AN EXAMINATION OF THE EFFECTS OF GENDER, AGE, AND COMPUTER USE ON THE PROCESS AND PRODUCTS OF MUSICAL COMPOSITION IN PRIMARY SCHOOL CHILDREN

by

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A thesis (type 2) submitted in partial fulfillment of the requirements for the degree of Master of Education in the University of Canberra.

1992
ACKNOWLEDGEMENTS

I gratefully acknowledge the contribution of my supervisor, Dr John Fraser of the University of Canberra, whose critical advice and unfailing support were of great assistance in this study.

Thanks are also due to the children of Taylor Primary School, ACT, for their participation in the study. I am grateful to the Principal of the school, Carol Grout Smith, and the staff, particularly the music specialist, Marjorie Lindenmayer, for their kind co-operation.

The expertise of the judges, and their interest in the project were most appreciated. The judges were:

Vivien Arnold
Lindsay Bingham
David Clarke
Peter Duggan
Patricia Fletcher
Maree Livermore
David Slater

Finally, my sincere thanks to my family for their patience and encouragement.
The purpose of this study was to build upon recent research dealing with the ways children of primary school age operate when composing original music. Through examining the musical and structural content of the musical products, and linking these features to working procedures in the composition process, the aim was to explore the interaction between process and product, and to identify any effects attributable to gender, age, or computer use.

Control of the circumstances in which the compositions were generated made possible the examination of the activity of the subjects during the working period, providing data which was linked to features of the compositional products for possible "cause and effect".

Compositions were collected from 60 primary school children aged 7, 9 and 11 years. Half of the students in each age-group used the computer to help them work out their music. There was equal gender representation in each subgroup.

The working session of ten minutes for each child was recorded, and later analysed, to discover the pattern of activities taking place during the composition process.
A second procedure was then undertaken which involved analysis of the final versions of the compositions of each subject. The pieces were evaluated by a panel of six judges who identified levels of achievement on a range of musical and structural items. The process and product data were analysed to ascertain the influence of gender, age and computer use. Any significant interactions between process variables and product variables were also noted.

The research design proved to be useful and functional in providing empirical data that allowed detailed statistical analysis. The major significant results related to the process were:

1. Age was a significant factor in subjects' use of the compositional activities (i.e. exploration, development and repetition [implying closure] of musical ideas).
2. Computer-users developed their musical ideas more quickly during the compositional process than non-computer users.
3. There were significant 2-way interactions between age and computer use.

The judges' evaluations of the product generated data that supported previous research that found a developmental sequence of stages in musical composition. Age was shown to be a significant influence in all factors derived from the developmental model. The significant period was between seven and nine years in all cases.
Although significant differences attributable to gender were not revealed overall, females were predominant in the high scoring groups on some product variables.

The influence of the computer emerged most clearly in profiles of subjects who received high/low scores from all judges in each of the main product variables. In the high scoring groups, computer users outnumbered non-computer users in every case.

Little is known of the effects of the use of the computer by young children for composition. Further research is indicated in order to understand the impact of the computer on the creative and cognitive processes in music. There is a need for greater understanding of its role in this area of music education.
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Chapter 1

INTRODUCTION
Chapter 1

INTRODUCTION

This chapter presents the major issues that form the context of this study, namely the emerging recognition of the importance of creative activity in music education, and the effects of the rapid development of new technology on all aspects of musical endeavour. The congruence of these events has, through their interaction, the potential to expand the body of knowledge of musical creativity, with resulting benefits for music education.
1.1 Background

1.1.1 Composition in Music Education.

The way that people attend to music includes three areas of experience: composing, performing, and listening. These music activities are common to all cultures, but the manner in which they relate to each other varies. The relationship depends upon the role that music plays within the society. Despite the fact that mass media are breaking down cultural differences, heralding the imminent arrival of a "global" culture, music in many non-Western European societies is still woven into the fabric of everyday life, and the dividing lines between composing, performing and listening are vague indeed. However, in the classical tradition of Western European culture, music thinking is dominated by a music that has been distanced from its audience through the practice of presenting performance to a "passive" audience, in formal surroundings. The role of the performer is perceived as the re-creation of the composer's ideas, carried out with due attention to exactitude and authenticity. As Fletcher (1989) points out:

Western music is unique in the extent to which it allows the silent act of composition to be considered as an entity in itself, separate from the art of performance. (p. 60)

This has been possible through the development of a notation system that can record much of the detail of complex compositions. In fact, "only in western music has the written
score become the medium through which the act of composition takes place, and this long before the actual sounds are heard." (Small, 1980, p.30).

Small identifies this scenario as one that emerged around the end of the Renaissance. It continued throughout the life of the tonal-harmonic tradition in which the key concepts were "logic and logical relations". He explains how in the twentieth century many musicians have worked to break down the constraints of such a system, but attitudes and values change slowly, and the area of music education particularly is "dominated by the values and technical conventions of the past." (Small, 1980, p.200).

At the same time, efforts to "legitimize" music in school curricula have compounded the problem of traditional, formalised structuring of music education. Shaping the subject to fit into the structured environment of the classroom has effectively limited practical music making because it is more difficult to assess. Instead, study has been directed towards paper work and a theoretical body of knowledge that could be examined in the same manner as other academic studies. Even external music institutions have maintained a highly structured series of graded public examinations that again focus on those skills and areas of musical knowledge that lend themselves to external assessment. As an example, the content and repertoire required for public examinations in performance in Australia can be criticized for their limitations in this respect (Bridges, 1988).
Needless to say, the expressive, experiential, creative aspects of music have not figured largely in this context. This system has produced generations of highly skilled performers capable only of re-creating music composed by someone else. Improvisation or extemporisation has been found mostly in the jazz genre. Students' experience of creating music has generally been confined to the type of exercises in melodic invention and four-part vocal harmony found in the music examination syllabuses.

Since the sixties there has been a growing recognition among music educators of the importance of creative activity in the development of musical understanding, acquisition of musical knowledge, and as a medium of personal expression. Techniques based on the approaches of Zoltan Kodaly and Carl Orff have been used to encourage improvisations linked to movement and discovery-based exploration of music elements. The trend towards freer expression received great impetus in the seventies from the work of Paynter (1970) in England and Schafer (1975) in Canada. Using the "raw" materials of sound, their emphasis was on the process rather than the product. Through experimental and creative activity, they promoted both the development of affective responses to music, and a knowledge of the basic music elements.

Such techniques are still found in Australian classrooms to-day. Young children are often encouraged to improvise, and explore elements of music through creative activities utilising movement, voice, musical instruments, and other environmental materials. Children's original chants and games, songs and
soundscapes are all an admirable foundation for composition, but there are limitations as to how far this approach can go. The perception of teachers has been that to advance children's composition beyond unstructured free expression requires a more formal approach to gain an understanding of the elements of music. Consequently, the initial involvement in creative activities has then decreased while the children concentrate on the acquisition of musical literacy and performance skills. These are the activities that predominate in most primary schools. "Serious" composition generally reappears towards the end of the high school years, when students tend to work in the same way as adults, using the knowledge and experience gained through years of music study.

Despite the fact that this approach to music education still has strong supporters, there is general agreement among music educators to-day that composition has a role to play in the acquisition of musical understanding, and should go hand in hand with listening and performing throughout the entire course of a child's music education. Prominent writers such as Hargreaves (1986), Webster (1987), Swanwick (1988), and Sloboda (1985), have clearly identified the importance of creative musical activity in the development of the child.

Support for this point of view is shown in the curriculum documents developed in recent years. In Australia, Curriculum Frameworks in each state designate composing, playing and listening as the essential areas of musical activity at all levels and ages.
Students' compositions and improvisations should be valued as an expression of their imaginative thinking. Composing gives students the opportunity to achieve an understanding of how music functions, how it uses sounds and how they are expressed. (Victoria Ministry of Education, 1990, p.211)

This emphasis on composition has recently been reinforced in the review of literature and resources (Emery, 1991) that will form the basis for the Australian National Collaborative Curriculum Statement for the Arts.

Most research in the field has focused on measures of creativity, the development of musical perception and imagery, and analysis of children's creative musical products. Recently, writers such as Gardner (1985), Sloboda (1985), Hargreaves (1986), Webster (1987), and Serafine (1988) have investigated the cognitive processes involved in musical creativity, but a teaching model that brings all the research together has not yet emerged. An holistic model incorporating the required components and activities should explain the implementation of creative music in the classroom. It should address the needs of students, the design of appropriate tasks, and the types of student activity that lead to the achievement of specific goals.
In the past fifteen years music has been dramatically affected by the impact of new technology, to the extent that traditional approaches and teaching methods are now being questioned at a fundamental level. Not only does the technology, manifested in the synthesizer and computer, present new perspectives of sound generation and manipulation, but, in conjunction with modern recording capabilities, it has changed the way many contemporary musicians operate within the musical experience.

In the Australian Capital Territory (ACT), computers are gradually making their way into school music departments, mostly in the secondary schools, and the students using them are usually at a fairly advanced level of sophistication in their music education (Livermore, 1990). Anecdotal evidence suggests that the situation is similar in the rest of Australia. Most of these students are using computers within the context of a music education based on traditional music making that proceeds through a sequence of (a) generation of creative ideas (b) conceived and recorded in written notation and (c) played "live" by performers: a "composer/notation/live performer" model. That is why the production of a traditionally notated score is promoted as such a desirable feature of "composer" software programs. In many schools, the computer is valued for printing out scores of original arrangements to be used by performing groups, and it does this very well. But for students to confine their approach to composition within these
theoretical constructs, is to ignore the potential of the computer to involve them in totally new creative experiences.

The computer is a "composition/performance" medium on its own. Musical gestures can be conceived in aural terms; musical material can be structured and realised in a manner far beyond the tonalities, formal constructs, instrumental resources, and human physical capabilities in which traditional music is grounded.

But the impact of working in the computer medium goes beyond a mere expansion of musical capabilities. The medium itself generates different patterns of cognitive behaviour. Cheseboro (1984), in discussing the cognitive and cultural relationships associated with electronic media, stated that "ways of knowing determine what is known." He proposed that the "sense impressions gained from the particular environment and a priori concepts interact within the human being to generate knowledge....Selective perception and varying human needs will...affect what is 'factual' or known." (p. 114).

The speed with which new technology is being introduced into music making is overwhelming. Constant refinement of operation, and expansion of the capabilities of new equipment, mean that obsolescence occurs after one or two years. The literature in the field mostly deals with new features of hardware and software. Occasional reports of trials of these products in an educational context focus on software capabilities and suggested activities. There is a lack of experimental and evaluative studies
that throw any light on the educational impact of computer use in the music classroom.

Simon Frith (1986) has identified three recurring issues in controversies surrounding the technological changes in music-making. They are:

1. Technology is opposed to nature.
2. Technology is opposed to community.
3. Technology is opposed to art. The issue here is not creativity, but the idea of self expression: the individual "feel" or "touch".

Coupled with such distrust of technology as being artificial or unnatural, there is a lack of evidence that working in this environment has educational value. It has not been shown how it should be effectively incorporated into music programs for young children. Brown and Purcell (1988) articulated their concerns:

What is needed... is a methodology for the successful implementation of technology into the music curriculum, one that does not stifle creativity or the urge to exploration in place of an over zealous (if well meaning) desire to pigeon-hole the role and applications of technology within an existing frame of reference. (p. 3)
1.2 Statement of the Problem

The challenge is that with computers, we have to be more explicit about what is involved in creating a design, a composition... The new focus of attention... is not the computer, but our own thought processes, processes of judging, deciding, choosing, in short of what we choose to call 'creating'. (Worrall, 1990, p.1)

Not enough is known about these thought processes within any environment, computer or otherwise. Teachers lack a sequential model on which to base their work. Such a model must consider children at all stages of learning. Composition should not be put on hold until students are thoroughly "educated" into the musical norms of the culture. Small (1977) makes it clear that the best way to learn about music is to use its materials creatively: "The techniques and creative purposes grow together by mutual stimulation." (p.201).

It is against the background of rapid development of computer applications in music and the need for greater understanding of the creative music processes in young children that investigation of the interaction between these events can benefit music education. Examination of the potential for computers to develop compositional skills and stimulate musical creativity in children will throw light on the essential nature of the creative processes themselves.
1.3 Purpose of the Study

The purpose of this study is to find out more about the way children of primary school age operate when composing original music, and whether use of the computer facilitates the process. Specifically, this study aims to engender a greater understanding of:

1. the circumstances and activities that facilitate the music composition process
2. children's behaviour when composing.

Through examining the musical and structural content of the musical products, and linking these features to working procedures in the composition process, the aim is to explore the interaction between process and product.

At all stages of the study, the influence of the following variables will be examined:

1. developmental factors, expressed as differences according to age
2. gender, expressed as differences between male and female subjects
3. computer use, expressed as differences between groups of computer users and non-computer users.
1.4 Significance of the Study

The demands of new curricula in music education, which are placing increased emphasis on creative activities, make it imperative that appropriate methodology be developed as a guide for teachers. Recent research into all aspects of music creativity has provided a body of knowledge that should be used for the formulation of teaching models. This study proposes a model of creative learning that deals with young children at a crucial stage in their musical training (i.e. at primary school level). At this stage, traditional music programs tend not to be concerned with developing the creative activities of early childhood, but instead, concentrate on more structured acquisition of skills and musical knowledge. Through an understanding of the complex interactions that occur in the compositional process, this study attempts to show ways of using the process to achieve specific goals in developing composition skills beyond the realm of unstructured free expression.

Recognition of the influences and constraints related to children's stages of musical development provides a framework for teachers to plan tasks, and realistically evaluate the results. This study presents a model for evaluation of creative work that addresses the relationship of the individual child's achievements to a series of developmental stages.

This study is timely given the impact of new technology on all aspects of music-making. The use of the computer by young
children for composition is only in its infancy and there is virtually no body of research in this area. Music educators in general are yet to be convinced that the computer is appropriate or effective for use in this way with young children. In addition, there is little understanding of precisely how the computer affects the composition process. This study is significant in identifying the computer's possible effects on activity during the creative process, and also in refining certain aspects of the musical product.
Chapter 2

REVIEW OF THE LITERATURE
Chapter 2

REVIEW OF THE LITERATURE

2.1 Introduction

This chapter is a review of the literature related to the study. It is organised under the general headings:

2.2 Foundations of Creativity Research in Music
2.3 Musical Cognition
2.4 The Working Environment
2.5 The Composer
2.6 Issues for Teaching and Learning

This chapter also forms the basis of the methodological model constructed for the study.
2.2 Foundations of Creativity Research in Music

2.2.1 General Creativity

Wallas (in Hargreaves, 1986) drew together elements of creative behaviour and formulated a four stage theory of the creative process that is widely accepted. The stages he defined were:

1. *Preparation* - collection of information relevant to the problem in a flexible open-ended manner.
2. *Incubation* - conscious attention is turned away from the problem, and unconscious processes predominate.
3. *Illumination* - a specific creative solution is defined: it appears with suddenness and a sense of certainty (the "Eureka!" stage).
4. *Verification* - formalisation of the solution: it is refined and adapted to meet practical constraints.

The theoretical model of general creativity proposed by Guilford (1968) has become the basis of subsequent constructs of musical creativity. In his Structure-of-Intellect model Guilford theorized that all intellectual abilities can be classified in three ways:

1. *Content of thought:*
   - visual and auditory figural information.
   - semantic information
   - symbolic information
   - behavioural information
2. Operations performed on the content:
   cognition
   memory
   convergent production
   divergent production
   evaluation

3. Products: (the result of #2)
   creating units, classes, relations, systems, transformations, and implications.

Guilford found that divergent production and transformation were the most closely related to creative thinking ability. Divergent thinking involves the generation of many possible solutions to a given problem, whereas convergent thinking involves the weighting of those possibilities and "converging" on the best possible answer. He identified four aptitudes for creative thinking (fluency, flexibility, originality, and elaboration) that are examples of divergent thinking, as well as redefinition, and sensitivity to problems.
2.2.2 **Musical Creativity**

Significant research by Wayne Gorder (1980) applied Guilford's theories to music. He showed that the four basic divergent production abilities are paralleled in musical creativity. The abilities were defined in musical terms:

*Musical fluency:* the production of musical ideas or phrases (content) from given music information.

*Musical flexibility:* the production of ideas or phrases that show shifts in content character.

*Musical elaboration:* the production of musical ideas or phrases that show detail or complexity of content characteristics.

*Musical originality:* the production of musical ideas or phrases that use musical content characteristics rarely used by the population to which the subject belongs.

In addition, Gorder defined a fifth musical ability that would appear to equate with Guilford's "sensitivity to problems":

*Musical quality:* the production of musical ideas or phrases that appeal to musicians' musical sensitivity.

Development of other aspects of Guilford's model, for example, "problem solving", has also been expressed in a music context.


2.2.3 *Problem Solving Models*

The Problem Solving model (Guilford, 1968, p.41) that Guilford developed out of the Structure-of-Intellect model involved five steps:

1. Awareness of the problem.
2. The problem is structured or understood in terms of the kind of information needed for its solution.
3. A search for answers, using divergent and convergent production of ideas for the solution.
4. Evaluation of the concept of the problem and solutions. If a solution is accepted, convergent production will bring the process to a conclusion. Otherwise, divergent production would reactivate the cycle again.
5. The information is stored in the memory for later use.

Webster (1979) defined musical creativity in concrete terms and developed procedures for measurement that were sensitive to the music process as a whole. He viewed the creative process in music in the problem-solving context and defined the sequence of events as:

1. sensing a need or responding to an inner drive to compose.
2. forming hypotheses in the form of small music units or ideas that are subject to endless modification.
3. synthesizing these ideas into a finished sound structure.
4. communicating these results in terms of this structure.

The educational preoccupation with process is linked to problem-solving. In the words of Bunting (1988, p. 269): "Composition is a problem-solving process in which the quality of the thinking interests us more than the aesthetic value of the final product." He divided the process into four similar areas: "responding" (to other people's ideas), "analysing and communication", "realising", and "developing."

DeLorenzo (1989) suggested that "problem finding may be a stronger indicator of true creative behaviour than the actual solving process." (p.190). She described four attributes that seem to guide the student: (a) perception of the problem structure, (b) the degree to which the musical events were allowed to shape the form of the music, (c) the capacity to sense musical possibilities, and (d) the degree of personal investment.

The theories based on problem solving were useful in focusing on the successive steps implicit in a creative process, but they have limited value if used in isolation. As Boardman (1992, p. 18) explains: "the prime mode of problem solving is analytical thinking." Musical creativity is a "system...a network which processes information in both the linear and nonlinear, or intuitive,
modes". (Boardman, 1992, p. 21). It is set in a complex 'labyrinth' of influences that not only affect the product, but shape the course of the composition process. Recent research has attempted to design a comprehensive structure that includes all of the different components and influences.

2.2.4 *Webster's Model of Creative Thinking in Music*

Webster (1987), in his more recent work, has enunciated a clear, definitive model of creative thinking in music composition, performance and analysis. Figure 1 (Webster, 1987, p. 162) portrays his conceptual model in diagrammatic form.
Figure 1

Webster's Conceptual Model of Creative Thinking in Music

PRODUCT INTENTION
Composition

THINKING PROCESS
Divergent Thinking

ENABLING SKILLS
Aptitudes
Extensiveness
Flexibility
Originality
Tonal Imagery,
Rhythmic Imagery
Syntax
Conceptual
Understanding

ENABLING CONDITIONS
Preparation
Incubation
Illumination
Verification
Motivation
Subconscious Imagery
Environment
Personality

Convergent Thinking

CREATIVE PRODUCT
Composition

Craftsmanship
Aesthetic Sensitivity
In this model, Webster has expressed creative thinking in music in terms of "enabling" skills and conditions, and the thinking processes involved. In referring to musical composition, he deals first with the framework on which the creative music process depends.

**Enabling Skills**
These form the basis of musical intelligence, and interact with the thinking process. They are:
1. Musical aptitude, including tonal and rhythmic imagery, musical syntax, musical extensiveness, flexibility and originality.
2. Conceptual understanding: facts that comprise the substance of musical understanding.
3. Craftsmanship, the application of factual knowledge.
4. Aesthetic sensitivity: the shaping of sound structures to capture the deepest levels of feelingful response.

**Enabling Conditions**
These are non-musical influences -
1. Motivation
2. Subconscious imagery
3. Environment
4. Personality
Music education has been devoted almost exclusively to the above skills and conditions. But they do not constitute the creative process, they simply facilitate it. "What has not received much study or attention by educators is the process by which these skills and conditions are connected to creative production." (Webster, 1987, p.165).

Movement Between Modes of Thought Through Composition Stages

There is a direct relationship between the modes of divergent and convergent thinking, and the enabling skills and conditions. Movement "back and forth" occurs between divergent and convergent thinking through the "stages" of the process:

1. The preparatory phase may include rhythmic, melodic or harmonic sketches, or early decisions regarding formal content. There is likely resistance to immediate closure.
2. Incubation may take the form of subconscious imagery or some "informal" thinking of the problems at hand. Divergent thinking would be the dominant mode to this point.
3. The illumination stage is one in which solutions come suddenly and provide the energy that drives thinking ahead to the final stages of completion. Thinking becomes weighted towards convergent processing, and craftsmanship and aesthetic sensitivity become very important.
4. Verification occurs when the final drafts of the composition can be heard and opinions of other musicians obtained.

