# AN INFORMATION PROCESSING STUDY OF INDIVIDUAL DIFFERENCES IN PERCEPTION OF PITCH FLUCTUATIONS IN MUSIC

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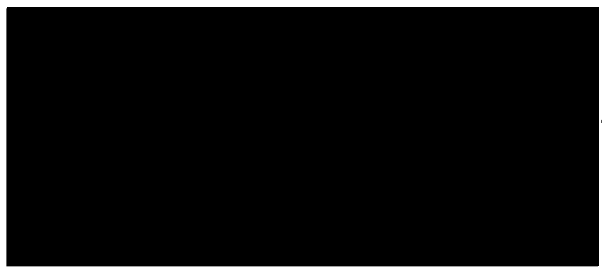
## CERTIFICATE

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.



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# ABSTRACT

Although extreme individual differences in the music abilities of children have been celebrated from long before Mozart, satisfactory cognitive models of such precociousness have been less forthcoming. This research program employed an information processing model based on the neuropsychological work of Alexander Luria to investigate individual differences in the perception of pitch sequences with various degrees of structural coherence, with particular attention to children who appear to be musically gifted.

The Luria model used in this study has three orthogonal dimensions of information processing: successive and simultaneous synthesis for encoding information, and executive synthesis which involves attentional and integrative processes. Psychometric operationalisations of the model have been used extensively in investigations of individual differences in mathematics and language performance of children at school. The model had not previously been applied to the domain of music. It was hypothesised that music perception involves the cooperative interaction of these three information processing dimensions.

This research focussed on the perception of fluctuations in pitch - the attribute of music which is most strongly predictive of music ability. Evidence from studies in the cognitive sciences suggests that musical elements such as pitch are hierarchically chunked to form meaningful musical Gestalts. Other studies in psychophysics suggest that these cognitive processes may exploit the fractal or self-similar form of fluctuations in musical attributes. Fractional Brownian motion (fBm) tone series have proved a valuable tool in studies of perceptual responses to pitch fluctuations. To this end, the autocorrelation function is particularly salient.

Three psychometric studies were conducted with 10 to 13 year old children as subjects. Multivariate analyses were undertaken where appropriate. The first study (N = 151) investigated relationships between abilities on simultaneous, successive and executive synthesis, and individual differences in pitch pattern discrimination, pitch contour inversion, and responses to algorithmically generated fBm tone series as a replication of an earlier study with adults. Success on the contour inversion test was partly accounted for by abilities on both

simultaneous and successive synthesis. The replication study showed that fractal music is preferred to either random or highly correlated fBm tone series. Significant sensitivity to structural differences in algorithmic music was related to abilities on successive synthesis by subjects with criterion scores on the pitch pattern discrimination tests.

Two instruments were developed to measure sensitivity to the autocorrrelation structure of algorithmically generated fBm tone series: one required an estimation of the strength of structural coherence, the second sought detection of a change in structural coherence. Study 2 (N = 135) investigated relationships between abilities on simultaneous, successive and executive synthesis, and individual differences in pitch pattern discrimination, sensitivity to autocorrelation structure, music education experience, and school academic performance. Abilities on the Luria model dimensions were measured by a new computer-based adaptive instrument. There were significant relationships between performance on the discrimination of pitch pattern tests, the perception of the two autocorrelation structure tasks, and the three Luria model dimensions. There were significant relationships between success at the two perception of autocorrelation structure tasks and performance levels of school mathematics and language studies, suggesting that common information processing dimensions underpin both musical and general cognition.

The third study (N=29) involved children with demonstrated musical precocity. They were also tested with the Luria model and sensitivity to autocorrelation structure batteries. The abilities of the musically gifted children on each of simultaneous, successive and executive synthesis were superior, especially on executive synthesis, to those of the normal sample of children in Study 2. High ability on executive synthesis, the processing dimension with responsibility for the integration of the two coding dimensions and for the evaluation of information redundancy, can explain the remarkable facility for music learning shown by the musically gifted subjects. Their scores on both tasks of sensitivity to autocorrelation structure were also superior to those in Study 2, suggesting that the perception of coherence in pitch fluctuations is an attribute of music ability. It was also shown that for musically gifted children, perceptual preference for fractal structure in pitch fluctuations is related to individual differences in abilities on simultaneous synthesis.

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