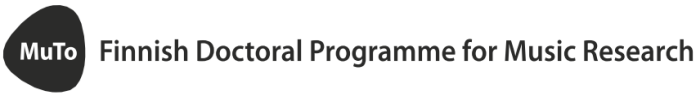
Perceptual Learning Style as an Influence on the Practising of Instrument Students in Higher Music Education

Albi Odendaal

Sibelius Academy of the
University of the Arts, Helsinki

Studia Musica 56



Sibelius Academy of the University of the Arts, Helsinki
Department of Music Education, Jazz and Folk Music
Studia Musica 56

Printed in Cape Town, South Africa
www.printondemand.co.za

Initial layout and typesetting done with OpenOffice.org 3 by Oracle.
Gratitude is expressed to the developers and opensource community.

Abstract

Odendaal, Albi (2013). *Perceptual Learning Style as an Influence on the Practising of Instrument Students in Higher Music Education.* Sibelius Academy of the University of the Arts, Helsinki. Department of Music Education, Jazz and Folk Music. Studia Musica 56. Doctoral Dissertation. 138 pages.

This thesis reports an investigation of the applicability of the theory of perceptual learning style to the practising of Western Classical instrument students in higher music education. Perceptual learning style claims that it is possible to differentiate between individuals on the basis of their preference for gathering information through one of three sensory modality channels: visual, auditory or kinaesthetic. The application of these claims to musical learning is shown to be problematic through two studies that are described in the thesis.

The first study used a researcher-designed questionnaire on practising strategy selection to investigate whether patterns that emerge from the self-report of students in the Sibelius Academy conform to the claims of perceptual learning style theory. The questionnaire was based on claims by authors who argue for the application of perceptual learning style to musical learning. A principal components analysis showed that perceptual learning style was not underlying the variation observed in the questionnaire. A cluster analysis further showed that individuals do not show similar preferences for specific modalities in differing situations, and groups of individuals who answer similarly for one situation do not do so in others. The questionnaire therefore does not support the claim that perceptual learning style is a major influence on the strategy selection of this sample. Instead, the possibility that instrument groups have an influence on the variety observed was noted, as was the possibility of the influence of personality.

The second study observed six pianists as they practised two stylistically different works of their own selection, and interviewed them using stimulated recall immediately after each observation session. Two observations were made for each work at different stages of its development. The range of practising behaviours of each pianist identified in the four observation sessions and interviews was compared with that of the other pianists. Thirteen groups of behaviours were identified that participants could be differentiated on. These included the use of recordings and self-recordings, vocalisation, use of a metronome, writing on the score, reliance on the score, visual memory, regular movements while playing and not playing, expressive or non-regular movements while playing and not playing, hands separate practice and simplifying or varying aspects of the music. Very few of these groups of behaviours allowed the possibility to be used as a means of identifying perceptual learning style theory, and where individuals behaved in ways that the theory predicts in one group, they did not also do this in other groups. Perceptual learning style was concluded to have very little influence on the practising behaviours and strategies of the participants. Instead, the influence of teachers on strategy selection was highlighted.

The two studies presented in the thesis therefore do not offer support for the claim that perceptual learning style influences the practising behaviours and strategies of the respondents and participants of this study. Several flaws in the conceptualisation of the theory are pointed out in a review of the literature, including: the conception of separate, clearly defined modalities; the ideal of matching instruction; and the use of learning style identification instruments. The results of the study point to a further problem with the conceptualisation of perceptual learning style as stable and inherent, and argues, in the light of findings that the

theory influences the learning of young children, that instruction in and development of skill play a more important role in the practising behaviours of the participants and respondents in this study.

Keywords: Learning styles, Learning strategies, Individual differences, Music – instruction and learning, Practising (Music)

Tiivistelmä

Odendaal, Albi (2013). *Oppimistyylin vaikutus soitonopiskelijoiden harjoitteluun musiikin korkeakoulutuksessa.* Taideyliopiston Sibelius-Akatemia, Helsinki. Musiikkikasvatuksen, jazzin ja kansanmusiikin osasto. Studia Musica 56. 138 sivua.

Tämä tutkielma selvittää aistimodaliteetteihin perustuvan oppimistyylin teorian soveltuvuutta soitonopiskelijoiden harjoitteluun länsimaisen klassisen musiikin korkeakoulutuksessa. Aistimodaliteetteihin perustuvan oppimistyylin teorian mukaan yksilöiden välillä on mahdollista tehdä eroja sen mukaan, mikä kolmesta aistimodaliteetista on heille luontevin informaationkeräämisen kanava: visuaalinen, auraalinen vai kinesteettinen. Tutkielmassa raportoidun kahden tutkimuksen valossa tämän teorian soveltaminen musiikin oppimiseen on ongelmallista.