The Webster model is significant in drawing together many strands of information to show the complexity of interactions and causal relationships. It is important to remember that the musical creative process is not purely sequential. There is a dynamic variation to the flow of activity which is defined by the process as it unfolds.

2.3 Musical Cognition

2.3.1 Musical Creativity and Brain Functioning

Surveys of musical creativity research acknowledge the importance of recent research into brain activity, with particular reference to differences between the activities of the right and left hemispheres. (Gardner, 1985, Woods, 1990) The commonly accepted generalisations are that the left hemisphere controls the analytical, sequential, logical style of thinking, while the right relates to the intuitive, simultaneous, metaphorical style of thinking. Early research showed that music perception is a "right brain" experience. More recent studies indicate that musical training develops critical skills, resulting in a transfer to perceiving music with a more analytical left-brain approach. (Harvey, 1986).
There is also a triune brain theory, based on the existence of three interconnected sections explained by MacLean (in Harvey, 1986) in an evolutionary context:

*The reptilian brain:* primal, controls ritualistic regulatory functions.

*The paleo-mammalian brain:* the emotional mind, made up of the limbic system. It is the control centre for glands, organs and functions connected with personal identity, attention and emotional responses. It is non-verbal, non-analytical, but powerful.

*The neo-mammalian brain:* the rational mind. It is made up of the cerebral cortex that provides connections or patterns, which are designated as indicative of learning.

Harvey (1986) classified responses to music into four types: cognitive, affective, physical and transpersonal. They equate fairly readily to Jung's (1964, p.61) functions of the human personality: thinking, feeling, sensing and intuition. He explained that these responses are governed by the different sections of the brain, and suggested that music programs should include situations with a specific response focus to utilise different aspects of brain processing.

Gardner's (1985) theory of multiple intelligences has received much attention in recent years. While recognising the division of function between the right and left hemispheres of the brain, he points out that "specificity of cognitive function can be tied much
more precisely to finer regions of the human cerebral cortex.." (p. 51). His criteria for an intelligence include:

1. The existence of one or more basic information-processing operations which can deal with specific kinds of input.
2. An identifiable developmental history in which disparate levels of expertise are visible.
3. A 'natural' gravitation toward embodiment in a symbolic system.

The six different areas that Gardner calls 'intelligences' are: (a) linguistic, (b) musical, (c) logical-mathematical, (d) spatial, (e) bodily-kinesthetic, and (f) personal. His specific references to the composition aspect of musicality stress that "audiation" (i.e. the ability to hear music internally) is an essential component. The musical images of audiation might only be simple fragments, but composing begins when these ideas begin to crystallize and take shape. The source of these ideas is in the variety of musical experiences in the tonal memory, submerged in the unconscious. He examined apparent similarities between music and other intelligences such as mathematics, where an appreciation of musical structures and how they can be repeated and transformed, resemble mathematical thought. But he came to the conclusion that "the core operations of music do not bear intimate connections to the core operations in other areas; and therefore, music deserves to be considered as an autonomous intellectual realm." (p. 126). The essence of the difference is that for the musician, "the
patterned elements must appear in sounds...that are put together...because they have expressive power and effects." (p. 127).

From this general understanding of how the brain processes music a more detailed examination of the cognitive processes can throw light on musical creativity

2.3.2 Cognitive Processes

The core of cognitive processing engages memory, imagery, perception and cognition in an intricate "web" of interactions. The following writers give various insights into the domain, each interpretation growing out of the individual focus of study.

Imagery has been mentioned in various guises in Webster's model, as it is in most writings on creativity, but the general perception of the imagination and its role in musical creativity is nebulous. Reichling (1990) has examined the literature of music, religion, and philosophy (especially aesthetics) to formulate a tentative definition as a basis for further study. She proposed that there are four facets of imagination:

1. Intuition - a kind of gestalt, an insight that can occur as a leap from the known to the unknown, or the reverse. Reasoning is not a part of the initial insight.
2. *Perception* - knowledge is gained through the mediation of the senses; that is, the basis for forming images is grounded in the sense world. (e.g. the aural image or the "sonorous image"). Knowledge obtained through perception, as with intuition, is distinct from reason.

3. *Thinking* -
   (i) Deductive thinking: reasoning from the general to the specific.
   (ii) Inductive thinking: reasoning from the specific to the general.
   (iii) Analogical thinking: reasoning through association. This is rooted in ambiguity and connotation, the poetic or symbolic.

4. *Feeling* - Interiorized thoughts, cognitive emotions.

Reichling posed the question - "If creativity is imagination expressed in perceptual form, are creative forms a result of imagination?" (p.291). She advocated that more attention be paid to developing the facets of imagination in music education.

Hargreaves (1986) suggests that imagery is one common feature of the introspections that occur during incubation. This seems to link with "associative" theories where new combinations of elements take place as a result of some stimuli, or by mediation of some common element. Although associative, the theory is one of cognitive functioning.
Sloboda (1985), in attempting to discover more about the creative process, turned to the work of known composers, examining four different sources of information:

* manuscript sketches,
* final manuscript,
* composers' writings on their own compositional processes, and
* observation of composers at work.

He summarized the process in a "typical" model, which he hastened to qualify because of the individual differences inherent in each composer's working process. He suggested that there are two areas of resources and processes in the model - the 'unconscious' and the 'conscious'. The unconscious area contains long-term knowledge, which is built up over the years, and superordinate constraints on form and direction. The conscious area contains the transitory materials that constitute the successive versions of a composition as it grows in the composer's mind. These versions follow the accepted sequence of creative thought, that is (i) idea, (ii) theme, (iii) intermediate form, (iv) final form. Linking the components of the unconscious and conscious memories are the processes that move backwards and forwards between the conscious and unconscious states to transform and modify the material.
Although the two memory states are specified, in the actual composition process there is no dividing line, and it is the "internal logic of the process" which varies according to each individual, that is important. Sloboda describes several instances of "sudden insight", or the "eureka!" phenomenon documented so often in the literature of creativity, where a solution is reached in a single step. This is obviously linked to the intuitive imagination where the thought processes preceding "inspiration" are often unplanned and undirected. He also points out that, to date, a computer program for composition has not been produced that can simulate the "interplay between the generative process and processes of verification."

The psychologist, McAdams (1987), explained the conscious and unconscious memories in different terms from Sloboda: short-term memory (STM), and long-term memory (LTM). He defined them as follows:

- **STM** is what we use for temporarily storing incoming information or recently activated information from long term storage in order to make calculations on it or make comparisons with succeeding information or with other elements in long-term memory. This memory is of very limited capacity and duration.

- **LTM** is more like permanent information storage and has no known upper bound on the quantity that can be stored. Information in LTM is highly structured. (p.21).

The perception process depends on the structure of stored information, aural imagery, and the representation of incoming information. McAdams explains the process as follows:
The perception of movement, of transformation and of musical significance depend on the perceived element being heard in relation to remembered elements. We might say that perception really only becomes musical when it is 'in relation to' events, sequences, progressions and structuring in memory. (p. 23).

Internal images of music are imagined or recalled. They must have some kind of temporal ordering that gives them structural coherence. The images that are selected tend to have some meaning within the constraints of the perceptual grouping processes.

In other studies the computer has assisted in efforts to understand the creative process in music. Johnson-Laird (1988) used the methods of artificial intelligence to test three different classes of algorithms that portrayed music composition processes. Using a computer program that generated music, he explored the improvisation of jazz bass lines, traditional melodies, and tonal chord sequences. Defining improvisation as "an example of creativity within a genre in 'real time', that is, there is no opportunity for revision", the pressure to produce an adequate performance imposes a considerable computational load on the mind. He proposed that the constraints within the generative process are the conventions of an existing genre, i.e. chords sequences and regular grammars of contours and rhythms. These are held in the long term memory, and only an algorithm of weak computational power is required to keep track of the current position in the piece, and a buffer for the most recently produced
note. People learn to improvise by improvising - at first disastrously, but with perseverance, mastering the skill. He then compared this process with that of composition which, he believes, depends on a "multi-stage" architecture. Certain constraints are used to generate ideas, and further constraints are used to judge, to monitor, or revise the initial products. There is no reason to rely on an extensive working memory, because the content is captured in notation or by some other means. It also allows successive generations of creators to contribute to the development of an idea. The search for a profoundly original idea depends on multi-stage architecture that is guided in part by constraints of some sort. Conscious critical knowledge is one constraint, but it is impotent when it comes to the unconscious generation of ideas.

The search for understanding cognition in relation to musical creativity extends beyond the process of creating to encompass the nature and structure of the product.

2.3.3 Structural Features of Musical Products

Analysis of musical compositions comprises a consideration of the assembling of sound events into musical sequences and structures. The process of selection of musical material depends on aesthetic sensitivity in order to compose something that is musically appealing. To understand musical structure, some writers have
turned to spoken/written language for clues as to how musical structures have evolved.

Sloboda (1985) examined the links between language and music and noted the similarity between the theories of the linguist, Chomsky and the musicologist, Schenker. They both based their theories on the structure of language and music rather than on linguistic and musical behaviour. Sloboda listed several similarities between language and music, and his observations about structure deserve mention. He stated that language and music have similar constructional components:

1. **phonology**, the basic sound units,
2. **syntax**, the rules governing the way in which sound units are combined, and
3. **semantics**, the way in which meaning is assigned to sound sequences.

**Phonology** incorporates the categorical perceptions of frequency and duration. The notions of scale and metre are the fundamental concepts underlying phonology in music, although timbre and intensity should probably also be included.

**Syntax** in music is based on constructs of harmony and tonality, rhythm and metre, and melody. Larger scale aspects deal with pattern and structure, achieved by repetition and transformation.

**Semantics** is the most difficult to identify because meaning in music is affected so much by its context. However Sloboda (1985) supported Meyer's assertion that there are two forms of meaning in
music, that is, "embodied meaning" (meaning in terms of its innate musical structure) and "designative meaning" (referring outside the music to objects or events in the non-musical domain.)

Serafine (1988) envisages music as "cognition" as opposed to communication, behaviour, nature, or sound. The essence of her argument is that our perception of musical thought is actively generated in cognition, not simply "processed" by it. Her emphasis is on organisation in an ongoing temporal context rather than on any perceived physical entities of sounds. She rejects any notion of an intrinsic structure of music into scales and chords as merely the result of reflection, and analysis after the event. In order to capture the essence of music construction she describes two sets of processes, the temporal and the non temporal. She has expressed the analysis of elements in musical structure in terms of the processes that assemble the various components.
Temporal Processes.

1. The successive dimension deals with the mental operation of chaining, grouping or horizontal addition. This includes:

   (i) *Idiomatic construction*, units of melodic fragments, longer melodies, rhythmic patterns, harmonic or timbral sequences, or any coherent block or unit of sound.

   (ii) *Motivic chaining*, the cumulative or additive process in which units are combined successively into a longer one.

   (iii) *Patterning*, repetition or alternation of units into sequences.

   (iv) *Phrasing* groups musical events into clusters, 'chunks' or phrases.

2. The simultaneous dimension combines and synthesizes musical events, vertically adding or superimposing one event on another. This can be done in two ways:

   (i) the identity of the events remains intact.

   (ii) the events form a new whole, e.g. a chord, timbre synthesis where combined timbres become a unique blend, melody and accompaniment, and fugue.
Non Temporal Processes

These deal with the more formal, logical, abstract operations performed on musical material.

1. **Closure**: Points of stasis and stability which imply cessation.

2. **Transformation**: Two events may be perceived as related if there is some similarity between them. There are three types of transformation:
   - (i) relative repetition which can be exact, or have a figurative change such as transposition, or tempo.
   - (ii) ornamentation
   - (iii) substantive transformation in which the relation to the original is more abstract, e.g. augmentation, diminution.

3. **Abstraction**: Sub unit or fragment is removed and used elsewhere.

4. **Hierarchic Levels**: Multiple sounds are organised into important/less important, focal events, i.e. a formal analysis.

The information in this section simply describes the basic elements and structures of music. The fashioning of these components into a piece of musical art depends on the individual, and can be varied according to style, genre, and purpose of the work.
2.4 The Working Environment

The working environment is constrained by the context in which composition exists. It consists of two components:

1. The means of expression: The manner of capturing the creative idea. It can be through notation (needed for live performance), or through computer processing and recording of the information for exact reproduction of the creative ideas.

2. The tools to be used: The type of musical instruments available, and/or appropriate to the task.

2.4.1 The Composition Medium: Notational/Aural

Children's early primitive explorations into sound can be compared to the "graphic scribblings" of early childhood (Prevel, 1974). While sound is transient, the drawings remain and act as an incentive which stimulates further gestures. In addition, the sheet of paper - a real space to be filled, constitutes an invitation. Music does not have these material supports. Its "ever-vanishing nature" provides neither a tangible "space" to fill, nor feedback that might prompt further experiment. Music teachers have realised the usefulness of the tape recorder in capturing students' work on audio tape, but this tends to happen as a final step, that is, recording a completed piece for posterity rather than using it in the "working out" process. Bunting (1988) advocated encouraging
pupils to collect their sketches on tape for closer listening, and learning techniques of self-appraisal.

Alvarez (1989) described the "liberating experience" of working with computers, explaining that immediate aural feedback subjects a given technique to aural judgement, but also allows the composer to question thought processes, preconceptions and materials. Furthermore, Alvarez believes that "perception itself is gradually broadened as a result of this active way of listening." (p. 204).

2.4.2 The Computer as the Working Environment

The computer medium provides a "space" that functions as a frame for a musical piece, and also a working environment that allows the composer to work directly with the materials of music: "the sound objects from the sonic continuum". Alvarez (1989, p.204) proposes that

musical language is both the sound and the sense which the composer intuitively sculpts out of this multidimensional environment....A meaningful musical language cannot rely on its conventional aspects,...it cannot simply be constructed from an arbitrary choice of materials (pre-reality), as in most European formalist and notational traditions...but on the discovery of how 'possible' and even unrelated sound objects actually behave in space and time and how forces can be articulated with them in music.

Wishart (1982) has argued in similar vein. He believes that the conceptual framework of music that has evolved over the centuries
is one that has been based upon the physical capabilities of the
instruments, and "analytic notation", in which music is reduced to
"a small finite number of elementary constituents with a finite
number of parameters". This contributes to the primacy of pitch
and duration in musical architecture, because these are the
elements that can be most conveniently placed on the two
dimensional lattice of conventional notation. It has also encouraged
the "lop-sided development" of features that can be explored
through notation, rather than through musical performance and
"intuition". This has led to the split between composer and
performer, between composition and interpretation mentioned in
Chapter 1. A further consequence of conventional notation based
musical development is the emergence of "musical formalism and a
kind of musical composition which is entirely divorced from any
relationship with our intuitive gestural experience." (Wishart, 1982,
p. 318).

Wishart proceeds to describe how developments in new technology
have gone beyond the scope of conventional music practice. Sonic
complexity of digital sound recording; the perception of timbre
within the sound spectrum, and its evolution through time;
difficulties in defining pitch frequency; these are some new
dimensions of the sound object. Notions of interpretation that
include subtle inflections and articulations, and studio manipulation
of acoustic parameters are some of the practices integral to music
that have developed within the new technology.
Alvarez (1989, p. 206) identified what may be the essential difference between music constructed in the aural medium, and that which is worked out through notation. He believes that the limitations of what we can represent in memory make it difficult to relate or compare musical patterns or structures adjacent to what is being currently perceived. "Notions such as symmetry and balance, while clearly seen on the printed page, are not aurally operative in music where elements are not able to serve each other element as context." He effectively crystallized the fundamental argument for pursuing music making in the computer medium:

I believe that the aural process available through electroacoustic techniques is of paramount importance to musical composition, for its tools allow musical thought to acquire higher levels of abstraction and imaginative power which unveil previously unimagined schemes, strategies and images. This...will lead us to the discovery of untried ways of listening and to the invention of a new aural tradition. (p. 230).

2.4.3 The Effects of Working in the Computer Environment.

Students tend to have positive attitudes towards using computers, and it has been shown that students' attitudes towards the subjects in which they have used computers have also become more positive. (Willett & Netusil, 1988). D'Arcy (1986) also stated that "one of the most consistent findings from research on the classroom use of computers is that pupils were more motivated when using computers." (p. 184).
A study by Evans, Mickelson and Smith (1987) examined the effect of computer use on written composition (language) in first year university students. It was found that there was a growth in complexity in the writing of the computer users, and that the computer encouraged more concentrated attention from students.

Selke and Wahlstrom (1988) drew attention to the need for more specific research into the effects of computer use in writing.

We have brought to the computer revolution a traditional vision of writing that is defined by theories and research on paper-and-pencil composing, and this vision may not be capable of accommodating the changes wrought by the electronic medium. (p. 58).

Their research suggests that computers may affect "composing activities, rhythms, and patterns." They identify questions that need to be answered in further research:

1. Does the use of computerized word processors affect "invention, recursiveness, planning goal setting, arrangement, task constraints, reading and rescanning, drafting, revising, editing or proofreading"? (p. 58)

2. Do computers affect writing when used "only at specific points during the composing process--first drafts, late drafts, or final products"? (p. 59).

3. "When authors use computers to produce text, is their writing different in some linguistic sense? In the number, types or frequency of words? In the syntactic structure of phrases, clauses or sentences?" (p. 61).
4. Does computer use affect the accepted theories of the composing process? Does the product have different textual features?

It is interesting that these are precisely the same types of issues that are of concern to musicians, and also need to be answered in further research.

2.5 The Composer

There is a considerable body of research into the many factors that influence the work of the composer. They include the personal qualities and musical qualities of the individual. Webster (1987) has classified them as "enabling skills and conditions". When the composer is a child, the level of development is an important additional factor that may constrain the expression of the individual. However, investigation that explores the influence of a specific set of developmental conditions must also consider that other factors could also affect the results. For example, Emery (in McMillan, 1990) found that "knowing the stage at which children were in their development did not presume an immediate understanding of their responses to artistic tasks." (p.9). Other factors such as motivation and social interaction were also found to affect the outcome. Before dealing more fully with children's musical development, it is worthwhile to examine the influence of some of the personal characteristics.
2.5.1 *Gender*

To hear only the creative voices of men is to hear with only one ear, to have half the choir on stage, to know only half of the music we might have known, and indeed, perhaps to have denied ourselves access to forms and visions that were more truly bound to us than men's have been. (Radic, 1991, p. 8)

The upsurge of interest in feminist theory has given rise to a re-examination of the apparent dearth of prominent women composers throughout history. Biographical and historical studies have revealed the hidden contributions of women, and, as in other fields of endeavour, cultural factors have been deemed responsible for inhibiting their success and recognition.

But this problem goes beyond a mere consideration of roles and power structures in society. Macarthur (1989) drew attention to the scholarly and theoretical modes of musical analysis which "have principally been installed to examine music by men, and these may very well be inappropriate when being applied to the music of women." (p. 8). She believes that until other ways of interpreting women's music have been explored, it will not be known whether women exhibit different expressive values from men.

In pursuing the notion of a biological determinant, Kassler (1989) cited some assumptions that have mitigated against the nurturing and developing of the musical talents of women. She believes that "the creative process involves, but is not limited to problem solving." (p. 22). The focus of human creativity on musical problem
solving and the assumption that music theory and composition are closely allied with logic (traditionally the prerogative of the male) have limited women's potential as composers.

Kristeva (in Grosz, 1989) describes the interaction of two forces, the \textit{semiotic}, and the \textit{symbolic}, in all cultural production. The \textit{semiotic} is identified with the "mother", the primitive, expressive, intuitive element providing energy. The \textit{symbolic} creates stable meaning through structure, syntax, and logic. Examples of the "normal" rule abiding workings of the symbolic order are the realist narrative, the classical sonata, three dimensional perspective. "Great works" tend to belong to the category of the symbolic, a weighting towards the masculine mode.

While much of this debate is still at the theoretical level, the ideas put forward are plausible enough to warrant serious consideration in the music education context. Various studies have identified differences in musical behaviour between males and females, but the notion of considering possible differences in creative, expressive style has received scant attention. To put it bluntly: "We need more studies of girls composing." (Bunting, 1988, p. 309).

Some empirical studies have produced data supporting differences in male and female behaviour. In a study using 47 second graders, Schmidt and Sinor (1986) found that males scored higher in tests of musical flexibility, musical syntax, and musical originality in Measures of Creative Thinking in Music (designed by Webster).
However, interpretation of the results noted a suspicion that the tasks in the test may have had a gender bias. (e.g. the use of imagery that referred to truck or robot sounds, and outer space).

Hassler and Feil (1986) explored gender differences in a composition/improvisation study on students aged from 10 to 15 years. Because of the limited sample, results are not conclusive, but some interesting results are worthy of further investigation. A significant correlation was found between composition quality and psychological androgeny in boys. No such relationship emerged for girls. Girls' right-hand performance was significantly correlated to composition, and to improvisation to a lesser extent. Boys showed the opposite: left-handedness was significantly correlated to composition, but not to improvisation.

