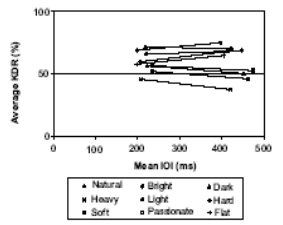
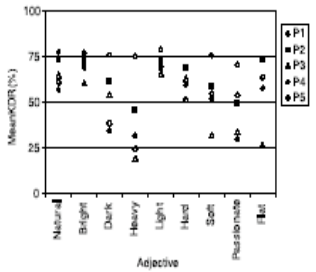


Fig. 10. Mean KDR for each adjective, averaged across pianists, and plotted against mean IOI for tones played *staccato*.

- Only the 8th & 16th notes are marked staccato, so Only 2 nominal IOI to consider
- KDR values for each adjective are almost constant -->staccato articulation is independent to IOI



- Smallest KDR values:
  dark, heavy, passionate
- Compare this with general opinion:
  Heavy->mezzo-staccato
  Passionate->staccato

Repeated tones articulation

- Material:
  first note of each repeated note pair, G4 and A4 in bar 15
- Analysis:
  2 factor ANCOVA

Result and Discussion

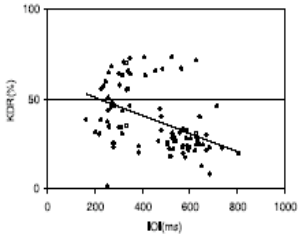


Fig. 12. IOI for tone repetitions. The line represents the best linear fit to the data points.

- Only 2 repeated notes in the score->only 2 nominal IOIs
- KDRs decrease at a mean rate of 5% with increasing IOI

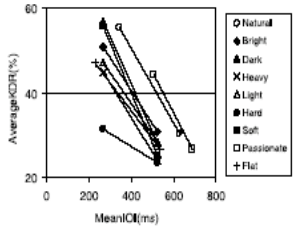
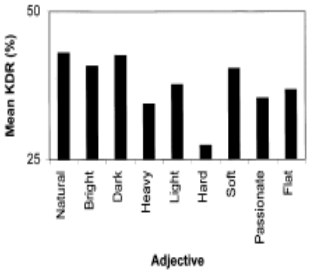


Fig. 13. Mean KDR for each adjective, averaged across pianists, and plotted against mean IOI for tone repetitions.

- Trend lines are almost parallel, and delimited by passionate and hard performance.
- Natural performance is the 2nd highest



- Hard versions were significantly different from the soft, bright, dark, natural versions

- Interactions between pianist and adjectives were non-significant
- No constant behavior was observed across pianist when switching from an adjective to the other
- Rendered differently from staccato notes

Outlook

- Director Musices (DM):
  articulation of repetition rule:
  insert a fixed micro-pause of k*35ms between repeated notes
- KTH performance system:
  faster uphill rule:
  the IOI for notes initiating descending intervals being played are 4 ms longer and with larger KOR than those with ascending intervals.

- legato is performed by means of overlap between adjacent tones; the duration of staccato tones is shortened about 40%:
  Analogies to walking and running
  Legato-walking:
  same qualitative tendency in overlapping(KOT increasing with IOI)
  Staccato-running:
  flight phase had a KDR corresponding to a mezzo-staccato articulation (KDR=25% of IOI) for short IOIs increasing toward a passionate staccato articulation(KDR=50% of IOI)

Conclusion

- General trends:
  1.Legato:
  the KOR decreased with increasing IOI of the 1st of overlapping tones; reflects the strategy to lengthen short note and to shorten longer notes
  IOI of notes initiating descending intervals were played longer and with larger KOR than the IOI of notes initiating ascending intervals

- 2.Staccato:
  KDR seems independent of IOI
- 3.repeated notes:
  KDR for the 1st note decreasing with increasing IOI; KDT remains constant in natural and heavy performance

- Application:
  Director musices performance system
  electro-acoustic instrument performance
- Further study:
  1.left hand material combine with present material
  2.other scores
  3.other instruments

ANCOVA(Analysis of Covariance)

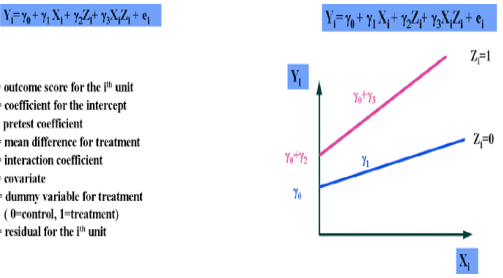
Assumptions

- independence (each subject is in only one cell)
- normality of population from which sample is chosen
- homogeneity of variance across all cells
- a linear relationship between covariate and dependent variable
- homogeneity of regression coefficients: the correlations are the same
- the treatment IV has no effect on the covariate. (they're independent)

$$Y_i = \gamma_0 + \gamma_1 X_i + \gamma_2 Z_i + \gamma_3 X_i Z_i + e_i$$

where :

Y_i = outcome score for the i^{th} unit
γ_0 = coefficient for the intercept
γ_1 = pretest coefficient
γ_2 = mean difference for treatment
γ_3 = interaction coefficient
X_i = covariate
Z_i = dummy variable for treatment
(0=control, 1=treatment)
e_i = residual for the i^{th} unit



- ANCOVA adjusts for disparities in covariates distributions over groups by artificially assuming that all groups have the same set of mean covariate values
- The ANCOVA adjustment procedure is equivalent to artificially assuming a common covariate distribution based on the combined sample over all group. That is, not only are the means assumed to be equal, but the entire distribution of the covariates in the combined sample is assumed to be the same as the distribution of the covariates in each group

- F-test of significance :
  used to test each main and interaction effect, for the case of a single interval dependent and multiple (>2) groups formed by a categorical independent.
  F is between-groups variance divided by within-groups variance
- If the computed p-value is small, then significant relationships exist.