Research into this field has not yet proceeded very far. But enough is known to warrant recognition in music education of the possible presence of innate differences between boys and girls, in the ways they perceive and process music. It appears that methods of analysis and judgement of musical products in the past have leaned more towards the male model.
2.5.2 Motivation

The element of motivation has received passing reference in some of the studies mentioned so far. The importance of intrinsic motivation, that is, the personal investment and drive that comes from within the individual, cannot be underestimated in the process of bringing creative ideas into being.

DeLorenzo (1989) found that the degree of personal investment in the compositional task rested largely in the degree to which the student participated in the musical decision making process. In her study, highly involved students "demonstrated increasing levels of excitement and intensified drive as they neared a solution." (p. 196). Control in shaping musical events, and perceived relevance of the task to the student's personal definition of music were major factors in promoting motivation. Such considerations have a bearing on the design of compositional tasks set for students in music education.

2.5.3 Imagination

Walker (1988) identifies the judgement of children's musical behaviours by adult standards as a particular problem that is evident in music education. While educators accept "childish" drawings as important sources of information about the intellectual, perceptual and psychological areas of the child's development, young
children's music is expected to reflect adult values. This is particularly obvious in repertoire (by adult composers) selected for young performers. By imposing adult perceptions on music, teachers impair the development of imaginative thought in music in their students.

In order to find the musical equivalent to children drawing (and telling their own stories), Walker advocates the encouragement of original, creative musical production throughout childhood. It can appear to be disorganised, and far from the realms of a Bach sonata or even the unique creations of the child Mozart, which are extraordinary for the maturity of their musical content and organisation. Some of the elements of rich musical imagination in children are: (a) nonconformity with established norms, (b) the notion of fun, playing with musical ideas, (c) attraction to the sensuous possibilities of sound, and realisation of its potential for personal expressive use, and (d) the musical expression is a complete synthesis of the individual personality.

Walker concludes by uttering a warning that the kind of abstract and concrete experiences that refer to language or mathematical activity are not relevant to children's music. The child abstracts meaning from the fixed meaning of words. The opposite is true of music; the symbolism of tones, chords and rhythms has no such representation of meaning, the music expresses itself.
The promotion of imagination in children's music depends upon a willingness of teachers to ignore many of the traditional constraints placed upon children's expression in music education. The nurturing of imaginative musical thought should be a cornerstone of musical programs for children.

2.5.4 Musical Experience

"Musical skill is constructed from a base of innate abilities and tendencies". (Sloboda, 1985, p. 194). Sloboda states that music learning occurs through (a) enculturation and (b) training. He identifies a strand of specifically musical development in which the propensity of young children to respond to music in the environment stimulates a developmental sequence that happens without their reflective awareness. Musical training, on the other hand involves explicit instruction, and effort on the part of the individual child. The form that such instruction takes is usually specific to a sub-culture.

Musical experience is a combination of specific training and the musical environment, which includes the powerful influences of contemporary entertainment media (Etzkorn, 1988). These are the foundations of the individual musical imagination, and are a major stimulus to musical creativity.
2.5.5 Musical Development

Introduction

"Composing music is a primary learning activity - like learning to read or to catch a ball, which each child must puzzle out at his own pace". (Bunting, 1988, p. 307). Bunting has drawn attention to two basic tenets in this statement, the first being that composing music, like other primary activities is an innate ability that will develop in a stimulating environment. "This development depends on an interaction between the genetic inheritance of each individual and the environment -- the physical world, home, school, society." (Swanwick, 1988, p.53). Zimmerman (1986, p. 21) points out that "neither innate capacity nor environment is wholly controlling, but that interaction between the two is essential."

The second item in Bunting's statement refers to "pace". It is this factor that has occupied the attention of many researchers. But "there are no unequivocal findings about what children can and cannot do in music at particular stages of development, largely because tasks and operational definitions of musical concepts have varied widely." (Serafine, 1986 p. 315). Gardner quoted Werner's (in Gardner, 1973) study that focused on the musical aspects of children's original melodies, which identified a discrete series of stages through which all children pass. However the vast majority of empirical studies of children's musical development have dealt with children's processing of music, testing recognition and response.
Zimmerman's (1986) survey of research studies in musical development lists Piagetian studies by Serafine, Jones, Perney, and Larson (in Zimmerman, 1986) which indicate that at about the age of nine, qualitative changes to concrete operational thinking begin to occur (e.g. double seriation, and understanding of simultaneity and succession). Zimmerman also quotes Schultz and Crews (in Zimmerman, 1986) who show that changes in timbre were identified by grade one, rhythm by grade five, melody by grades five and seven, and harmony by grade eight. These are examples of studies where the methodology is based on perception and discrimination, which imply cognitive understanding. The question arises as to what extent children are able to use concepts instinctively in the creative process in a way that Bamberger (in DeLorenzo, 1989) describes as an intuitive, "know-how", figural approach.

Bamberger, identified two cognitive strategies -- "figural" and "formal" in the perception and mental reconstruction of musical information. "Figural rhythmic organization refers to the listener's ability to naturally organize the sounds he or she hears into meaningful groups or figures." (Upitis, 1987, p. 55). Upitis proceeds to explain that "chunking" is a common method of making sense of information in many areas of human cognition. Younger children tend to use this method, and it is only as they get older that they are able to discern the individual components that form the chunk.
Children's Creative Development

Holahan (1987) has drawn parallels between Chomsky's research into children's acquisition of linguistic competence with the acquisition of musical competence. Chomsky described language as a "mental organ" that grows in the mind of every human being, and is partly genetically determined and partly environmentally determined. He maintained that traditional empiricist models of learning fail to explain how infants make the transition from "babbler" to knowledgable and self directed users by the age of five. Similarly, Holahan believes that laboratory studies of music cognition do not explain how children acquire music understanding, and suggests that more research into how the young child represents songs mentally would lead to a more accurate theoretical foundation for developmental studies of music in early childhood.

Memory plays a major role in musical development. "Memory in music relies on mental imagery in three different modalities: sensorimotor, visual and auditory." (Davidson and Colley, 1987).

"Everything a child does with music, whether listening, performing, or improvising, is within the context of remembered experience." (Zimmerman, 1986, p. 22). The growth of the memory system follows a developmental pattern - during middle childhood the shift is from an "aural centering" on a specific element to a more global comprehension of a musical phrase, i.e.
consideration of all musical elements. The understanding of more formal musical structuring such as transformation relies on retention of the musical event over time. Serafine (1988) has shown that training appears to enhance the memory skills needed to sustain attention to whole compositions.

Torrance (1965) conducted longitudinal studies into creativity, using *Tests of Creative Thinking*. He found "a steady increase in creativity from grades one to three, followed by a sharp decrease between grades three and four, with a recovery during grades five and six."

Webster (1987) placed the slump later than grades three and four. He stated that "the enabling conditions of motivation and environment are important for musical development in children" (p.168), and noted the middle school years (10-13) as being vulnerable to outside distractions. He cited evidence in general creativity literature of "creative slumps" during transitional periods in schooling (e.g. entrance into high school), and during adolescence, where external motivation might be necessary for the continued development of creative ability.

**A Developmental Model of Musical Creativity**

Prevel (1974), in research that involved observation of children's creative behaviour in an unstructured musical environment
described stages of development in children's compositions: "gesture control", "alternating different colours of sound", "varied intensity of volume", "use of glissandos", "introductions and conclusions", and "expressive devices".

Webster (1987) gave a more detailed description of three levels of development in children's compositions:

1. Until the age of 5 or 6, children exhibit very individualistic approaches to tonal, rhythmic, and motivic patterns and tonal centre. A sense of overall musical syntax is absent in original song production.

2. Between 6 and 9, rhythm and tonal patterns become much more predictable and seem to be closely related to music the children have heard as part of their culture. Changing meters are common, and a feeling for tonality is more pronounced, although feeling for musical cadence and phrase structure is not clear.

3. After the age of 10, children become much more conscious of "correctness" of musical structure. There is a tendency to imitate more closely the sounds of commonly heard music.

Probably the most detailed and comprehensive study of its type is that which has produced "the spiral of musical development".

Swanwick and Tillman (1986) produced a spiral model of musical creative development that identified eight modes. The model was
based on a study of over seven hundred compositions collected from 48 children over a period of four years. Initially the children were aged from 3 to 11 years, and were from South London schools where they had regular music classes that included opportunities for composition and performance. Their compositions were recorded three times each term, and every child was asked to play each composition a second time to estimate the extent of musical memory, and observe which elements survived repetition.

The conceptual framework which emerged recognised distinct sequences in the areas of (i) "mastery" (control of sound materials), (ii) "imitation" (in the Piagetian sense of "accommodation"), and (iii) "imaginative play" (transformation of structural relationships). The definition of "composition" in this study was in the broadest sense, one that covered what may also be termed "improvisation", "invention" or "creative music". Figure 2 is a diagrammatic representation of the developmental spiral.
The reasons for presenting the model as a spiral were:
1. The process is cyclical; all people re-enter the cycle repeatedly, whatever their age, or musical experience.
2. The process is cumulative, and the various components interact with each other.
3. The spiral form depicts the pendulum swing in musical development between the individual and idiosyncratic perspective, and the socially stimulating and communally responsive.
Swanwick explained that although approximate ages were nominated as typical of each stage, operation at a more elementary level may occur in situations where a person may be confronted with a new style, or in situations of musical impoverishment. Thus the spiral is essentially a "sequence" of development, the speed of which may vary according to individual circumstances. Characteristics of the levels that are most relevant to the age group and minimal compositional experience involved in the present study are presented hierarchically:

**Manipulation**

- Interest in the technique of playing instruments.
- Devices related to the physical structure and layout of the instrument. e.g. glissandi, scalic and intervallic patterns.
- The beginning of an organised regular pulse.
- Long and rambling compositions.

**Personal Expressiveness:**

- Exploitation of changes of speed and dynamics.
- Signs of elementary phrases or musical gestures, not always able to be repeated.
- Little structural control.
The Vernacular:

- Melodic and rhythmic patterns begin to appear.
- Pieces are often short, and fairly conventional, and very predictable.
- Metrical organisation and devices such as ostinati and sequences are common.
- Imaginative deviation, contrast, the surprise of a novel ending.

There are many possible applications of this framework in music education, particularly in general curriculum planning, monitoring individual development, and in formulating teaching strategies. It is a useful concept in musical development in that while it identifies specific levels, they are not designed to label people. Rather, they are designed to point up differences between individuals in the way they work.

In order to verify the findings of the first study, Swanwick replicated it in Cyprus in 1990 (Swanwick, 1991). He collected 600 items, and 28 were randomly selected to include seven from four age groups: 4/5; 7/8; 10/11; 14/15. These were recorded onto one tape and played to eight judges in Britain, who were asked to assess each piece and place it in a criterion category. The categories were derived from the spiral model, and descriptive criteria for each were based on the descriptions of its modes of development.
The age levels identified by the judges in the Cyprus study were found to be higher than those in the original. This was explained by the fact that the Cyprus children came from schools with several different teachers, and they did not have the benefit of a systematic music program aimed at developing creative skills. The sequential order of developmental levels was found to be reliable and the overall framework appeared to have predictive power.

2.6 Issues for Teaching and Learning

2.6.1 The Task and its Effect on Behaviour

The nature of the creative task affects the way children behave in the creative context. This essentially deals with the degree to which the child defines the parameters of the problem.

The Search for Form

"The search for form, shaping musical thoughts into a communicable product, connotes the search for a method of solving the problem." (DeLorenzo, 1989, p. 195). DeLorenzo found that 6th grade students organized their musical pieces along one of the following lines:

1. The given problem structure served as a matrix for inserting sound material
2. A nonmusical plan such as a story or chain of events became the organizing structure
3. The musical character of sound events directed the shape of the resulting piece.

When students used mode 1 or mode 2, their decision making centred less on musical content and more on the operational aspects of performance. When working in mode 3 they demonstrated increasing concern for the musical relevance of each sound gesture. DeLorenzo believes that teachers' guidance is needed to help students realise that "sound events change in character depending upon what precedes or follows." (p. 197). She suggests that tasks that encourage students to find form in music may also facilitate higher-level musical thinking. This approach is preferred over the imposition of a structuring device by the teacher. The way the student cognitively perceives the problem structure has a greater effect on the element of choice of solutions than teacher-constructed choices. This carries through into a notion of "ownership" of the emerging product with an attentiveness to the development of the piece. "The more control one perceives in shaping musical events, the more likely the created product truly represents one's expressive intent." (DeLorenzo, 1989, p. 196).

2.6.2 Children as Evaluators.

Paynter and Aston (1970) stated that that "exploration with sound involves both the ability to produce sound and the capacity to
evaluate its expressive import." DeLorenzo (1989) found that "the act of producing sound was in no way synonymous with music exploration" unless it was followed by efforts to develop, transform and shape that musical event into an expressive idea.

Webster (1987) makes the important point that while conceptual understanding grows with age and experience, transfer of this conceptual information into the mosaic of creative thinking does not occur naturally, and should become a goal of formal music education. He also believes that little is being done to encourage divergent thinking as it interacts with the more convergent aspects of musical thought. This is essential for creative thinking in music.

Understanding of all aspects of the process is required, so that students become aware of how they operate, what effect the different processes have, and how they interact. It is not only a matter of making judgements about the quality of the final product. With increased awareness, children should learn to monitor their progress through the working out process, and manipulate it for specific purposes.

Students find it difficult to reflect on their own work and analyse their progress. It is a skill that needs to be learnt, but it can also be facilitated by providing the means to hear the way the work sounds, not only at the end, but throughout the entire creative process. Bunting (1988) believes that the ability to reflect and analyse can be developed by regular discussions with the teacher throughout the
composition process. Being called upon to communicate their ideas in words helps students in the clarification of problems.

2.6.3 *Teacher Assessment*

The notion of "quality" in evaluating students compositional work is a particularly difficult one, because children have their own criteria that are not the same as those of adults. "What may please or displease our adult ears is in no way significant to the musical development of a child" (Prevel, 1974). Young children particularly, do not hear the same things in their work that adults hear. Prevel found that their hearing can be selective in that it focuses on, for example, the rhythm, and they will declare two songs the same by virtue of this similarity, despite the fact that the melody might be different. They also hear in chunks, rather than a specific sequence of pitches and rhythms, and this is the way they compose. Their "coarse" construction of musical materials, more like a series of "impressions", defies assessment by adult criteria. The importance of comparison with previous work is accepted by music educators (Bunting, 1988) as assessment places the piece according to the level of individual development.

But this is not always possible. With the acceptance of composition as an area of study suitable for final year assessment for University entrance, examination procedures often include judgement by an external examiner. In this context, evaluation must relate to a
recognised "standard", identified according to set criteria. Simmonds (1988) conducted an investigation into music assessment during the period when external assessment procedures were being refined for the General Certificate of Secondary Education (G.C.S.E.). Groups of assessors were asked to reach a consensus regarding the mark to be given for each of a set of five compositions. Ostensibly, the aim was to focus on criteria rather than standards, so it is interesting to note that the language - "like, dislike, indifferent", "good, satisfactory, poor", was used as levels on a list of criteria, which then formed the basis of a consensus mark given out of ten. There was a disappointing level of agreement in the individual marks given by each judge, but most were "keen - perhaps too keen" to compromise in order to arrive at group consensus.

This type of assessment appears to be totally at odds with the idea that control of structural elements in composition is a developmental process in which levels of development can be identified in terms of a description of content. Rather than using emotive terms to grade such features as "formal structure", "development of material" etc, descriptive criteria would allow identification of a level of development that, if necessary, could then be converted to a mark according to a formula based on a range of developmental stages. Emotional judgement is hard to justify, whereas the presence of clearly described factors is much easier to defend. This could also account for problems associated with style preferences.
In the same context of the G.C.S.E. examination, Swanwick (1988) was critical of criteria that are not based on "serviceable theoretical models". "Understanding...the parameters within which we might assess artistic work is quite a different activity from directly responding to an art object or event." (p. 150) Therefore, he envisages "impact and overall impression" as belonging to a different conceptual category from "maintaining a style, exploitation of the medium", for example. The latter would be subsumed under the more general "overall impression" item. Swanwick puts forward, as a theoretical model, the Spiral of Musical Development (Swanwick and Tillman, 1986), and suggests that grades be linked to the various stages identified in the model. Because the level of control of musical materials and musical ordering are described specifically at each level, assessment becomes a much more straightforward and justifiable exercise. This method does not rely on a comparison between students, but focuses directly on analysing features of each work.

In a case study that evaluated compositions of 12 year old girls, McMillan (1990) asked judges to assess the products according to two criteria: "originality" and "presentation", awarding a mark out of 5 for each. Details of the results were not discussed in the report, but the non-specific nature of such criteria would appear to require a degree of interpretation from the judges, which would lead to rather subjective assessments.
The literature appears to suggest that as creative musical activities are accepted into the music curriculum, appropriate assessment procedures must be developed that are expressed in terms specific to musical structures, and graded according to levels of development. Criteria based on these factors can be justified by their clarity, and their effectiveness in the teaching/learning context.

2.6.4 **Computers in the Music Classroom**

Although computers have been introduced extensively into primary schools in recent years for programmed learning and as interactive tools, their use has generally been confined to core academic subjects. Their introduction into a music program should be carefully planned to ensure that the essential processes of music learning are allowed to take place, and that the computer is central to that learning, not just an "add-on" feature for extra interest, or to reinforce musical concepts and skills.

In discussing appropriate uses of computers with young children, Swick (1989) emphasized that their utilization "must be based on an understanding of how children learn." (p. 7). Furthermore he believes that they should be integrated into the natural context of the classroom, and used as "interactive" learning tools. He identified advantages in their use, such as: (a) gaining self confidence in controlling technology, (b) acquiring some
perspective on cause-effect relationships, and (c) experiencing building environments.

Miller (1986), in speaking specifically about computer use in music classrooms, identified some important considerations:

1. that there is a need to relate classroom music to the contemporary music children listen to;
2. that the new technology calls for a reassessment of attitudes to composing and performance skills;
3. that its usefulness is largely determined by the "friendliness" and musicality of the system.

Although limited by the poor quality of the sound produced by the computer, Miller recounted the successful introduction of an "ostinato" program for the BBC computer in several primary schools. The children were able to work out the program very quickly, and showed imagination, determination and musicianship in creating music of a high quality.

But successful integration of the computer into the music education program relies on the teacher's acceptance of the fact that the manner of reification of musical ideas in the computer medium is fundamentally different from that of traditional music, both in the way in which the ideas are conceived and worked out, as well as the means of realisation or "performance". Therefore one must expect that musical architecture and the musical experience that is put into effect by this architecture will be different from that of traditional music. Teachers must devise procedures that are appropriate to this medium, and which take into account the
different musical structures and working methods intrinsic to the computer medium.

2.6.5 Gender Issues

Cant (1990, p.11)) suggests that "the romantic ideology of the nineteenth-century and its surrounding social system" have created a mythology regarding an intrinsic lack of aptitude for composition on the part of women. She sees this mythology operating in British schools where the practising teachers (mostly women) have been reluctant to take up the composition element in new curricula (written by mostly men, several of whom also happen to be composers). In order to increase the confidence of girls in their ability to compose, she advocates the promotion of music written by women on radio, in record collections, and through reference to the increasing number of available books dealing with women composers.

The needs that appear to emerge from the literature are that in (a) setting compositional tasks, and (b) assessing them, consideration should be given to methods and forms of musical thinking and expression that may differ from the presently accepted norms. Such consideration should include the language and imagery used to stimulate musical imagination.
2.7 Chapter Summary

This review has ranged over the many aspects related to the compositional process. The literature has formed a basis for the methodological approaches adopted in this study. In particular it has been used to construct a model of compositional behaviour, to be described in more detail in Chapter 3.
Chapter 3

THE RESEARCH DESIGN
Chapter 3

THE RESEARCH DESIGN

3.1 Theoretical Framework

The structure of the theoretical framework of this study is outlined in diagrammatic form on the following pages. Because of the complexity of the composition process in which there is interaction among many factors, it is not appropriate to simply identify isolated assumptions. Instead, the framework of this study is the proposition that the following outline is a realistic and logical model of music composition in children, and that the individual components are placed in relation to the overall context of the composition act.
There are four sections (the composer, the task, the process, and the product) that represent the main components of the compositional act. The design of this framework has grown out of a need to not only identify the main elements and influences, but to understand where they fit into the overall framework, and how they interact. This is not to suggest that this framework is the framework for musical creativity as enacted in composition. It is one that serves the purposes of this study, and is based on the literature reviewed in Chapter 2, which dealt with the particular issues under investigation. The model has obvious limitations, particularly in that more needs to be done in relation to the nature of the interactions over time. Detailed analysis and a full discussion of such issues are outside the scope of this thesis.

The specific references that have formed the basis for the model are referred to in the discussion of each section.
3.1.1 *The Composer*

*Figure 3*

THE COMPOSER

<table>
<thead>
<tr>
<th>Personal Psychological Variables</th>
<th>Musical Qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Aptitude</td>
</tr>
<tr>
<td>Personality</td>
<td>Experience</td>
</tr>
<tr>
<td>Imagination</td>
<td>Training</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
</tr>
<tr>
<td>Motivation</td>
<td>Stage of development</td>
</tr>
</tbody>
</table>

*Figure 3* gives an overview of the personal attributes of the composer, and shows what the composer brings to the composition process. It includes what are called in the literature, "enabling skills and conditions" (Webster, 1987), that are experienced at the unconscious level, and operate in the long term memory (Sloboda, 1985). These factors have been shown to affect all aspects of the composition process. They fall into two categories:
1. **Personal Psychological Variables**

   (i) **Gender**: the attitudes, values, mental processes and emotional perspectives that may vary between male and female. (Radic, 1991, Kassler, 1989, Grosz, 1989)

   (ii) **Personality**: the individual character, especially the qualities of fluency, extensiveness, flexibility and originality. (Guilford, 1968, Gorder, 1980)

   (iii) **Imagination**: unconscious imagery. (Walker, 1988, Reichling, 1990)

   (iv) **Motivation**: "intrinsic", where the urge to compose comes from within, and "extrinsic" which relies on an external stimulus. (Webster, 1987, DeLorenzo, 1989)

2. **Musical Qualities**:

   (i) **Musical aptitude**: innate ability. (Sloboda, 1985, Hargreaves, 1987)

   (ii) **Musical experience** that occurs as a result of (a) environmental influences, and (b) training, that produces knowledge and skills. (Sloboda, 1985)

3.1.2 The Task

Figure 4

Figure 4 shows the way in which the nature of the task governs subsequent procedures, and defines the character of the final product (DeLorenzo, 1989). The requirements of the task, that is, its purpose and artistic intentions, govern the entire process. It takes place within a working environment that also influences the process. The major components are:
(i) the means of expression of the creative idea, that is, (a) notation, (b) computer, (c) live performance (as in the case of improvisation). (Alvarez, 1989, Wishart, 1982, Swick, 1989).

(ii) the tools. These may be in the form of musical instruments/voice, or electronically produced sound.

The nature of the task has an "umbrella effect" over the entire project. It

(i) defines the artistic intentions.

(ii) sets the physical and structural parameters of the product.

(iii) identifies problems to be solved.
3.1.3 *The Process*

*Figure 5*

<table>
<thead>
<tr>
<th>Creative Process</th>
<th>Operational Skills</th>
<th>Working Processes</th>
<th>Musical Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>Imagination</td>
<td>Explore</td>
<td></td>
</tr>
<tr>
<td>Incubation</td>
<td>Divergent thinking</td>
<td>Perception</td>
<td></td>
</tr>
<tr>
<td>Illumination</td>
<td>Aesthetic judgement</td>
<td>Cognition</td>
<td>Develop</td>
</tr>
<tr>
<td>Verification</td>
<td>Convergent thinking</td>
<td>Reflection</td>
<td>Repeat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluation</td>
<td>Close</td>
</tr>
</tbody>
</table>

*Figure 5* outlines the sequence of events in the working process in a time line that runs down the page.

1. The Creative Process column lists the sequence of events commonly found in models of general creativity. (Wallas, in Hargreaves, 1986)
(ii) Operational Skills are the overt, active skills used to bring a musical product into being. They are utilised at the conscious level. (Webster, 1987, Sloboda, 1875, McAdams, 1987, Johnson-Laird, 1988)


(iv) Musical Activities describe the manner of working with musical materials, leading to closure on a final product. They match the stages of general creativity listed in the first column.
3.1.4 Product

Figure 6

THE PRODUCT
(Replicable)

Structural elements  Musical appeal

Figure 6 describes the components of the compositional product that fall within the context of this study. By definition for the purpose of this study it must be replicable, a piece that is recognised as the final result of the working process. Analysis of the elementary compositions in this study dealt with simple structural elements and musical appeal. (Sloboda, 1985, Serafine, 1987, Swanwick and Tillman, 1986).
3.2 Delineation of the Research Problem

3.2.1 Introduction

The aim of this research study was to obtain a body of data associated with the composition process in children of primary school age (i.e. from 7 to 11 years). The major task was to design a procedure demonstrating behaviour that could be called "typical" for children of that age, and that took place in circumstances as "realistic" as possible. Because composition as a process is influenced by many factors, it was important to control the effects of some of them in order to focus on the effects of the main independent variables. Confounding variables such as performance achievement and notational skills, as well as previous training in composition, were of particular concern.

The main areas of interest in this study were
1. child development. It is accepted that development in musical activity is a matter of working through various sequential stages, the speed of which can vary in individuals. However, it has been shown that it is possible to identify patterns of behaviour that roughly equate with age.
2. gender. Given the evidence of gender differences in thinking and learning styles in all educational contexts, understanding of the composition process in children could not ignore possible differences in gender behaviour.
3. computer use. Assertions of the distinctive nature of working in the computer environment need to be tested in the music context.

It has been shown that the nature of the task can affect both the working process and the nature of the eventual product (DeLorenzo, 1989). Although there is a body of knowledge derived from analysis of children's creative musical products, it is essential that in investigating the creative process, there should also be consideration of "cause and effect", that is, how different working processes affect the nature of the product. It could be assumed that differences in that working process could affect different aspects of the final creation.

First of all it had to be established that the child had closed on something that could be identified as a finite product. An analysis of the musical and structural content of the products depended on using appropriate procedures to obtain factual information about the level of achievement, (e.g. the number, or manner of sequencing motifs) rather than relying on numerical scores or grades.

It was decided to use research carried out in 1987 by Kratus (1989) as a model for the first section of this study. He analysed the ways in which children aged 7 to 11 used their time when composing a short musical piece on a keyboard. He identified three compositional processes to study:
1. Exploration of new ideas.
2. Development of ideas already heard.
3. Repetition of music played previously.

His analysis of the product only involved the identification of closure on a final version. This was shown by the students being able to play their piece the same way twice.

Following the procedures used by Kratus, compositions were collected from 60 primary school children between the ages of 7 and 11 years in ACT. Half of the students in each age group used the computer to help them work out their music.

The working session of ten minutes for each child was recorded, and later analysed, to identify the kind of activity taking place during the composition process. In addition to the working processes of exploration, development and repetition, periods of silence or conversation, and computer playback were also noted.

At the end of ten minutes the children were asked to play their piece the same way twice, to ascertain to what degree they had managed to close on a final product.

A second procedure was then undertaken which involved analysis of the final versions of the compositions of each subject. The pieces were evaluated by a panel of six judges who assessed the degree of replication in the recordings of the final versions, as well as identifying levels of achievement on a range of musical and structural items.
These data were then analysed to discover any links between product variables, and significant interactions between process variables and product variables were noted.

3.2.2 Variables Utilized in the Study

Definition of terms is given in 3.2.3

Dependent Variables:

**Process**  
Exploration  
Development  
Repetition  
Silence  
Computer playback

**Product**  
Replication  
Musical appeal  
Successive events  
Simultaneous events  
Musical structure  
Sense of closure  
Rhythmic patterns  
Regular metre  
Expression
Independent Variables:

Gender (male/female)
Age (7 years/9 years/11 years)
Computer use (use/non use)

3.2.3 Definition of Terms

For the purposes of this study, the following definitions apply:

Composition: When referring to a process, composition is the act leading to the production of a unique, replicable sequence of pitches and durations. When referring to a product, it is a unique sequence of pitches and durations that its composer can replicate.

Activities occurring in the composition process:

Exploration: The music sounds unlike music played earlier in the process. No specific references to music played earlier can be heard.

Development: The music is similar to, yet different from, music played earlier. Clear references to music played earlier can be heard in the melody, the rhythm, or both.
Repetition: The music sounds the same as music played earlier.

Silence: No music is heard because of subject silence, subject statement or question, or statement by researcher.

Computer playback: The music heard is the playback by computer of a track recorded by the student.

Features of the products:

Replication A measure of the degree to which each subject's composition and its repetition at the end of the composition process sounded alike.

Musical Appeal An overall evaluation of musical quality by expert judges.

Successive Events Musical units that are chained or grouped to constitute a unified whole.

Simultaneous Events Musical events that are combined or vertically superimposed (i.e. polyphony or homophony).
<table>
<thead>
<tr>
<th><strong>Musical Structure</strong></th>
<th>The organisation or design of musical events forming a coherent musical statement.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sense of Closure</strong></td>
<td>A point of stasis and stability that implies an ending.</td>
</tr>
<tr>
<td><strong>Rhythmic Patterns</strong></td>
<td>Sounds and silences of varying lengths sequenced in a musically coherent manner.</td>
</tr>
<tr>
<td><strong>Regular Metre</strong></td>
<td>The presence of a regular pulse or beat.</td>
</tr>
<tr>
<td><strong>Expression</strong></td>
<td>A musical gesture or device that enhances the expressive qualities of the music, e.g. a variation in dynamics or tempo.</td>
</tr>
</tbody>
</table>
3.2.4 *Relationship Between the Variables*

1. *Process*

The study was designed to collect information regarding the manner in which subjects spent their ten minutes of working time. Analysis of the processes obtained the following information:

(i) The total amount of time spent by subjects on each of the activities over a 10 minute working period.

(ii) The amount of time spent by subjects on each of the activities during each minute of the working period.

(iii) The total amount of time spent by subjects on each of the working processes, (i.e. exploration, development and repetition) over a 10 minute working period.

The influence of gender, age and computer use on these activities was examined.
2. **Product**

Analysis of the product included a ranking on each of the product variables, of the composition of each subject.

The influence of gender, age and computer use on these scores was examined.

Analysis of the interactions between process and product included a comparison of the scores on each of the product variables with the time spent on working activities in the process.

The data for subjects who scored highest and lowest on replication and highest on musical appeal, and successive events was extracted, and a profile obtained regarding their gender, age and computer use. The behaviour of these groups during the working time was analysed to discover any significant differences in the way they used exploration, development and repetition that could be linked to the high/low scores on the particular product variable.

3.2.5 **Questions to be Answered**

1. How did the subjects spend their time during the composition process and how did they vary the activities involved?
2. Were the activities influenced by gender, age or use of the computer?
3. Were the subjects able to produce a replicable product?
4. What was the nature of this product in terms of musical structure and content?
5. Did gender, age or computer use affect the musical structure, content, or the ability to replicate?
6. Were there links between behaviour during the working time, and achievement relating to particular factors in the structure and content of the product?
7. What were the most effective ways of using the working time?

3.2.6 Hypotheses to be Tested

Hypotheses have been grouped for the sake of clarity and brevity. \( H_0(1 - 9) \) is used as a generic term covering a group of hypotheses. In presenting the results in Chapter 5, they have been referred to specifically.

Process

Group 1

\( H_01 \): That there will be no significant differences between males and females in measures of

(a) exploration
(b) development
(c) repetition
Group 2

\(H_02\): That there will be no significant differences between 7 year olds, 9 year olds, and 11 year olds in measures of
(a) exploration
(b) development
(c) repetition
(d) silence
(e) computer playback

calculated as a portion of the full working time.

Group 3

\(H_03\): That there will be no significant differences between computer users and non-computer users in measures of
(a) exploration
(b) development
(c) repetition
(d) silence

calculated as a portion of the full working time.

Group 4

\(H_04\): That there will be no significant differences between males and females in measures of
(a) exploration
(b) development
(c) repetition
calculated as a portion of time spent on working processes.

Group 5
Ho5: That there will be no significant differences between 7 year olds, 9 year olds, and 11 year olds in measures of
(a) exploration
(b) development
(c) repetition
calculated as a portion of time spent on working processes.

Group 6
Ho6: That there will be no significant differences between computer users and non-computer users in measures of
(a) exploration
(b) development
(c) repetition
calculated as a portion of the time spent on working processes.

Product

Group 7
Ho7: That there will be no significant differences between males and females in measures of
(a) ability to replicate
(b) musical appeal
H₀₈: That there will be no significant differences between 7 year olds, 9 year olds, and 11 year olds in measures of

(a) ability to replicate
(b) musical appeal
(c) complexity of successive events
(d) structure of simultaneous events
(e) musical structure
(f) sense of closure
(g) presence of rhythmic patterns
(h) presence of regular metre
(i) presence of expression
Group 9

H$_{09}$: That there will be no significant differences between computer users and non computer users in measures of

(a) ability to replicate
(b) musical appeal
(c) complexity of successive events
(d) structure of simultaneous events
(e) musical structure
(f) sense of closure
(g) presence of rhythmic patterns
(h) presence of regular metre
(i) presence of expression

3.2.7 De-limitations

Composition is a volatile process that is influenced by cultural, environmental and personal factors. In itself, the geographical location of Canberra and the distinctive nature of its population must be acknowledged. Even within Canberra, the age and socio-economic level of different regions contributes to a lack of uniformity with respect to attitudes and values associated with musical activities. Therefore, the findings refer only to the group involved in the study, although some statistical tests to be applied to the the data will allow inferences concerning population characteristics to be made from the sample characteristics.
Other factors that should be noted are:

1. The specific nature of the compositional task used in the study. For example: Constraints were placed on the notes to be used, and the fact that the piece should be replicable restricted its length and complexity.

2. The conditions under which the compositions were produced, that is live performance on a keyboard within a set period of time.

3. The computer software and its implementation. Although there are numerous programs of this type, they vary in their "friendliness", and ease of use. Computer operations required by subjects were idiosyncratic and clearly related to the package used.

It is only over time, after many more studies of this type have been conducted, that definite trends will be identified. At this stage, the results of this study should be accepted as exploratory, and their value lies in their contribution to a growing body of knowledge.
Chapter 4

METHOD
The methodological model used for this study was based on research carried out in 1987 by Kratus (1989). His study was entitled *A Time Analysis of the Compositional Processes Used by Children Ages 7 to 11*. The purpose of the study was to examine the amount of time children spent on various compositional processes while composing a short melody. 60 children (ages 7, 9, and 11) were given 10 minutes to compose a melody on an electronic keyboard under carefully controlled conditions. Kratus was able to analyse in some detail, stages that he defined as typical of the creative process in music. Differences in the way the time was used by children of different ages and gender were examined.

He clearly differentiated between the processes of "improvisation", which is constrained by immediacy and fluency.
and "composition" which allows time for reflection and revision of the musical product. He defined

(a) composition, the product, as "a unique sequence of pitches and durations that its composer can replicate",

and

(b) composition, the process, as "the act leading to the production of a unique, replicable sequence of pitches and durations." (p. 8).

He used studies of the compositional processes used by adult composers, and reference to methodologies used to investigate problem solving processes as the basis of the method in his study. Such methodologies assume that the overt behaviours of children during the problem solving process, such as writing and verbalizing, can be used as "evidence of internal problem-solving processes." (p. 7). Similarly, Kratus believed that "the sounds that children make on an instrument as they compose can be viewed as an audible analogue of their internal thought processes." (p. 7).

He identified three compositional processes: (a) exploration of new musical ideas, (b) development of some music already played, and (c) repetition of some of the material.

Because the process of composition takes place over a period of time, Kratus did a time analysis of changes in the use of the compositional processes as they occurred in the 10 minute working period. He emphasized that
this method of using the sounds made during composition to infer internal creative processes cannot show why a subject makes certain compositional decisions, but it does reveal what a subject does to explore, develop and review musical ideas. (p. 7).

In referring to the Swanwick and Tillman (1986) research into developmental differences in children's use of structure and expression, Kratus suggested the possibility that "differences in created products are the result of differences in creative processes." (p. 7).

The definition of composition used in Kratus' study required that the creative process had to lead to a composed product that the subject could replicate.

The results of the study were reported in two parts. The first dealt with age and gender characteristics and differences in the subjects' use of composition time. In the second part, the working methods of two groups were compared. The groups were:

1. subjects who demonstrated proficiency by successfully composing and repeating a song.
2. subjects who could not replicate their songs.

The results of Kratus' study can be summarised as follows:

1. As the children's ages increased, so did their use of development and repetition. 7-year-old subjects used mostly exploration, and their creative efforts were closer to improvisation than composition. The 11-year-olds used significantly more repetition than did the 7-year-olds.
2. Kratus compared the compositional processes used by the 9 and 11-year-olds to those used by adult composers and found that the data supported the presence of the three stages of exploration, development, and repetition, which equated with "preparation", "incubation" and "verification" - the stages in Webster's (1987) model. However, the stages were not discrete, nor defined sequentially. There was an intermingling of the processes, one with another.

3. There were no significant differences in performance that could be attributed to gender.

4. Subjects who explored less and repeated more while composing were able to replicate their songs more effectively than those who spent most of their time in exploration. They understood that the task required repeated reference to the melody, and spent less time exploring new material. Kratus concluded that "to compose a replicable song requires an understanding of the importance of repetition of musical ideas and a product orientation to the act of composition." (p. 19).

5. Profiles of age and gender were drawn up for the highest and the lowest scorers on replication. (Highest scorers received the top rating of 3 from each of two independent judges, while the lowest scorers received a score of 1 from each). Girls outnumbered the boys (approximately 2:1) in the high scorers. In the low scorers the ratio of girls to boys was 3:4. The success rate increased with age.
4.2 Introduction to the Main Study

This study was modelled on Kratus' study in terms of the basic organisation, and in collecting and analysing data. It was extended to include use of the computer during the working process by half of the subjects. In addition to analysing the effects of age and gender, use of the computer was an added variable in the time analysis of the compositional processes. This variable was also included in the profiles based on analysis of the final products.

During the course of the study, the decision was made to expand the analysis of the final products to include musical appeal and elements of musical structure. This was done in order to discover if there were different processes and profiles related to these factors.

4.3 Sampling Procedure

The school selected for the study was similar to that used in the Kratus study. It was a government primary school in an established suburb of Canberra. Permission to conduct the study was obtained through informal contact with the Principal and the specialist music teacher. Formal application was then made to the ACT Ministry of Education, and subsequently approved.

The school population numbers 304 students divided into ten classes. All children in the school participate in one half hour
music class each week, taught by a music specialist. This program does not include compositional activities. All children use computers at the school for publishing their stories.

To control for prior experience on a keyboard instrument, children who had taken piano or keyboard lessons were excluded from the study. It was not possible to control for access to keyboard instruments, given the proliferation of inexpensive keyboard instruments in homes today, and the ready access to the piano and keyboards in the music room and at after school care.

All students without previous keyboard tuition were identified in the 7, 9, and 11 year-old age groups. 10 girls and 10 boys were randomly selected in each age group, and five of each gender sub-group were randomly allocated to use the computer.

*Table 1*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 years</td>
<td>20</td>
<td>7.5</td>
<td>.3</td>
</tr>
<tr>
<td>9 years</td>
<td>20</td>
<td>9.5</td>
<td>.2</td>
</tr>
<tr>
<td>11 years</td>
<td>20</td>
<td>11.6</td>
<td>.3</td>
</tr>
</tbody>
</table>

Table 1 shows the range of ages within each age group to one decimal place.
Letters describing the nature and purpose of the study were sent home to the parents of each child selected, to provide an opportunity for them to refuse permission for the child to participate. None did so.

4.4 Equipment Used

A Yamaha electronic keyboard YPR-9 was linked by MIDI to an Atari 1040 computer, and a Roland U220 sound module set on "Acoustic Piano 2". The sound was heard through a Roland "Cube 60" keyboard amplifier.

The software used by the computer was Steinberg Cubase, version 2.0. All tracks were assigned to MIDI channel 1 to allow for recording of all versions played by each child. "Solo" was activated so that only one track would play back at a time. The metronome click was turned off to allow for rhythmic freedom, and the two bar lead in was de-activated for simplicity of operation.

A cassette tape recorder was used to record the 10 minute session for each subject, and a large clock was placed where it could be easily seen by the subjects.
4.5 The Pilot Study

4.5.1 Purposes

The purposes of the pilot study were:

1. to practice and affirm the procedures described in the Kratus study.
2. to refine the instructions and procedures associated with use of the computer for recording and playback.

Because of the limited scope of the pilot study, it was conducted informally, using 6 children, a boy and a girl in each of the three age groups, who had not received previous keyboard tuition. The computer was used in all cases.

4.5.2 Method

The same equipment was used as for the main study, and set up in a small quiet room where each subject was tested individually. The six subjects were known to the researcher and were at ease. They were seated at the keyboard and encouraged to explore steps, skips, repeated notes etc. They were given a brief demonstration of the computer operation, and shown how to operate the record and playback function keys for themselves. The instructions they were then given were essentially the same as those given by Kratus:
To-day you are going to make up a short song on this keyboard. Your song will be a brand new song, one that no one has ever heard before. You may use the white keys not covered by masking tape and play anything you like, but you should start on the key in the middle marked with a piece of tape [middle C]. You may use the computer whenever you wish to hear how your music sounds. You will have 10 minutes to make up your song, and at the end I will ask you to play your song two times for the tape recorder. Be sure you can remember your song, so that you can play it the same way two times. Do you have any questions?

4.5.3 Outcomes of the Pilot Study

The Kratus procedure was straightforward. The pilot study simply served the purpose of familiarising the researcher with the order of events and instructions, as well as experiencing the different responses of children at each age level. It was helpful for the researcher to practise giving the instructions because it made her more fluent and able to relax with the children. It was also important to time the whole procedure in order to work out a timetable for the main study. By the end of the pilot study, the time had been established at 16-17 minutes for each subject.

The younger children were initially less comfortable with the task, and it seemed that the instructions had been given too quickly, and in a manner that was too businesslike. As the pilot study proceeded, an effort was made to make more fun of the occasion, and the task more inviting.
Because the computer application was elementary, the pilot study only tested the order of instructions, and refined them. The main value of the exercise was in observing how the children incorporated the computer into the working process. Initially there appeared to be some uncertainty about when it should be used, so the sentence enclosed in [ ] was inserted into the instructions. (p. 9). There was variation in its use according to the individuals; some were keen to use it more as a plaything; others were more circumspect in using it only when they had some music worked out. This experience was valuable, as it pointed up the unpredictable nature of the child/computer interaction in the main study.

4.6 Collection of Data

The method used for the main study incorporated the procedures refined in the pilot study. Each subject was tested individually in a small quiet room in the school. They were seated at the keyboard and encouraged to explore steps, skips, repeated notes etc. This was done in a manner designed to put the children at their ease. Those who were assigned to the computer were given a short demonstration of recording and playing back some nonsense music. They were then shown how to use the function keys:

- "*" - Record
- "0" - Stop
- "0" - Return to start
- "Enter" - Playback.
They were given one practice in using them to quickly record a random sequence of notes. All of the children were at ease with the computer and readily grasped the use of the function keys.

The instructions used in the pilot study were then given to each subject. Children using the computer were told that they could record tracks whenever they wished.

Three restrictions were placed on the musical materials that could be used:

1. Only white notes, one octave on each side of middle C. A strip of masking tape was placed across the other notes.
2. The starting note should be middle C. This note was identified by a small piece of tape.
3. Only the "piano" sound could be used.

These restrictions were included in Kratus' study, citing Regelski's guidelines for creative activities in general music classes: "If too much free choice is allowed...students can quickly become lost, waste time or lose interest for lack of guidance". (Kratus, 1989, p. 9).

A large clock, placed within easy vision of the children, was then set on a five minute interval, and the 10 minute limit shown, so that they knew when their time would finish. The tape recorder was started, and the entire ten minute session was recorded as well as the performances at the end. New tapes were used for
each subject for ease of use later on. All students, whether they used computer or not, were allowed 10 minutes. The researcher remained unobtrusive, only reminding the children of the time left at two minutes from the end, or assisting in use of the computer if necessary. Some children initiated conversation or asked questions, but these episodes were kept as brief as possible.

At the end of ten minutes the children were asked to play the song, and then play the same song again. Some children worked out their ideas very quickly, and after playing their tune over and over many times were ready to record early. Two children found the task unappealing, and after several minutes wished to record what they had worked out so they could finish. To continue aimlessly repeating just to fill up the time appeared to be counterproductive and not within a reasonable interpretation of "realistic" behaviour. Initially, it was intended to use the ten minute time span in order to follow the Kratus model, but in view of the students' behaviour the decision was made to allow an early finish if it seemed appropriate. All subjects were encouraged to use as much of their time as possible, but when they were sure that they were ready to record, they were allowed to do so.

There is no mention in the Kratus study of any early finishes. He stated that "all 60 subjects were able to approach [the] creative musical task in a meaningful way by working the entire 10 minutes." (p. 18).
The time taken by a group of students to complete any activity of this type will vary between individuals. To make judgements about working processes that are contained within an arbitrary time span would appear to defeat the purpose of a study such as this. It would also appear to limit the usefulness of the findings if the circumstances were not more closely related to normal patterns of behaviour. It must be assumed that those subjects who completed the task early would have used the time to make further changes, or continue to repeat their final version until the time was up. This would have affected the results, giving an increased loading to the amount of repetition used by subjects who completed the task quickly. It could not be assumed that this proportion of time spent on repetition was a natural behaviour in the composition process.

The analysis of the composition process required judges to make evaluations as they listened to each tape. In the Kratus study only the evaluations of the researcher were used for analysis. Two independent judges analysed a sample of the tapes, and correlations between their scores and those of the researcher were used as an indicator of the reliability of the researcher's evaluations. The two independent judges used in this study were both highly trained musicians with excellent musicianship.
4.7 Data Analysis

The analysis followed the same procedures as the Kratus study for the process, with a more detailed examination of the working processes. Analysis of the final products dealt with "replication", as did Kratus, but in this study, other features were also examined.

4.7.1 The Process

The purpose of the first part of the analysis was to describe the composition processes during the 10 minute sessions. The 10 minute sessions were divided into 120 intervals of 5 seconds each, and the compositional process used in each interval was categorised as being one of the following:

1. Exploration: The music sounds unlike music played earlier, that is, exploration of new musical ideas.
2. Development: The music is similar to, yet different from music played earlier. There is clear reference to melodic and/or rhythmic material already used.
3. Repetition: The music sounds the same as music played earlier.
4. Silence: No music is heard. Either the child is silent, or some conversation is taking place.
5. Computer playback: The music heard is the playback by computer of a track recorded by the student.
Following the Kratus model all of the tapes were analysed by the researcher. In order to check the validity of these observations, the two independent judges analysed 12 of them, the same sized sample as that used in the Kratus study. These tapes were randomly selected and ordered, using tables of random numbers. The selection was stratified to include equal numbers of each sex in each age group, with half of each using computers. A blind procedure of coding the tapes was used to hide the age and sex of the subjects from the independent judges.

The analysis required judges to make an evaluation of the process every 5 seconds as they listened to the tapes. They recorded their evaluations on forms (Appendix 1) containing 120 blank boxes. The characters E,D,R,S, and C were used to denote the compositional activities. Empty squares resulting from an early finish were labelled Z. This was necessary so that a comparison could be made between all subjects as to how their 10 minutes was spent, and to ensure that there were no significant groups of subjects who finished early. Judges timed the five second intervals using a metronome set at 60 beats per minute, with an accent on every 5th beat. If more than one activity was heard during one 5 second interval, the process that made up most of the time was chosen.

*Results:*

The number of observed five second intervals of exploration, development, repetition, silence and computer use for each subject were determined. The correlation between the totals for the 12 tapes from each of the judges and those of the researcher...
were tabulated. (Details are presented in Chapter 5.) They were at an acceptable level, and very similar to those in the Kratus study. They were thus used as an indicator of the reliability of the researcher's evaluations. Therefore it was deemed valid to use the evaluations of the researcher as data for this study.

4.7.2 The Product

For this section of the analysis, the final compositions from the end of each of the 60 tapes were re-recorded in random order on to one tape. Three different tapes ("tape 1", "tape 2", "tape 3") were prepared in this way, and copies distributed to six judges. The panel of judges consisted of the following:

Two teacher educators, with extensive experience with primary music programs. (Female - tape 1, male - tape 2)
Two experienced classroom music teachers, both successful composers. (Female - tape 2, male - tape 3)
Two highly trained musicians, with excellent musicianship skills, and some experience in instrumental teaching. (Female - tape 3, male - tape 1)

Judges were selected from a variety of musical backgrounds to ensure that judgements reflected the broad range of musical experience. It was also important that each judge should have had some teaching experience. In order to take into account differences in the ways music is constructed and responded to.
by men and women, there was equal gender representation on
the panel.

Judging was "blind" with regard to subjects' age, gender, and use
of computer. Judges were asked to evaluate the final versions
and allocate scores for each of nine variables, according to
criteria that were explained by a set of descriptors for each
score.

Score Descriptors for Product Variables:

1.  *Replication* was an evaluation of the degree to which each
subject's song and its replication sounded alike, using the
following 3-point scale:

   3. Replication is the same as or almost the same as
      the original.
   2. Some sections of the replication are the same as
      the original.
   1. None or almost none of the replication is the same
      as the original.

This was the only scale used in the Kratus study. For the
purposes of this study further factors regarding musical content
were also included.
2. *Musical Appeal* was a subjective judgement of the "like/dislike" variety, using a 3-point scale:

3. Good
2. Average
1. Poor

This factor was included to elicit the following information:
(a) A comparison between this factor and Replication.
(b) The relationship between this factor and the structural and developmental factors following.

3. *Successive Events* referred to the degree of complexity in the way that musical ideas were sequenced. Ratings were on a scale of 1-4:

1. Rambling, unstructured.
2. One basic idea or motif.
3. Two or more motifs in succession.
4. Patterning such as repetition or alternation of basic motifs.

4. *Simultaneous Events* indicated the presence of harmonic or polyphonic material using three categories:

0. Single note melody only.
1. Chords or clusters.
2. Combination of melodic events.

5. *Musical Structure* identified different methods of organising sounds, commonly found in the early stages of musical development.
1. Structure of melody depends only on working through patterns such as scales, intervals, glissandi, or patterns based on the structure of the keyboard.

2. Motifs were sequenced without regard for musical flow.

3. Ideas were phrased or grouped in musically coherent units.

These are discrete categories, not a hierarchy. However, categories 1 and 2 could be collapsed as being un-musical.

6. *Sense of Closure* identified three different types of endings.
   
   0. No sense of finality.
   1. Ending implies a final cadence.
   2. Some other musical gesture indicating finality. e.g. a rallentando before the final note, or a cluster, or flourish of some description.

7. *Rhythmic Patterns* indicated the presence of some rhythmic elements.

   0. Not present.
   1. Present.

8. *Regular Metre*

   0. Not present.
   1. Present.
9. *Expression* indicated the presence of expressive devices such as variation in dynamics, speed.

0. Not present.

1. Present.

Because items 2-9 reflect levels in stages of development, they describe elements that were essentially the same in both renditions of the composition even if the subject was unable to replicate exactly. In the rare cases where there was a different score for one item in each rendition, the higher score or the one which appeared to reflect the intentions of the subject was used.

Each judge was prepared for the task in a short interview with the researcher, in which the purposes of the study were described, and the descriptors and marking scheme explained for each of the criteria. Each judge was given a sheet summarizing the descriptors and marking scheme (Appendix 2). Criteria were listed on printed charts (Appendix 3), where scores for each subject were placed by judges in the order played on the prepared tape. The researcher later re-organized the scores into the subjects’ original order, so that scores from all judges for each subject could be analysed. All judges evaluated songs and replications from all 60 subjects.

It should be noted that the Kratus study only analysed the products for the degree to which the two final versions were the same. He used the same two judges who had checked the
process evaluations to obtain this data, and then dealt with the groups with the highest and lowest scores.

Following the methodology of qualitative research, the following discussion is included at this point to explain the decision to expand analysis of the products beyond the scope of the Kratus study. The decision grew out of observations of student behaviour during the study, and a desire to extract information that related to more musical features of the products.

During the testing period, it became apparent that the nature of the compositional task, namely the creating of a replicable song, was having a strong influence on the working behaviour of the subjects. There were some who focused on this to the exclusion of any aesthetic considerations. Several students quickly worked out a sequence of notes that they could remember, often very short and of limited musical interest, and after practising it thoroughly were able to replicate satisfactorily. In terms of music education, such behaviour has minimal value, and although knowledge of the working processes in this context was of interest, more information about the musical quality of the compositions was sought.

The difficulty of obtaining valid data from judgements of such factors, is acknowledged in the field, and well documented. Cultural influences, and conformity to established norms of preference often prevail. Moreover, personal preference and individual musical experience can produce widely differing opinions. Hargreaves (1986) cites Childs who found that "it is by
no means clear that experts...do agree about standards of aesthetic merit, either within or between cultures". (p. 138). In this context, evaluation is not a matter of "right" and "wrong", but more a matter of seeking consensus. It was therefore appropriate to use a larger panel of judges from a variety of backgrounds for this type of evaluation. The only data used for interaction analysis was that which showed a high level of agreement between all judges. For example, subjects who received uniformly high or low scores from all judges were identified, and profiles examined to establish relationships with composition processes or the independent variables.

### 4.7.3 Statistical Tests

Statistical analysis of the data was carried out on a Burroughs system, using the SPSS\textsuperscript{x} program (1986). Details of the tests used are as follows:

1. **Agreement between judges on process evaluations.**
   Evaluation of the processes produced interval data. The correlation was between two populations of scores. (The scores of each of the independent judges was measured against those of the researcher.) Pearson Correlation Coefficient was used.

2. **Differences in the use of compositional processes attributable to the influence of the independent variables.**
   Using interval data, the type of hypothesis was a difference between several means on scores of exploration, development, repetition, silence, computer playback. There were three
independent variables, and the sampling procedure was independent. The Three-way Analysis of Variance was used, with the Two-tailed t-test as a post hoc procedure.

3. Differences in the scores for each of the product variables attributable to the influence of the independent variables.
Non-parametric tests were used in this instance. The level of measurement was ordinal. (Scores were the sums of rankings given by judges on each of the variables.) The type of hypothesis was a difference between rank scores.

To test for differences attributable to age (three levels - 7 years, 9 years, and 11 years), the Kruskall-Wallis One-way Anova was used. The Mann-Whitney U test was also used as a post hoc procedure to test for significance at the .05 level.

To test for differences attributable to gender and computer use (two levels), the Mann-Whitney U test was used.
Chapter 5

RESULTS

5.1 Introduction

Initially, the results presented in Chapter 5 address the validation of the judges' data used for analysis in the study. In the "Process" section this consisted of a comparison of the evaluations of the researcher with evaluations of a random sample of the subjects' tapes by two external judges. In the "Product" section, where diversity of opinion was sought, the data used for evaluating subjects' behaviour was derived from aggregate rankings from all judges on each variable.

The analysis of results moves systematically through the processes, with time analyses of various categories of subject behaviour. The "Product" data are used to formulate profiles of different subject groups, and to test for interactions with the "Process" data.
5.2 Analysis of the Data

Statistical analysis of the data was carried out on a Unisys A9 mainframe computer, using the SPSSX statistical package (SPSS Inc., 1986). Graphs were produced on a Macintosh SE computer, using the Excel program, Version 3.0.

In all cases where there were matching statistical procedures, the results of the present study have been compared to those in the Kratus study. However, the Kratus results published did not always show levels of significance (e.g. for correlation coefficients for agreement between judges), nor were standard deviations provided for mean percentages of time use. In the present study these statistics were used to obtain a more complete analysis of the level of agreement between judges, and a clearer picture of the distribution in the analysis of use of time in the composition process.

The .05 level of significance was used throughout the data analysis.

5.3 The Process

Analysis of the compositional process used data derived from evaluations by the researcher of the subjects' behaviour during the ten minute working periods. Computation of the total time spent on each of the compositional processes over the full ten
minutes, in addition to their use minute by minute, provided information that could be examined for the influence of gender, age, and computer use.

5.3.1 The Process Evaluations

The method of evaluating the subjects' behaviour during the composition process has been described in Chapter 4.7.1. The first task was to establish the reliability of the researcher's evaluations by comparing them with the evaluations of a random selection of 12 tapes by two independent judges. The correlations between the researcher's totals and the totals of each of the judges were used as an indicator of the reliability of the researcher's scores. Only the researcher's evaluations of the compositional processes were used in the study. This procedure followed exactly the procedure used by Kratus in his study.

Table 2 shows the Pearson product-moment correlation coefficients, with significance levels in brackets.


Table 2

**Interjudge Reliability of Process Evaluations**

<table>
<thead>
<tr>
<th>Process</th>
<th>Judge 1</th>
<th>Judge 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>.90 (P=.000)</td>
<td>.87 (P=.000)</td>
</tr>
<tr>
<td>Development</td>
<td>.72 (P=.004)</td>
<td>.59 (P=.023)</td>
</tr>
<tr>
<td>Repetition</td>
<td>.89 (P=.000)</td>
<td>.92 (P=.000)</td>
</tr>
<tr>
<td>Silence</td>
<td>.98 (P=.000)</td>
<td>.92 (P=.000)</td>
</tr>
<tr>
<td>Computer</td>
<td>.99 (P=.000)</td>
<td>.99 (P=.000)</td>
</tr>
</tbody>
</table>

Overall, the correlation coefficients were quite high, and statistically significant at the .05 level, suggesting substantial agreement between each of the judges and the researcher. They were similar to those in the Kratus study, which ranged from .76 to .98. Thus it was valid to use only the evaluations of the researcher for this study (as did Kratus).

The incidence of lower coefficients for development was also evident in the Kratus study. This aspect of the evaluation was the most difficult to interpret within a 5-second time frame, as much of the musical material had similar elements, and the degree to which it was the same or different was often unclear.
5.3.2 *Subjects' Use of Time During the Composition Process*

Raw data from the total number of 5-second intervals used in each category was converted to a percentage of total time used. (e.g. thirty 5-second intervals of development out of 120 equal 25% of the total time used.) Table 3 shows the mean percentage of time used by subjects, and standard deviations (to two decimal places) for exploration, development, repetition, silence, computer playback and unused time owing to early finishes. Total scores for the entire group are included as a source of comparison for sub groups.
Table 3

Mean Percentages of Time Devoted to Exploration, Development, Repetition, Silence, Computer Playback and Early Finish by Gender, Age and Computer Use.

<table>
<thead>
<tr>
<th>Source</th>
<th>E%</th>
<th>D%</th>
<th>F%</th>
<th>S%</th>
<th>C%</th>
<th>2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects</td>
<td>28.28</td>
<td>23.67</td>
<td>21.44</td>
<td>16.51</td>
<td>3.55</td>
<td>6.54</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>30.51</td>
<td>23.21</td>
<td>19.34</td>
<td>17.29</td>
<td>3.64</td>
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<tr>
<td>Female</td>
<td>26.04</td>
<td>24.14</td>
<td>23.55</td>
<td>15.72</td>
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<tr>
<td>Age</td>
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</tr>
<tr>
<td>7 yrs</td>
<td>27.85</td>
<td>20.65</td>
<td>19.19</td>
<td>20.84</td>
<td>4.13</td>
<td>7.33</td>
</tr>
<tr>
<td>9 yrs</td>
<td>24.85</td>
<td>23.09</td>
<td>23.30</td>
<td>14.49</td>
<td>3.68</td>
<td>5.59</td>
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<tr>
<td>11 yrs</td>
<td>32.14</td>
<td>27.28</td>
<td>16.84</td>
<td>14.18</td>
<td>2.85</td>
<td>6.71</td>
</tr>
<tr>
<td>Computer Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23.89</td>
<td>17.67</td>
<td>22.82</td>
<td>22.26</td>
<td>7.10</td>
<td>6.26</td>
</tr>
<tr>
<td>No</td>
<td>32.67</td>
<td>29.68</td>
<td>20.07</td>
<td>10.75</td>
<td>0.00</td>
<td>6.83</td>
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</tbody>
</table>

125
Exploration, Development and Repetition

The results for all subjects show that they divided their time fairly evenly between exploration, development and repetition, with slightly more time spent on exploration.

Males and females were similar in their use of time. However, females using more repetition and development and less exploration and silence. (Results in the Kratus study showed the same relationships between males and females.)

7 year olds spent most time on exploration and slightly less on repetition than development. (The Kratus study showed much greater differences, with exploration particularly high - 66%.)

9 year olds spent similar time on all three activities. (The Kratus study showed more time spent on exploration; others similar.)

11 year olds spent more time on exploration than either of the other age groups, and least on repetition. (In the Kratus study there was a fairly even use of time with less exploration and more repetition than 7 and 9 year olds.)

Results related to computer use were affected by (a) the time taken by computer playback, and (b) the additional time in the silence category due to procedures related to computer operation. Computer users spent less time on development than exploration or repetition. They spent more time on repetition than the non-computer users, despite the silence and computer playback factors.
Silence
Results were similar for all gender and age groups with the exception of the 7 year olds whose scores were higher. (Results in the Kratus study were in a similar range to those for the non-computer users in the present study. The "silence" results of the gender and age groups in the present study were affected by the presence of computer users.)

Computer Playback
Computer use was similar across all gender and age groups.

Early Finish
Similar levels of early finish were present in all groups.

To determine whether there were significant differences in the use of the compositional processes attributable to gender, age or computer use, a series of three-way analyses of variance were performed on the data. The percentages of time spent on exploration, development, repetition, silence, computer playback and early finish were the dependent variables (Table 4). The two-tailed t-test was used as a post hoc procedure to test for significance at the .05 level.
Table 4

Summary of Three-Way Analyses of Variance (for each category), by Gender, Age, Computer Use.

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
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<td>1</td>
<td>299.69</td>
<td>0.99</td>
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<td>1157.62</td>
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<td>.06</td>
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<td>2-way interactions:</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>2</td>
<td>92.82</td>
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<tr>
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<td>12.28</td>
<td>.00*</td>
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<td>Mean Square</td>
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<td>P</td>
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<td>----------------</td>
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<td>.00*</td>
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<tr>
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<td>2</td>
<td>1.09</td>
<td>0.13</td>
<td>.88</td>
</tr>
<tr>
<td>Gender x Computer</td>
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<td>1</td>
<td>0.51</td>
<td>0.06</td>
<td>.81</td>
</tr>
<tr>
<td>Age x Computer</td>
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<td>2</td>
<td>8.44</td>
<td>0.96</td>
<td>.39</td>
</tr>
<tr>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Gender x Age x Comp.</td>
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<td>2</td>
<td>1.09</td>
<td>0.13</td>
<td>.88</td>
</tr>
<tr>
<td><strong>Early Finish</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
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<td>1</td>
<td>17.76</td>
<td>0.12</td>
<td>.73</td>
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<tr>
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<td>15.59</td>
<td>0.11</td>
<td>.90</td>
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<td>5.01</td>
<td>0.03</td>
<td>.86</td>
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<tr>
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<td>2</td>
<td>35.89</td>
<td>0.24</td>
<td>.79</td>
</tr>
<tr>
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<td>211.47</td>
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<td>.24</td>
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<td>Age x Computer</td>
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<td>2</td>
<td>36.91</td>
<td>0.25</td>
<td>.78</td>
</tr>
<tr>
<td><strong>3-way interactions:</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>150.81</td>
<td>2</td>
<td>75.40</td>
<td>0.51</td>
<td>.61</td>
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</tbody>
</table>

*p<.05
Exploration

There were no significant differences in measures of exploration in any of the categories. However, the main effect of computer use approached significance, where computer users had lower scores on exploration.

All null hypotheses pertaining to measures of exploration calculated as a portion of the full working time (i.e. 1[a], 2[a], 3[a]) were accepted.

Development

1. There was a significant difference in the main effect of development attributable to computer use (t=-3.30, df=58, p<.01).

Table 5

<table>
<thead>
<tr>
<th>Computer Use</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17.67</td>
<td>29.68</td>
</tr>
<tr>
<td></td>
<td>(.13)</td>
<td>(.16)</td>
</tr>
</tbody>
</table>

Table 5 shows that there was less use of development overall by computer users.

There were no significant differences in the use of development in the other categories.
Null Hypothesis $H_{03(b)}$: That there will be no significant differences between computer users and non-computer users in measures of development calculated as a portion of the full working time was rejected.

Other null hypotheses in this category (i.e. 1[b], 2[b]) were accepted.

2. There was a significant 2-way interaction between age and computer use in the development category for 7 year olds and 9 year olds. (7 year olds: $t=-2.92$, df=18, $p<.01$; 9 year olds: $t=-3.30$, df=18, $p<.01$).

Table 6

Mean Percentages (sd's) of Time Used in Development: Two-Way Interaction: Age x Computer Use

<table>
<thead>
<tr>
<th>Age</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>(sd)</td>
<td>(sd)</td>
</tr>
<tr>
<td>7 years</td>
<td>12.84</td>
<td>28.45</td>
</tr>
<tr>
<td></td>
<td>(.06)</td>
<td>(.15)</td>
</tr>
<tr>
<td>9 years</td>
<td>11.52</td>
<td>34.67</td>
</tr>
<tr>
<td></td>
<td>(.08)</td>
<td>(.21)</td>
</tr>
</tbody>
</table>

Table 6 shows that there was less use of development by 7 and 9 year olds who used the computer.
Repetition

There were no significant differences in measures of repetition (main effects) in any of the categories.

All hypotheses pertaining to measures of repetition (main effects) calculated as a portion of the full working time (i.e. 1[c]. 2[c]. 3[c]) were accepted.

There was a significant 2-way interaction between age and computer use in the repetition category. (9 year olds: t=2.36, df=18, p<.05).

Table 7

<table>
<thead>
<tr>
<th></th>
<th>Computer Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>9 years</td>
<td>37.35 (.17)</td>
</tr>
</tbody>
</table>

Table 7 shows that there was a greater use of repetition by 9 year olds who used the computer.

Silence

1. The difference attributable to the main effect of age in the silence category approached significance between 7 and 9 years (t=1.99, df=38 p=.055), and 7 and 11 years (t=2.00, df=38, p=.057).
Table 8

Mean Percentages (sd's) of Time used in Silence by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>7 years</th>
<th>9 years</th>
<th>11 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.84</td>
<td>14.49</td>
<td>14.18</td>
</tr>
<tr>
<td></td>
<td>(.12)</td>
<td>(.08)</td>
<td>(.09)</td>
</tr>
</tbody>
</table>

Table 8 shows that measures of silence were significantly higher for 7 year olds than 9.

2. There was a significant difference attributable to the main effect of computer use in the silence category. (t=5.15, df=58, p<.01)

Table 9

Mean Percentages (sd's) of Time Used in Silence by Computer Use

<table>
<thead>
<tr>
<th>Computer Use</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22.26</td>
<td>10.75</td>
</tr>
<tr>
<td></td>
<td>(.10)</td>
<td>(.07)</td>
</tr>
</tbody>
</table>

Table 9 shows that measures of silence were significantly higher for computer users than for non-computer users.

There were no significant differences in measures of silence attributable to gender.
**Null Hypothesis** $H_{O2}(d)$: That there will be no significant differences between 7 year olds, 9 year olds, and 11 year olds in measures of silence calculated as a portion of the full working time was rejected.

**Null Hypothesis** $H_{O3}(d)$: That there will be no significant differences between computer users and non-computer users in measures of silence calculated as a portion of the full working time was rejected.

Null hypothesis $1(d)$ was accepted.

**Computer Playback**

There were no significant differences in measures of computer playback in any category.

Both null hypotheses pertaining to measure of computer playback calculated as a portion of the full working time (i.e. 1[e], 2[e]) were accepted.

**Early Finish**

There were no significant differences in measures of early finish in any of the categories.
General Comments

Despite the fact that scores in this study would generally have been affected by the use of the computer and the acceptance of early finishes, there is an obvious "bulge" in the 9 year old group, with higher scores for repetition and lower for exploration.

Subjects who used the computer spent less time on development than the non users, and the marked difference in the silence category reflects the extra time associated with computer operation.

Early finishes were distributed fairly evenly across all groups.

There were some differences between the two studies in the results for the three age groups. In the Kratus study, there was a marked decrease in the use of exploration as the subjects became older, with a corresponding increase in the amount of development and repetition. In this study, the amount of development increased with age, but the use of exploration and repetition was quite different, exploration being lowest for 9 year olds and highest for 11 year olds. Similarly, repetition was highest for 9 year olds, and lowest for 11 year olds.
5.3.3 Subjects' Use of the Working Processes

Because of the substantial amount of time taken up by silence, computer playback and early finish, it seemed important to find out how the groups within the independent variables compared solely in measures of exploration, development and repetition—the "overt" working processes. Therefore, the raw scores for exploration, development and repetition were again converted to form a percentage of the total time used in these activities only. (Table 10)
Table 10

Mean Percentages of Working Time Devoted to Exploration, Development and Repetition by Gender, Age and Computer Use.

<table>
<thead>
<tr>
<th>Source</th>
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<th>D%</th>
<th>R%</th>
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</thead>
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<td>30.65</td>
<td>30.66</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
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<td>28.25</td>
</tr>
<tr>
<td></td>
<td>(.25 )</td>
<td>(.20 )</td>
<td>(.23 )</td>
</tr>
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<tr>
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<td>(.24 )</td>
</tr>
<tr>
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<td></td>
<td></td>
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</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>(.22 )</td>
<td>(.15 )</td>
<td>(.22 )</td>
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<td>40.74</td>
</tr>
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<td>(.19 )</td>
<td>(.20 )</td>
<td>(.29 )</td>
</tr>
<tr>
<td>11 yrs</td>
<td>40.89</td>
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<td>22.90</td>
</tr>
<tr>
<td></td>
<td>(.24 )</td>
<td>(.15 )</td>
<td>(.16 )</td>
</tr>
<tr>
<td><strong>Computer Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37.88</td>
<td>26.35</td>
<td>35.78</td>
</tr>
<tr>
<td></td>
<td>(.25 )</td>
<td>(.17 )</td>
<td>(.27 )</td>
</tr>
<tr>
<td>No</td>
<td>39.50</td>
<td>34.96</td>
<td>25.54</td>
</tr>
<tr>
<td></td>
<td>(.19 )</td>
<td>(.17 )</td>
<td>(.19 )</td>
</tr>
</tbody>
</table>
Results in table 10 show that males used more exploration than females and that 9 year olds used less than the other two age groups.

The weighting of 9 year old use of repetition is much higher in this table. (Table 3: 7 yrs: 19.19, 9 yrs: 23.30, 11 yrs: 16.84
Table 10: 7 yrs: 28.33, 9 yrs: 40.74, 11 yrs: 22.90)

The subjects on computer used less development time.

This procedure generally served to amplify the differences already noted in the full analysis. It particularly highlighted the differences between computer users and non computer users. A shift in levels of significance also occurred as a result of the analysis procedure.

In order to gain precise information regarding the subjects' use of the composition processes (i.e. exploration, development and repetition), a further series of three-way analyses of variance was performed (Table 11) using the totals for each as percentages of working time. The two-tailed t-test was used as a post hoc procedure to test for significance at the .05 level.
Table 11

**Summary of Three-Way Analyses of Variance (for working processes only), by Gender, Age and Computer Use.**

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exploration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>855.98</td>
<td>1</td>
<td>855.98</td>
<td>1.81</td>
<td>.16</td>
</tr>
<tr>
<td>Age</td>
<td>1723.70</td>
<td>2</td>
<td>861.85</td>
<td>1.82</td>
<td>.17</td>
</tr>
<tr>
<td>Computer Use</td>
<td>39.76</td>
<td>1</td>
<td>39.76</td>
<td>0.08</td>
<td>.77</td>
</tr>
<tr>
<td>2-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age</td>
<td>371.99</td>
<td>2</td>
<td>189.96</td>
<td>0.39</td>
<td>.68</td>
</tr>
<tr>
<td>Gender x Computer</td>
<td>26.24</td>
<td>1</td>
<td>26.24</td>
<td>0.06</td>
<td>.92</td>
</tr>
<tr>
<td>Age x Computer</td>
<td>1865.69</td>
<td>2</td>
<td>932.85</td>
<td>1.97</td>
<td>.15</td>
</tr>
<tr>
<td>3-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age x Comp.</td>
<td>840.15</td>
<td>2</td>
<td>420.07</td>
<td>0.89</td>
<td>.42</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>112.91</td>
<td>1</td>
<td>112.91</td>
<td>0.46</td>
<td>.50</td>
</tr>
<tr>
<td>Age</td>
<td>926.45</td>
<td>2</td>
<td>463.23</td>
<td>1.90</td>
<td>.16</td>
</tr>
<tr>
<td>Computer Use</td>
<td>1111.86</td>
<td>1</td>
<td>1111.86</td>
<td>4.56</td>
<td>.03*</td>
</tr>
<tr>
<td>2-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age</td>
<td>713.09</td>
<td>2</td>
<td>356.55</td>
<td>1.46</td>
<td>.24</td>
</tr>
<tr>
<td>Gender x Computer</td>
<td>20.15</td>
<td>1</td>
<td>20.15</td>
<td>0.08</td>
<td>.76</td>
</tr>
<tr>
<td>Age x Computer</td>
<td>2230.61</td>
<td>2</td>
<td>1115.31</td>
<td>4.57</td>
<td>.02*</td>
</tr>
<tr>
<td>3-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age x Comp.</td>
<td>560.66</td>
<td>2</td>
<td>280.33</td>
<td>1.15</td>
<td>.32</td>
</tr>
<tr>
<td><strong>Repetition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>347.11</td>
<td>1</td>
<td>347.11</td>
<td>0.77</td>
<td>.38</td>
</tr>
<tr>
<td>Age</td>
<td>3344.70</td>
<td>2</td>
<td>1672.35</td>
<td>3.72</td>
<td>.03*</td>
</tr>
<tr>
<td>Computer Use</td>
<td>1572.15</td>
<td>1</td>
<td>1572.15</td>
<td>3.49</td>
<td>.06</td>
</tr>
<tr>
<td>2-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age</td>
<td>177.63</td>
<td>2</td>
<td>88.82</td>
<td>0.20</td>
<td>.82</td>
</tr>
<tr>
<td>Gender x Computer</td>
<td>0.40</td>
<td>1</td>
<td>0.40</td>
<td>0.00</td>
<td>.98</td>
</tr>
<tr>
<td>Age x Computer</td>
<td>4429.35</td>
<td>2</td>
<td>2214.67</td>
<td>4.92</td>
<td>.01*</td>
</tr>
<tr>
<td>3-way interactions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender x Age x Comp.</td>
<td>1543.93</td>
<td>2</td>
<td>771.96</td>
<td>1.72</td>
<td>.19</td>
</tr>
</tbody>
</table>

p<.05
Exploration

There were no significant differences in measures of exploration in any of the categories.

All null hypotheses pertaining to measures of exploration calculated as a portion of the time spent on working processes (i.e. 4[a], 5[a], 6[a]) were accepted.

Development

1. The difference in measures of development attributable to the main effect of computer use approached significance (t=-1.99, df=58, p=.051).

Table 12

Mean Percentages (sd's) of Working Time Used in Development by Computer Use

<table>
<thead>
<tr>
<th>Computer Use</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26.35</td>
<td>34.96</td>
</tr>
<tr>
<td></td>
<td>(.17)</td>
<td>(.17)</td>
</tr>
</tbody>
</table>

Table 12 shows that there was less use of development overall by computer users.

There were no significant differences in the use of development in the other categories.
Null Hypothesis $H_06(b)$: That there will be no significant differences between computer users and non-computer users (main effects) in measures of development calculated as a portion of time spent on working processes was rejected.

Other null hypotheses in this category (i.e. 4[b], 5[b]) were accepted.

2. There was a significant 2-way interaction between age and computer use in the development category. (9 year olds: $t=-2.78$, $df=18$, $p<.05$).

Table 13

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Computer Use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9 years</td>
<td>17.19</td>
<td>38.71</td>
<td>(.11) (.22)</td>
</tr>
</tbody>
</table>

Table 13 shows that there was less use of development by 9 year olds who used the computer than those who did not use it.

Repetition

1. There was a significant difference attributable to the main effect of age in the repetition category between 9 and 11 years. ($t=2.43$, $df=38$, $p<.05$)
Table 14

<table>
<thead>
<tr>
<th>Age</th>
<th>9 years</th>
<th>11 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40.74</td>
<td>22.90</td>
</tr>
<tr>
<td></td>
<td>(.29)</td>
<td>(.16)</td>
</tr>
</tbody>
</table>

Table 14 shows that 9 year olds used more repetition than 11 year olds.

There were no significant differences in the main effect of gender in measures of repetition

Null Hypothesis  $H_{05(c)}$: That there will be no significant differences between 7 year olds, 9 year olds and 11 year olds in measures of repetition calculated as a portion of time spent on working processes was rejected.

Other null hypotheses in this category (i.e. 4(c), 6(c)) were accepted.
2. There was a significant 2-way interaction between age and computer use in the repetition category which was evidenced by differences between 9 year old computer users and non-computer users (t=3.33, df=18, p<.01).

Table 15

<table>
<thead>
<tr>
<th>Age</th>
<th>Computer Use</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9 years</td>
<td>58.01 (.23)</td>
<td>23.47 (.23)</td>
<td></td>
</tr>
</tbody>
</table>

Table 15 shows that there was a greater use of repetition by 9 year olds who used the computer.

Table 16 is a summary of the two sets of significant results for calculations based on (a) all the activities occurring in the ten minute working period, and (b) the "overt" working activities of exploration, development and repetition only. Significant results from the Kratus study appear in table 17 for the purposes of comparison.
Table 16

Summary of Significant Results for Process Evaluations

<table>
<thead>
<tr>
<th>Full Working Time</th>
<th>Category Variable</th>
<th>P</th>
<th>Working Processes Only</th>
<th>Category Variable</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>Computer use</td>
<td>&lt;.05</td>
<td>Development</td>
<td>Computer use</td>
<td>.051</td>
</tr>
<tr>
<td>Development</td>
<td>Age (7 years) x</td>
<td>&lt;.01</td>
<td>Development</td>
<td>Age (9 years) x</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>computer use</td>
<td></td>
<td></td>
<td>computer use</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>Age (9 years) x</td>
<td>&lt;.01</td>
<td>Repetition</td>
<td>Age (9 years)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>computer use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetition</td>
<td>Age (9 years) x</td>
<td>&lt;.01</td>
<td>Repetition</td>
<td>Age (9 years) x</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>computer use</td>
<td></td>
<td></td>
<td>computer use</td>
<td></td>
</tr>
<tr>
<td>Silence</td>
<td>Computer use</td>
<td>&lt;.05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 16 shows the slight shifts in significance that occurred in the two analyses. The two-way interaction between age (9 years) and computer use appeared in both analyses. The influence of the computer in this age group was evidenced in less use of development, and more use of repetition by those 9 year olds using the computer. The overall influence of age and computer use is apparent in both sets of results.

Table 17

Significant Results from Kratus' Study

<table>
<thead>
<tr>
<th>Full Working Time</th>
<th>Category</th>
<th>Variable</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>Age (7 years used more than 9 &amp; 11 years)</td>
<td>&lt;.05</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>Age (7 years used less than 9 &amp; 11 years)</td>
<td>&lt;.05</td>
<td></td>
</tr>
<tr>
<td>Repetition</td>
<td>Age (7 years used less than 11 years)</td>
<td>&lt;.05</td>
<td></td>
</tr>
</tbody>
</table>
Although the results in the Kratus study do not match in detail those of the present study, the overall influence of age is apparent in both.

5.3.4 *Sequential Time Analysis of the Compositional Process*

The following figures 7, 8, and 9 are a graphic representation of the way the subjects in each age group used their composition time. Each age group has a separate graph for computer users and non-computer users. The graphs illustrate a minute-by-minute account of how subjects divided each of the 10 minutes they were given between exploration, development, repetition, silence, computer playback (where appropriate), and early finishes. They show clearly that all of the activities were used throughout the working period. Although exploration dominated the first few minutes, all processes were used throughout the ten minute period. There was a dynamic pattern of behaviour in which the subjects moved freely between activities according to their progress in refining musical ideas.
Figure 7a  Time analysis of composition period, composite 7 year olds using computer.

Figure 7b  Time analysis of composition period, composite 7 year olds not using a computer.
Figure 7a depicts the pattern of activity employed by 7 year olds using computer. Figure 7b deals with the 7 year old non-computer users. There is a linear similarity between both graphs. All activities are present throughout most of the time, with occasional peaks and troughs.

In each group Exploration is the main activity at the beginning, and its use gradually decreases until it is almost non-existent by the 10th minute.

The use of development is greatest between the 4th to the 7th minutes in both groups, but the difference already noted between groups, in the amount of its use is seen clearly.

The amount of repetition gradually increases towards the end of the period in both cases.

There is a clear difference in the amount of silence, between computer and non-computer users.

The use of computer playback is minimal at the beginning and the end. Otherwise its use is distributed evenly, with a slight increase in the middle period.

Computer users tended to stay working for a few minutes longer than the other group. The sudden increase in early finishes at the end reflects the few seconds left after the subjects' final practice.
Figure 8a  Time analysis of composition period, composite 9 year olds using a computer

Figure 8b  Time analysis of composition period, composite 9 year olds not using a computer
Figure 8a depicts the pattern of activity employed by 9 year olds using computer. Figure 8b deals with the 9 year old non-computer users. There is a clear difference between the contours of these two graphs.

The use of exploration in Figure 8b is the main activity at the start, and gradually falls away to nothing at the end. In Figure 8a its use falls away sharply to 5% after the 7th minute.

There is an even more marked difference in the use of development in these graphs than in the previous age group. The non-computer users again focused on this activity during the middle period, and continued a little longer. The computer group used less development overall, with only a little development after the 5th minute. The decrease at the 5th minute coincides with an increase in exploration and computer use, until near the 7th minute where repetition increases.

Repetition is the dominant activity in Figure 8a especially after the 4th minute. In Figure 8b, its use peaks at the 7th minute, and overall this activity is used less by the non-computer users.

Silence is again more apparent in the computer groups. Overall there is less of this activity than in the previous age group. The younger children were more inclined to initiate conversation, and spend time in silence.

The use of computer playback follows the same pattern as the 7 year olds, but is used less.
Figure 9a  Time analysis of composition period, composite 11 year olds using a computer

Figure 9b  Time analysis of composition period, composite 11 year olds not using a computer.
Figure 9a depicts the pattern of activity employed by 11 year olds using computer. Figure 9b deals with the 11 year old non-computer users.

Exploration is again used more by group B with a steady reduction in use after the first minute. Its use in Figure 9a falls away more sharply, but not to the same extent as in the 9 year old group A.

The distribution of the use of development is even in Figure 9a, but figure 9b shows more peaks and troughs, with use concentrated at the 3rd, 4th and 8th minutes.

Both graphs show an increase in the use of repetition at the 5th minute, and use was fairly similar throughout. This age group used less repetition overall than the 7 and 9 year olds.

The same patterns of silence as before are again apparent here.

Computer playback was used a little less in this age group.

Figure 9b shows more early finishes than Figure 9a.
A Comparison with the Kratus Graphs.

For the purposes of comparison, reference should be made to Kratus (1989, pps. 13 & 14).

Owing to the computer factor, only the graphs of the 'b' group could be compared with graphs from the Kratus study. There is one obvious difference. In this study, the use of exploration follows much the same path for all age groups, with an initial use around 65%, gradually falling away to nothing by the end. This was true of the 11 year old group in the Kratus study, but the overall use of exploration by his subjects was higher for the 7 and 9 year olds than in the present study, with exploration remaining in use throughout the entire 10 minutes. It finished at the 60% level in the 7 year old group, and at 30% for the 9 year olds.

The proportion of time spent on development by Kratus' subjects was of necessity less than in the present study for 7 and 9 year olds, given the preponderance of exploration. However, the pattern of use was similar. It is interesting to note that the 11 year old subjects in Kratus' study also peaked with their use of development at the 3rd, 4th, and 8th minutes. Such a pattern of use is worthy of further investigation since it may reflect a consistent sequence of movement between compositional activities.

Kratus' subjects showed a greater use of repetition in the last two minutes of the 10 minute period than subjects in the present study. However this is offset by the early finishes
allowed in this case. Had the time for early finishes been transferred to repetition, the present study would have shown a similar expansion in the repetition figures.

The patterns for silence are very similar in distribution, and also in quantity, with the exception of the 7 year olds in the present study where the quantity was greater.

With the exception of the 7 and 9 year old discrepancy in exploration, the degree of congruence between the graphs generated by the studies is noteworthy. It is not only a matter of the quantity of use of each activity, but the visual evidence of similar patterns of movement between activities throughout the 10 minute period that is of great interest. The clear differences in use of exploration by the 7 and 9 year old groups suggests that factors other than just differences in the makeup of the groups must also have had an effect the subjects' use of this activity. These differences could be procedural, attributable to musical experience, or to other reasons. They are worthy of further investigation.
5.4 The Product

Analysis of the compositional products used data derived from evaluations by the panel of six judges of various musical and structural elements present in the final products. Rankings from each judge provided information that could be examined for the influence of gender, age, and computer use. These data were then linked to the process data in order to identify interactions between working methods and features of the products.

5.4.1 The Product Evaluations

In the Kratus study, two judges ranked two versions of the final product on their degree of replication, on a scale of 1-3. Subjects who received 3 from both judges, and those who received 1 from both judges were identified and profiles of gender and age compiled for each group. Analysis of their behaviour during the working time was then compared to the behaviour of all the subjects.

The evaluation of the musical products in the present study was expanded from the Kratus study, in order to examine a wider range of factors than just the ability to replicate. The nine factors included in the product evaluations in the present study also appraised musical and structural features.
The judging panel of six (3 males, 3 females) was selected for the quality of their musicianship, experience with teaching, and a diversity of musical experience.

The judges ranked each performance according to set criteria. In order to maintain a hierarchical progression in the rankings for each factor, items 1 and 2 in Musical Structure were collapsed to one rank considered less musical than item 3. Items 1 and 2 of Sense of Closure were similarly collapsed to one rank indicating the presence of a closing gesture.

Rankings from each judge for each of the nine product variables were added together to form a total score on each variable for every subject. For example: The highest ranking for replication was 3. It was possible for one subject to receive this score from all six judges. In that case the subject's score for replication would be 18. Scores for replication could range from 18 to the lowest possible score of 6 (a ranking of 1 from every judge).
5.4.2 *Tests for Significant Differences in Mean Ranks of Product Variables*

1. *Age*

The Kruskall-Wallis One-Way Anova was used to test all product variables for significant differences attributable to age. This non-parametric test is appropriate for ranked data when testing for difference between three populations of scores. (7 years, 9 years, and 11 years). The Mann-Whitney U test was used as a post hoc procedure to test for significance at the .05 level.

Table 18 shows results obtained from the Kruskall-Wallis One-Way Anova.
### Table 18

**Age Differences in Scores for Product Variables**

<table>
<thead>
<tr>
<th>Product variable</th>
<th>7 yrs</th>
<th>9 yrs</th>
<th>11 yrs</th>
<th>Chi-square</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>20.55</td>
<td>36.75</td>
<td>34.20</td>
<td>10.25</td>
<td>.01*</td>
</tr>
<tr>
<td>Musical appeal</td>
<td>20.30</td>
<td>35.35</td>
<td>35.85</td>
<td>10.40</td>
<td>.01*</td>
</tr>
<tr>
<td>Successive events</td>
<td>19.13</td>
<td>36.65</td>
<td>35.73</td>
<td>12.89</td>
<td>.00*</td>
</tr>
<tr>
<td>S'taneous events</td>
<td>29.32</td>
<td>33.32</td>
<td>28.85</td>
<td>0.99</td>
<td>.61</td>
</tr>
<tr>
<td>Musical structure</td>
<td>21.00</td>
<td>34.15</td>
<td>36.35</td>
<td>9.38</td>
<td>.01*</td>
</tr>
<tr>
<td>Sense of closure</td>
<td>28.80</td>
<td>31.63</td>
<td>31.07</td>
<td>0.32</td>
<td>.85</td>
</tr>
<tr>
<td>Rhythm patterns</td>
<td>21.53</td>
<td>33.25</td>
<td>36.73</td>
<td>8.80</td>
<td>.01*</td>
</tr>
<tr>
<td>Regular metre</td>
<td>20.68</td>
<td>33.03</td>
<td>37.80</td>
<td>10.61</td>
<td>.01*</td>
</tr>
<tr>
<td>Expression</td>
<td>20.63</td>
<td>35.70</td>
<td>35.18</td>
<td>10.44</td>
<td>.01*</td>
</tr>
</tbody>
</table>

*P<.05

Age was a significant influence on all variables except simultaneous events and sense of closure.

Table 19 shows the results of the Mann-Whitney U test used as a post hoc procedure for those product variables that were significant in Table 18.
Table 19

Post Hoc Procedures: Significant Differences in Scores for Product Variables Attributable to Age

<table>
<thead>
<tr>
<th>Product variable</th>
<th>Ages</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>7 yrs/9 yrs</td>
<td>-3.11</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-2.36</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Musical appeal</td>
<td>7 yrs/9 yrs</td>
<td>-2.78</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-2.79</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Successive events</td>
<td>7 yrs/9 yrs</td>
<td>-3.18</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-3.00</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Musical structure</td>
<td>7 yrs/9 yrs</td>
<td>-2.41</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-2.86</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Rhythm patterns</td>
<td>7 yrs/9 yrs</td>
<td>-2.22</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-2.74</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Regular metre</td>
<td>7 yrs/9 yrs</td>
<td>-2.38</td>
<td>&lt;.05</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-3.02</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Expression</td>
<td>7 yrs/9 yrs</td>
<td>-2.84</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>7 yrs/11 yrs</td>
<td>-2.73</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

In Table 19 post hoc tests revealed significant differences between 7 year olds and each of the higher age groups in measures of all product variables except simultaneous events and sense of closure. No significant differences were found between 9 and 11 year olds. It is obvious from these results that age, that is, the stage of development is a dominant factor influencing the nature of the musical product. However it should be noted that on the factors tested in this study, the significant period is between 7 and 9 years. This is probably due to the elementary level of the criteria used in this study.
Null hypotheses $H_0$: That there will be no significant differences between 7 year olds, 9 year olds, and 11 year olds in measures of

(a) ability to replicate
(b) musical appeal
(c) complexity of successive events
(e) musical structure
(g) presence of rhythmic patterns
(h) presence of regular metre
(i) presence of expression

were rejected.

Other null hypotheses in this group (i.e. 8[d] and 8[f]) were accepted.

2. **Gender and Computer Use**

The Mann-Whitney U test was used to test all product variables for significant differences attributable to gender and computer use. This non-parametric test is appropriate for ranked data when testing for difference between two populations of scores. (male/female, and computer/non-computer).
Table 20

**Differences Attributable to Gender and Computer Use in Scores For Product Variables**

<table>
<thead>
<tr>
<th>Product variable</th>
<th>Gender</th>
<th>Z</th>
<th>P</th>
<th>Computer use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Replication</td>
<td>27.65</td>
<td>33.35</td>
<td>-1.28</td>
<td>.19</td>
</tr>
<tr>
<td>Musical appeal</td>
<td>27.53</td>
<td>33.47</td>
<td>-1.33</td>
<td>.18</td>
</tr>
<tr>
<td>Successive events</td>
<td>28.87</td>
<td>32.13</td>
<td>-0.73</td>
<td>.47</td>
</tr>
<tr>
<td>S'taneous events</td>
<td>31.55</td>
<td>29.45</td>
<td>-0.52</td>
<td>.60</td>
</tr>
<tr>
<td>Musical structure</td>
<td>28.75</td>
<td>32.25</td>
<td>-0.79</td>
<td>.09</td>
</tr>
<tr>
<td>Sense of closure</td>
<td>26.80</td>
<td>34.20</td>
<td>-1.71</td>
<td>.08</td>
</tr>
<tr>
<td>Rhythm patterns</td>
<td>26.00</td>
<td>35.00</td>
<td>-2.05</td>
<td>.04*</td>
</tr>
<tr>
<td>Regular metre</td>
<td>28.43</td>
<td>32.57</td>
<td>-0.93</td>
<td>.35</td>
</tr>
<tr>
<td>Expression</td>
<td>28.23</td>
<td>32.77</td>
<td>-1.05</td>
<td>.29</td>
</tr>
</tbody>
</table>

|                        | Z   | P  |            |                |    |
|------------------------|-----|----|------------|----------------|
|                         | 32.77 | 32.53 | 32.15 | 29.70 | 33.47 | 35.28 | 32.25 | 30.70 | 32.50 |
|                         | -1.02 | -0.91 | -0.74 | -0.40 | -1.34 | -2.22 | -0.80 | -0.09 | -0.92 |
|                         | .30  | .36  | .46       | .69           | .18 |

Table 20 shows that with the exception of simultaneous events, females had higher mean ranks on all product variables. However, females scored significantly higher than males in measures of rhythm patterns.

The null hypothesis $H_0\ 7(g)$: That there will be no significant differences between males and females in measures of presence of rhythmic patterns was rejected.
All other null hypotheses in group 7 were accepted. With the exception of simultaneous events, computer users had higher mean ranks than non-computer users on all variables. In measures of sense of closure, computers users scored significantly higher than non-computer users. The fact that simultaneous events had a different pattern of scores from all the other variables is worthy of further investigation.

The null hypothesis $H_09(f)$: That there will be no significant differences between computer users and non-computer users in measures of sense of closure was rejected.

All other null hypotheses in group 9 were accepted.

**Links Between Product Variables**

In order to discover the degree of similarity between scores on the first three product variables, their Spearman correlation coefficients were examined. The purpose of this exercise was to look for links between the ability to replicate, musical quality and musical complexity. Table 21 depicts significant correlations between replication, musical appeal, and successive events.

<table>
<thead>
<tr>
<th>Table 21</th>
<th>Significant Correlation Coefficients for Product Variables</th>
</tr>
</thead>
</table>
| Musical appeal | .4874  
(p=.000)  |
| Successive events | .4490  
(p=.000)  | .7821  
(p=.000)  |
| Replication | Musical appeal |

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Table 21 shows that there is a high correlation between scores for musical appeal and successive events. This relates the degree of musical complexity to musical quality. The relationship between the ability to replicate and these factors is not as strong.

5.5 Interactions

To identify interactions between use of the working processes and the main product variables, groups of high and low scorers in Replication, Musical Appeal and Successive Events were identified. The groups were selected by identifying cut-off scores which reflected the highest degree of agreement between the six judges. The scores for each variable were as follows:

Replication
  Range: 6-18
  High group: >16; Low group: <13

Musical Appeal
  Range: 6-18
  High group: >13; Low group: <10
  (Scores on this variable were lower overall than those for replication.)

Successive Events
  Range: 6-24
  High group: >18; Low group: <12

Profiles of each group are shown in tables 22 and 23.
Table 22

Profiles of High Scorers on Product Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
<th>N</th>
<th>Gender</th>
<th>Age</th>
<th>Computer use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M  F</td>
<td>7  9 11</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Replication</td>
<td>&gt;16</td>
<td>20</td>
<td>10 10</td>
<td>4 9 7</td>
<td>12   8</td>
</tr>
<tr>
<td>Musical appeal</td>
<td>&gt;13</td>
<td>11</td>
<td>2   9</td>
<td>1 5 5</td>
<td>6    5</td>
</tr>
<tr>
<td>Successive events</td>
<td>&gt;18</td>
<td>11</td>
<td>4   7</td>
<td>1 4 6</td>
<td>7    5</td>
</tr>
</tbody>
</table>

Table 22 shows that gender representation was equal for replication. There were more females than males in the musical appeal and successive events groups.

Nine year olds were the most successful age group in replication. Seven year olds had the lowest representation in each case.

There was a higher representation of computer users compared to non-computer users in all cases.

Table 23

Profiles of Low Scorers on Product Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
<th>N</th>
<th>Gender</th>
<th>Age</th>
<th>Computer use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>M  F</td>
<td>7  9 11</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Replication</td>
<td>&lt;13</td>
<td>13</td>
<td>9   4</td>
<td>10 0 3</td>
<td>4    9</td>
</tr>
<tr>
<td>Musical appeal</td>
<td>&lt;10</td>
<td>19</td>
<td>10 9</td>
<td>11 4 4</td>
<td>8    11</td>
</tr>
<tr>
<td>Successive events</td>
<td>&lt;12</td>
<td>10</td>
<td>4   6</td>
<td>8 1 1</td>
<td>5    5</td>
</tr>
</tbody>
</table>
Table 23 shows that males outnumbered females in each case.

Seven year olds had a much higher representation than the other age groups in all cases. There were no nine year olds in the replication group.

There was a higher representation of non-computer users in each case.

A series of two-tailed t-tests on the use of the three working processes, exploration, development and repetition, was undertaken for each musical product. Table 24 indicates that significant differences between the two groups were obtained for each product variable.
The low scoring groups used more exploration and less repetition. In the high scoring groups, the opposite was true.

The results for replication in the Kratus study found the same relationships, but the differences between the use of exploration and repetition were greater between high and low scoring groups.
Figures 10 and 11 depict graphically the high and low scoring groups' use of the working processes. A comparison is made between the replication and musical appeal groups. (Figures for the musical appeal and successive events groups were similar) These two examples are sufficient to illustrate the contrasting behaviour of the two levels of achievement.
Figure 10a  Time analysis of composition period, Replication Scores >16

Figure 10b  Time analysis of composition period, Replication Scores <14
Figure 10a (replication >16) shows a steady decline to 2% in the use of exploration after an initial use of 70%. Use of development is constant throughout. The substantial use of repetition is apparent.

Figure 10b (replication <14) shows the far greater use of exploration and development than repetition. Their combined use began at 99%, and was around 60%, even at the ninth minute.
Figure 11a  Time analysis of composition period, Musical Appeal Scores >13

Figure 11b  Time analysis of composition period, Musical Appeal Scores <10
Figure 11a (musical appeal >13) has more jagged contours than figure 10a (replication >16). Although exploration and development decline in a similar fashion to the high replication scorers, there are more exaggerated rises and falls. There is also a greater use of development in the musical appeal group.

Figure 11b (musical appeal <10) has smoother contours than figure 11a. Use of development is apparent through to the end.

Both of the low scoring graphs show the subjects' inability to move out of exploration and development into repetition.

The Kratus graphs (Kratus, 1989, p. 16) referred to high and low scores on replication only. The low scorers had an extremely high use of exploration ranging from 88% at the beginning to 70% at the end. There was an even use of development throughout, and very little repetition. High scorers moved away from exploration very quickly, after beginning at 55%. Kratus' graph was notable for the marked increase in the use of repetition as the working time proceeded, ending at about 68%.

The Kratus graphs for high and low scorers have again illustrated the differences between the two studies in the amount of time spent subjects spent on exploration and repetition.
There are two consistent threads running through the results of this study. The influences of age and computer use, individually and in 2-way interactions, are evident in both the process and the product data. Several other interesting, but less pervasive influences also emerged to fill out the picture of effects and interactions. The data have clearly shown the presence of links between specific elements of each stage of the composition process.
Chapter 6

DISCUSSION AND CONCLUSIONS
Chapter 6

DISCUSSION AND CONCLUSIONS

Chapter 6 reviews the study, initially dealing with the research design to evaluate its appropriateness, ease of implementation, and effectiveness in generating useful data. Discussion of the results includes an interpretation of the various interactions within and between the process and product variables. Throughout, comparisons are drawn between the Kratus study and the present study. The final section deals with conclusions that have been made from the findings of the study, and suggestions for future directions of research in this field.
6.1 The Research Design

6.1.1 Introduction

The research design proved to be useful and functional in providing empirical data that allowed considerable detailed statistical analysis. In this area of musical endeavour where there can be a wide disparity in behaviour, and which has a complex web of interactions and influences, the value of ethnographical research is not disputed. However, this study has attempted to collect data in a situation that simulated "natural" behaviour, but was controlled to the extent that reliable data was obtained which could reveal relationships not easily perceived in a more descriptive research context. The realistic enactment of the compositional process was constrained by few task limitations. The subjects were able to work freely and generate their own musical material without the influence of language, imagery or subject matter foreign to them.

The Kratus study as a model was invaluable in setting out a clear direction, particularly in addressing the intricacies of changing compositional activities over a period of time. By replicating Kratus' study as closely as possible, not only was useful data obtained, but comparisons were made between results in both studies. Thus, areas of similarity between the studies served to strengthen the results, and, where there was disparity, the search
for possible reasons highlighted the vulnerability of certain aspects of the study to a range of volatile influences.

The major difference between the two studies was the use of the computer by half of the subjects in the present study. Its introduction was achieved within the framework of the original study, and did not essentially change the composition focus. In fact, it was most important to establish measures of the non-computer, more traditional approach as a benchmark, a source of comparison. Throughout the course of the study circumstances prompted some other variations and extensions (e.g. the inclusion of early finishes, and the additional product variables dealing with musical structure and quality) to be made to the Kratus procedures. These did not change the nature of the study, nor did they affect the validity of data analysis. They were introduced in response to behaviour of the subjects, which was judged to be reasonable and natural within the composition context, and therefore worthy of investigation. In fact, these elements added extra dimensions to the data analysis and served to qualify some of the previous findings.
6.1.2 Sampling

The age groups selected were appropriate. The range covered a period in which research has shown that considerable developmental changes in musical perception and cognition occur (Zimmerman, 1986). The most substantial and consistent statistical differences in behaviour and achievement were found to be attributable to age. The grouping of subjects into age clusters of 7, 9, and 11 years, rather than having a continuous spread, served to concentrate the effects of age difference, providing for clear-cut comparisons.

Equal gender representation emerged as an increasingly important factor as the study progressed. Kratus had found little of significance that could be attributed to gender differences. However, the additional components in the product variables particularly, and some interactions with computer use, uncovered areas of discrepancy between male and female results. These differences will be discussed in detail later in the chapter.

Controlling for musical experience is an area of notorious difficulty in music research. Control in this study was partially achieved by using subjects who had no previous keyboard tuition. This eliminated variations in technical fluency and exposure to repertoire that might have influenced the content of the compositions. It was apparent during the working sessions that the
element of being able to play what was intended was a source of difficulty for many, so it was important that some uniformity of keyboard experience was achieved. Kratus, in his study, also excluded students who had a keyboard at home. However, given the rapid development of relatively inexpensive compact keyboard instruments in recent years, and their proliferation in homes, the classroom and after-school care, it was not practical to control for casual contact in the present study.

Other influences such as experience on another instrument or membership of musical ensembles, such as choir or band, were not considered in either study. Influences of home or social environment were also ignored, even though their possible effects are acknowledged. To take account of so many factors in the selection of subjects would require a study on its own, and is far beyond the scope of this thesis.

It was therefore considered that the specifications of the sample population were acceptable for a study dealing with students at a "beginner" level of musical composition.

Other criteria set down in the Kratus study were followed: the type of school and its music program were similar. Any major differences in results could be accounted for by acknowledging the essentially individual nature of musical creativity, and by accepting that differences attributable to the cultural and social environment are inevitable. Results in this area of research will attain
recognition over time, when consistent patterns begin to emerge from numerous studies in a variety of settings. This study contributes to that process.

Within the designated school population, selection of subjects and allocation to groups followed random procedures, either by drawing names "from a hat", or by utilizing tables of random numbers. The subjects can therefore be accepted as representative of the full range of students in the specified age groups attending the school.
6.1.3 *Procedures*

After the initial trials carried out in the pilot study, the working sessions with the subjects in the main study proceeded smoothly. The time allocation was adequate, and the same procedure was used with each child. Nevertheless, there were occasional variations due to individual personalities. Some children were "chatty", and initiated conversation; others looked for reassurance and encouragement. In an effort to maintain a pleasant relaxed atmosphere, such situations required sensitive handling to keep the children on task.

Some of the children, particularly the younger ones, spent much of their time wandering over the keyboard. It was only when they were reminded that there were two minutes to go that they started to try and decide on something definite. Others had some good ideas early on, but were not able to develop or remember them, and went on to other ideas that were not as effective. The seven year olds often did not have any notion of an appropriate length that could be remembered. All of this suggests that the development of the short term musical memory is essential to effective compositional strategies. There is also the possibility that the computer could compensate in this regard.

Designation of the starting note often made it a point of reference for different patterns emanating from it. For many of the children
the difficulty of remembering musical material was overcome by working in mathematically based or spatial patterns. Scallic patterns, contrary motion, and ever expanding intervals from a set note were common strategies.

Children quite often had a little tune perfected and then did not do so well in the final performance. Physical difficulties in performance were also the cause of problems in replicating. In fact, as the working period progressed, it was apparent that in many cases, creative thinking was set aside and replaced by such practical concerns as finding some sequence of notes that could first, be remembered, and secondly, played accurately. To a degree this study was about performance almost as much as it was composition.

Students who approached the task musically, and had adequate memory skills (more often the older ones) worked logically and artistically to refine their ideas to a point where they could play accurately what they intended, and displayed some satisfaction with the artistic result. They were also the ones who made most effective use of the computer, listening to what was played back and making adjustments. Other students did not appear to learn anything from what they heard on the computer and just went on trying something new. However, it was obvious over the days of testing that the computer did have the effect of focusing attention on the need to produce something, and students did respond to
hearing their work, even if the response was nothing more than an expression of the "like/dislike" order.

The addition of computer use and analysis of the associated data were achieved within the framework of the Kratus study. The simplicity of operation and the subjects' general familiarity with computers facilitated this aspect. Most subjects used the computer between three to five times throughout the 10 minute session. It was often a source of pleasure and excitement for the children to hear their music played back, but at the time it did not appear that many of them made constructive use of what they had heard. It often seemed as though the process of playing something and hearing it, complete with stumbles and mistakes, was an end in itself. Subsequently, the pervasiveness of the computer factor in the results was unexpected.

The matter of early finishes was discussed in chapter 4. The decision to allow the subjects to record early if they were sure they were ready caused no difficulties in the data analysis. In fact it became obvious as the analysis proceeded that to have insisted on continued playing for the full time would have seriously affected the results. It would have not only increased the total time allocated to other procedures (probably repetition), but would also have affected the pattern of use over time in the latter stages of the 10 minute working period. That Kratus did not mention this fact is a source of puzzlement. The nature of the task was such that several of the older capable children particularly, completed the task quickly, and
a few worked out more than one piece. Even those who worked right through came to a point where they were anxious to record, even a few seconds early, because they wanted to capture their work immediately. Other children found the task rather difficult and not very rewarding, and were relieved when they succeeded in finding something suitable. They had no wish to prolong the session beyond that point.

The effort to maintain equality of time available to all subjects in such a study should be tempered with a realisation that people work at different paces. To insist on complete uniformity does not necessarily produce the equality intended, because the time is not always being used productively, and is likely to cause confusion and aimless repetition. Such action would distort the results.

The Cubase program used in the study is a very powerful and sophisticated software package used by many musicians in the commercial field. Its capabilities are far in excess of what children of primary school age could utilize, but it has the advantage of a high degree of "friendliness". Its screen layout is clear and uncluttered and it shows the successful recording of some music on a track by the appearance of a horizontal bar, with a cursor moving along in time during playback. Less powerful software is procurable, but it is not always as straightforward in operation. The availability of the Cubase package, and its proven ease of use with students in other situations made it an obvious choice.
6.1.4 Data Collection

1. Process Evaluations

The division of compositional activities into exploration, development, repetition and silence, (also used by Kratus) proved to be appropriate to the composition process, and valid for the purposes of analysis. The addition of computer playback and early finish in this study was accommodated without affecting the basic organisation of the study. Because there was equal representation of computer and non-computer users in all subgroups, data analysis could be carried out on the same basis as the Kratus study. Computer and non-computer groups were separated for the purpose of comparison in graphs of the minute by minute time analyses.

In order to compare the means for the composition processes between the two groups, a second analysis of the data took into account exploration, development, and repetition only. This caused a slight shift in significance in the second analysis of variance, but it served to highlight the main differences between groups. This set of data became very useful when the high and low scorers on the product variables were isolated. Because these groups consisted of unequal numbers of computer and non-computer users, the "working process only" data allowed a valid analysis of working behaviour to be made. There were no contaminating effects from silence, computer playback or early finishes.
Analysis of the taped material in five-second blocks of activity was difficult and demanding. The description of difference between exploration and development and, to a lesser extent, repetition, could benefit from more specific definition. Repetitive patterns that differed in pitch or direction, or were extensions of previous material were often difficult to categorise.

In addition to the problem of definition, making "split second" decisions within a five-second time frame while the tape continued to play required intense concentration. To check on areas of uncertainty required the tape to be started again, as it was not possible to identify the beginning of each five-second interval "mid stream". There was a steep "learning curve" in carrying out this process, however, and on the occasions when a tape needed repetition, it was gratifying to find the high level of similarity in judgement on the second occasion. The evaluation of the compositional activities for each subject was therefore an arduous and time consuming task. The external judges also found this to be so. Despite the difficulties, both the Kratus study and the present study achieved a satisfactory level of agreement to allow the researcher's data to be used for analysis.

2. Product Evaluations

The present study expanded this section of the Kratus model. The more subjective nature of some of the product variables made it imperative that a larger panel of judges be used. In view of the
consideration given to gender differences in the study, equal gender representation on the panel was desirable. Given the frequent incidence of higher female scores in the present study, equal representation on the judging panel assumed even more importance. The varied musical backgrounds of the members of the judging panel also served to strengthen the validity of the product evaluation data, representing points of view from educators, composers, and practising musicians.

The replication factor employed the same criteria as the Kratus study. Criteria for the other variables were derived from highly respected research into children's use of musical elements and structures, typical for the ages included in the study. They dealt with the elementary stages of development, and the data they generated supported the approximate ages generally accepted for these levels. The language of the criteria was simple, and in several cases only identified the presence or absence of certain musical elements.

The judges found the evaluation task a relatively simple and pleasant one, despite the primitive nature of most of the musical products. Although the evaluation criteria were apparently straightforward, it was obvious that there were different approaches between the judges. Those who were experienced in dealing with young children in an education context, appeared to be more inclined to judge on what they perceived as the child's intentions, despite some inability to carry out these intentions in practice.
Their interpretation of what are rhythm patterns and "regular" metre was coloured somewhat by their experience of young children's primitive explorations in these areas. The composers were attracted by originality and flair. The performing musicians were more "matter-of-fact" in identifying the presence of the various elements. However, despite the variety in their comments and in their approaches to the task, the attitudes of the judges were more a matter of style than of differing judgements. Their scores in combination yielded useful data that was linked effectively with the process data.
6.1.5 **Reliability and Internal Validity**

The difficulties associated with the collection of reliable data in studies dealing with creative processes in music are universally acknowledged and well documented (Kratus, 1989). The difficulties encountered in this study have been described. Nevertheless there emerged a high degree of consistency in the interactions of the two sets of data (process and product evaluations) that were derived from the evaluations of two different sets of judges. Although there was variation in the membership of the various high scoring groups in the product variables, the interactions with the process variables were logical, and showed similar patterns of behaviour. That the results also supported other research findings, particularly those that related to child development in music, is another indicator of internal validity.

6.2 **Interpretation of Results**

In Chapter 5, the detailed results of each section of the study have produced interesting data on the whole composition process. All of these pieces of information contribute to an overview of the sequence of events. At this stage it is important to relate the items of data so that the interactions and connecting threads are perceived.
6.2.1 Relationships Between the Working Processes

One of the most useful features of the study is the light it throws on the process itself. It is clear from an examination of the data and graphs that there are three distinct activities that occur during composition: exploration, development and repetition. Both the Kratus and the present study produced similar patterns of behaviour in their subjects -- a predominance of exploration at the beginning, then moving on to development, which reached its peak in the middle stages, and a concentration on repetition in the final stages. However, these activities were not pursued in discrete clearly defined stages. All of the processes appeared throughout the working period, and they intermingled, even if one tended to predominate at any time.

It should be pointed out that repetition was not only related to the music contained in the final version. In the earlier stages it grew out of musical ideas that were developed to a point where they could be repeated. Occasionally the early music was retained and used at the end, but more often it was either completely discarded, and further exploration undertaken, or the subject went back to develop it in some different way. The period when repetition was directly related to the final product was generally in the last two or three minutes when the subject was preparing for the final performances on tape.
Cases where subjects decided on their final version quickly, and then spent their time on practice and repetition were rare. These were more likely to be the students who finished early, as they became bored with playing the same tune over many times. Most of the subjects explored and developed many different melodies, and experimented with a variety of material and effects. Some did go back to an early idea, but others who tried could not remember. Most were content to use the material that had evolved, or they had worked out by trial and error over seven or eight minutes.

The interpretation of these patterns of activity is not a clear cut exercise, and cannot be undertaken without reference to the product. In Kratus' study, only the ability to replicate was evaluated in the product, and there was a clear link shown between more repetition and less exploration during the process, and replication of the product. Kratus concluded that "learning to compose a replicable song requires an understanding of the importance of repetition of musical ideas and a product orientation to the act of composition." (Kratus, 1989, p.18). This may be true, but it appears to be a rather superficial interpretation of the way that the children used repetition. To refer to students who used more repetition as "product oriented" implies that repetition is an expression of convergent thinking, leading to closure. This would be true of the final period, but certainly not so earlier on.

The analysis of the interactions between the process activities and product variables in the present study supports the Kratus data
with regard to replication and repetition. However the musical appeal and successive events factors were also significantly linked to repetition. Therefore repetition must have a role that extends beyond the necessity to repeat something often enough to be able to replicate in performance.

The product variable musical appeal refers to musical quality, the successive events variable to a level of complexity. The varying proportions of time spent on the compositional activities are the obvious key to success. But to simply state that success rests on "an understanding of the importance of repetition" ignores the intermingling of the activities and their relationship to each other. It may be more correct to say that less successful subjects were not readily able to move beyond the development stage. So the problem may not be a lack of understanding of the importance of repetition, but rather an inability to refine and clarify ideas to a point where they could be recognised as a musical entity that lent itself to repetition. The behaviour of subjects in the present study tended to support this view. The less able students spent considerable time wandering over the keyboard without any notion of employing elements of musical shape or pattern.

In order to understand fully the significance of the relationship between the compositional activities, a detailed analysis of the content would be required, noting the treatment of different musical strands, and tracking their progress throughout the working period. Although the relationships observed in the two
studies are a valuable insight into the composition processes, caution should be exerted in assuming their function in relation to aspects of the product until more detailed information about their content is obtained.

6.2.2 *The Influence of the Computer*

Although the children enjoyed using the computer during their working sessions, there were few occasions when they appeared to listen to the playback for the purpose of making adjustments to their music. Those who overtly did so were the more capable students, whose memory and skills were at a high level. Nevertheless, computer use consistently appeared as a factor associated with higher scoring on the product variables. It was also related to development and repetition, especially in two-way interactions with age.

Again, without more detailed knowledge of its effects on the users, it is difficult to find reasons for its influence, but it appeared to give the children an opportunity to be still, and to hear what they had played. The computer assisted them to focus on the realisation of a product, whereas the non-computer users were more inclined to explore aimlessly for longer periods.

One clue to its possible function is that computer users had significantly lower scores for development and higher for
repetition. This does not necessarily mean that development was a process less used by the computer group. The graphs show that the incidence of computer use follows the same pattern as development (i.e. very little at the beginning, increasing during the middle period, and easing off at the end). Computer use could be another medium for development, listening and evaluating without having to play. The results could be interpreted as suggesting that this type of listening, focusing on what is heard without the distraction of performance, could be a more efficient method of moving through the development process and on to repetition.

Seven and nine year-old computer users made significantly less use of development, and the nine year-old computer users had extremely high scores on repetition. Reasons for the absence of a difference due to computer use by the eleven year-olds are not clear. A possible explanation could be that their level of development provided them with the skills required to evaluate and refine their work, without the need of outside assistance. In the case of the younger children, the computer may have acted as a facilitator for evaluation and refinement, - skills not normally present in children of that age.

It was interesting to note that computer use was the only significant influence in the "sense of closure" product variable. Without further evidence one can only surmise that the act of listening to the playback heightened an awareness of the need for such a feature in the composition.
Although the non-parametric tests used were not able to show higher level interactions between the variables, the pervasive influence of computer use is evident in the profiles of high and low scorers in the three product variables: replication, musical appeal, and successive events. In each case, computer users outnumbered non-computer users in the high scoring group, and the opposite was true in the low scoring group.

6.2.3 **The Effects of Age.**

Age emerged as a consistently strong factor in all areas of the study. There were definite patterns of behaviour and levels of achievement within the three age groups.

1. **Seven year-olds**

In their use of the compositional processes, seven year-old spent more time on exploration and less on development than the other age groups. Kratus' study found a similar relationship. However they used more repetition than the eleven year olds, and this is a contradiction of the Kratus findings. There is no obvious reason for this disparity. There can only be conjecture regarding the different nature of the two groups used in the studies, or the possibility of the older children's greater capability of abstract thought.
The mean ranks for the product variables show that seven year olds scored lower than other age groups on all factors. With the exception of simultaneous events and sense of closure, these differences were all significant at the .05 level. No such differences emerged between the 9 and 11 year age groups, indicating that with respect to this research group, the critical period of development for these factors occurs between 7 and 9 years.

The lower level criteria for successive events, musical structure, rhythmic patterns, regular metre and expression were all derived from the "manipulative" and "personal expression" stages of the Swanwick/Tillman (1986) developmental spiral, and are said to occur approximately between the ages of four to six years. The higher level criteria belong to the "vernacular" and "speculative" stages of the spiral, in evidence from approximately six to eight years. Given the "beginner" status of the subjects in this study, their results can be considered to match the Swanwick/Tillman stages of development for that age level.

It should be noted that the two product variables that did not produce significant results attributable to age (i.e. simultaneous events and sense of closure) were not derived from a developmental model. These items are features identified in Serafine's structural analysis of music (Serafine, 1988). It may also be that the criteria used are not hierarchical in the same sense as the specifically developmental factors. Other structural items relating to sequencing and patterning were significantly affected by
age, probably because of the cognitive element involved in sequencing material in a musical manner.

2. *Nine year-olds*

This age group figured prominently in the results related to repetition and replication. Their significantly higher scores for repetition than 11 year olds were attributable almost entirely to computer use. Similarly, in the profiles of high scorers on replication, they outnumbered each of the other age groups. In line with other results related to computer use, this age group displayed significantly less development time than either of the others.

The effect of the high repetition scores only followed through to replication. They were similar to eleven year olds in musical appeal, and although the means for successive events were similar, they had less representation in the high scoring group. In all of the other developmental variables (except expression), their scores were lower. This is an interesting deviation from the results of the Kratus study in which the repetition/replication scores implied a strong developmental factor between each of the three age groups. The only differing factor in the two studies which appears to be relevant, is the computer. The significant interaction in this study between 9 year olds and computer use would seem to indicate that this is the source of difference in results.
3. **Eleven year-olds**

In a discussion of the results, the music specialist from the school used in the study, indicated that the eleven year old group was recognised throughout the school as being less able in most areas. There was a higher than normal incidence of children with learning problems, and the attitude of the group to music was particularly negative. This could be a reason for the small difference in most areas of the study between the 9 and 11 year groups. It could also be a fact that the elements measured in this study were such that the main developmental effects were in evidence between the 7 and 9 year olds. Nevertheless, one could still expect a stronger showing on the complex musical appeal and successive events variables. Further studies are needed to clarify the answers to this question.

6.2.4 **Gender Effects**

Results of the present study agreed with those of the Kratus study, in which no significant differences due to gender were found in the analysis of process evaluations. The results of product evaluations showed that females scored significantly higher on measures of rhythmic patterns. There was equality of representation in the high scoring group in replication, but males outnumbered females in the low scoring group by 9:4.
The greatest contrast occurred in the musical appeal variable. The ratio of males to females in the high scoring group was 2:9. In successive events it was 4:7. Although such differences are not reflected in "use of time" measurements of the process variables, females obviously worked more effectively. This again highlights the need for content analysis of the working procedures.

6.3 Summary and Recommendations

The significance of this study lies in manner in which it has drawn together several strands of inquiry in the field of musical composition in children. It has been particularly effective in drawing out evidence of interaction between the variables used. Although reasons for some of the effects were not always apparent, the fact that such effects have been identified provides an impetus for further research. The exploratory aspects of the study used previous research in the area as a starting point, and the findings of some of them, particularly those related to a developmental sequence of stages in composition, were confirmed. The influence of the computer, evidenced in the results, was observed within the framework of previous research. Thus there was a reference point for any comparisons that were made.

Both the procedures and the results obtained from this study have presented many unresolved issues. This reflects the fact that the area under investigation includes two elements about which little is
known: (a) the processes used by children in composing music, and (b) the impact of computer use on this activity. There are many aspects that require further research. Those related to this study are listed below.

1. The individual nature of musical composition is vulnerable to environmental influences. Differences in results are almost inevitable when such studies as this are reproduced in different contexts. More studies must be carried out before consistent patterns of data are identified. In this way, a clearer understanding of the effect of various influences will emerge.

2. There is a need to systematically conduct similar studies in the higher age groups, in order to complete the sequence of child development and confirm the sequential levels that others have identified. The effects of the computer factor also need extended investigation into the higher age groups.

3. Control for musical experience continues to pose difficulties. Studies using older subjects will have greater problems in this area, as will studies that deal with more advanced concepts, using children with higher level skills. Continued refinement of procedures is needed to specifically control and focus on the influences of training and experience.

4. The interest in understanding the implication of gender differences in creative music is a comparatively recent
phenomenon. Gender was not a significant influence in the process, nor did it show overall significance in the product variables. However the predominance of females in the high scoring group, particularly in measures of musical appeal, invites further investigation.

5. The function of the short term musical memory, particularly in younger children, is an important area of possible future research. It is of special interest because the computer may well compensate, or provide support by capturing fleeting ideas, making it possible for children to return to them if desired.

6. Difficulties experienced by the subjects in playing their music was often a source of frustration because they were not able to reproduce what was a clear artistic intention. The necessity to replicate often became a major concern that outweighed artistic considerations. Research that can help to remove such constraints will facilitate greater understanding of the creative intentions.

7. The obvious pleasure derived by the subjects in the interaction with the computer was not always associated with constructive or productive activity. It was more in the realm of "play" - the fun of doing something, even with mistakes, and having it immediately playback. This type of play has great educational potential. The recognition of "cause and effect" is a most useful learning procedure. Through immediate feedback, children relate their action to the outcome.
8. The pervasiveness of the computer factor in the high scoring group on the product variables could indicate the computer's influence on musical cognitive processing. Further research should specifically address the validity and extent of this possibility.

9. The differences in working style, indicated by the differing periods of time required by the subjects to complete the task, is a factor that must be acknowledged and accommodated in future research. To be relevant, such research should aim to reflect "real life" as much as possible.

10. In both the Kratus and the present studies, the activity of development in the process evaluations emerged as the most difficult to achieve consistency and agreement between judges. This was probably due to a lack of clarity in the definition of "same" and "different" in that activity. In addition, the operational difficulty of making subtle judgements was highlighted in this area of greatest ambiguity. Future studies of this type could record all compositional periods by the subjects' playing via MIDI on to computer. This would capture the recorded sound, and transform it into notation for use if necessary for detailed analysis. It would also allow exact measurement of time blocks with the capability of re-examining material at will. The availability of a notated score would facilitate analysis and categorisation. Such a procedure would be of great benefit, as the validity of the whole study rests upon this data.
11. Items such as "successive events" and "musical structure" require further development to achieve more clarity, and remove any likelihood of differing interpretation. They could also be extended to devise different sets of criteria for a range of levels. These elements of musical construction require complex intellectual and perceptual processing, and there is not yet the same background of research in relation to them, as the use by children of the basic elements of rhythm and melody, and stylistic expression.

12. The issue of the constituency of the judging panel drew attention to the influence of other factors in the varying backgrounds of the judges. Although the topic was outside the realm of this thesis, it is an area where further study is desirable. With the refinement of effective, descriptive criteria for the assessment of composition, greater control is possible in exploring patterns of assessment behaviour, and relating them to other specific factors in the musical background of judges. Given that evaluation of the more subjective aspects of music is notorious for its inconsistency, such information would be most valuable.

The issues that have arisen from this study are many and varied. In order to exploit the great potential of the computer as an interactive medium for creative expression, a great deal more needs to be known about its effects on the creative process. Music practice is moving into a new era, one that will establish new ways of thinking about music. Such a situation demands that music
education keeps pace with new developments, and promotes an open attitude towards the demands for a fundamental shift in teaching approaches.
BIBLIOGRAPHY
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## Process Evaluation Chart

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Appendix 2

Descriptive Criteria for Product Evaluations

1. Replication
   3. Both versions the same or almost the same. (Maybe 1 or 2 notes out.)
   2. Some sections the same.
   1. None or almost none the same.

2. Musical Appeal (General impression)
   3. Good
   2. Average
   1. Poor

3. Successive Events
   1. Rambling, unstructured.
   2. One basic idea or motif.
   3. Two or more motifs in succession.
   4. Patterning such as repetition or alternation of basic motifs.

4. Simultaneous Events
   0. Single note melody only.
   1. Chords or clusters.
   2. Combination of melodic events.

5. Musical Structure
   1. Structure of melody depends only on working through patterns such as scales, intervals, glissandi
      OR patterns based on the structure of the keyboard.
   2. Motifs sequenced without regard for musical flow.
   3. Ideas phrased or grouped in musically coherent units.

6. Sense of Closure
   0. No sense of finality.
   1. Ending implies a final cadence.
   2. Some other musical gesture indicating finality

7. Rhythmic Patterns.
   ✓ Some rhythmic elements present.

8. Regular Metre
   ✓ Regular metre present.

9. Expression
   ✓ Presence of expressive devices such as variation in dynamics, speed.
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