Ensimmäisessä tutkimuksessa kartoitettiin tutkijan suunnitteleman kyselyn avulla opiskelijoiden harjoittelustrategioita pyrkien selvittämään, vastaavatko heidän omissa raporteistaan ilmenevät harjoittelun muodot aistimodaliteetteihin perustuvan oppimistyylin teoriaa. Kysely nojasi aiemmassa tutkimuskirjallisuudessa esitettyihin väitteisiin, joiden mukaan aistimodaliteetteihin perustuva oppimistyylin teoria soveltuu musiikin oppimisen tutkimuksen lähtökohdaksi. Pääkomponenttianalyysi osoitti, että aistimodaliteetteihin perustuva oppimistyylin teoria ei selitä kyselyssä havaittuja vaihteluita. Ryhmittelyanalyysin perusteella yksilöt eivät myöskään näytä osoittavan samanlaisia preferenssejä modaliteetteihin eri tilanteissa, eivätkä yhdessä tilanteessa tietyllä tavalla vastaavat ryhmät vastaa samalla tavalla toisessa tilanteessa. Näin ollen kysely ei tule väitettä, että aistimodaliteetteihin perustuva oppimistyylin teoria olisi pääasiallinen selittäjä aineistossa esiintyville harjoittelustrategiavalinnoille. Sen sijaan huomioitiin mahdollisuus, että instrumenttiryhmillä ja persoonallisuudella voi olla yhteys aineistossa havaittuun vaihteluun.

Toisessa tutkimuksessa havainnoitiin kuuden pianistin harjoittelua heidän valmistaessaan kahta tyylillisesti erilaista itse valitsemaansa teosta. Pianisteja myös haastateltiin havainnointi-istuntojen jälkeen stimulated recall -tekniikan avulla. Molempien teosten kohdalla tehtiin valmisteluprosessin eri vaiheissa kaksi havaintoa. Neljässä havaintosessioissa ja haastatteluissa ilmennyttä harjoittelua verrattiin muiden pianistien harjoitteluun. Tätä kautta tunnistettiin kolmetoista harjoittelukäyttäytymisen muotoa, joihin sisältyi äänitteiden käyttö, vokalisaatio, metronomin käyttö, omien merkintöjen tekeminen nuottiin, nuottikuvaan tukeutuminen, visuaalinen muisti, säännönmukainen liikehdintä soitettaessa tai muuna aikana, ilmaisullinen tai epäsäännölliset liikehdintä soitettaessa tai muun aikana, käsien erillinen harjoittaminen ja musiikin aspektien yksinkertaistaminen tai variointi. Vain harvat näistä muodoista viittasivat aistimodaliteetteihin perustuvaan oppimistyyliin. Aistimodaliteetteihin perustuvan oppimistyylien teorian pääteltiinkin vaikuttavan hyvin vähän tutkimuksessa mukana olleiden opiskelijoiden harjoittelustrategioihin. Sen sijaan tutkimuksessa korostui opettajien vaikutus strategian valinnassa.

Tutkielmassa raportoidut kaksi tutkimusta eivät näin ollen tarjonneet tukea väitteelle, jonka mukaan aistimodaliteetteihin perustuva oppimistyylin teoria vaikuttaa aineistossa mukana olleiden opiskelijoiden harjoittelukäyttäytymiseen ja harjoittelun strategioihin. Kirjallisuuskatsauksessa osoitetaan ongelmia teorian käsitteellistämisessä, mukaan lukien erillisten aistimodaliteettien ymmärtäminen erillisiksi ja selkeästi määritellyiksi, oppimistyyliin perustuvan harjoittelun merkitys sekä oppimistyylin perusteella tapahtuva instrumentin valinta. Tutkimuksessa viitataan myös ongelmaan aistimodaliteetteihin perustuvan oppimistyylin

käsitteellistämisessä pysyvänä ja luontaisena ominaisuutena sekä argumentoidaan pienten lasten oppimista käsittelevien tutkimusten valossa, että taidon opettaminen ja kehittyminen näyttelevät oppimistyylejä tärkeämpää roolia harjoittelukäyttäytymisessä.

Asiasanat: oppimistyylit, harjoittelu, oppiminen, musiikkikasvatus.

Acknowledgements

I wish, firstly, to thank the students of the Sibelius Academy who endured my pestering to fill in a questionnaire, and the six participants who allowed me into their practice rooms. Thank you Carlos, Khatia, Martha, Maurizio, Rosalyn and Vladimir for enduring the inconvenience, and I hope that participating in this work has offered something back to you.

Several people have had a telling influence on the academic development of this project. Thanks, firstly to Harald Jørgensen and Lauri Väkevä for their continued and critical engagement with this work from the earliest to the final stages. Without your input I would *still* be shooting at little targets with big cannons. Thanks also to David Hebert and Tuomas Eerola for their supervisory input at various stages of this work. Also, Heidi Westerlund has played a pivotal role in my studies at the Sibelius Academy. Her mentoring has gone far beyond the academic input she has given to this work. Thank you.

A number of scholars read and commented on my developing ideas in various contexts. My sincere thanks to: Randall Allsup, Phillip Alperson, Maria Calissendorff, David Elliot, Jane Ginsborg, Helga Rut Gudmundsdottir, David Hargreaves, Sidsel Karlsen, Roberta Lamb, Siw Nielsen, Patrick Schmidt, and Marissa Silverman.

My studies at the Sibelius Academy were enlivened through participation in a stimulating community of doctoral researchers, each of whom have had a telling impact on my thought and development in these years. My gratitude goes to Aleksi, Analia, Anna, Eeva, Guillermo, Hanna, Heidi P, Inga, Laura, Minja, Olli-Taavetti, Sigrid, Tuulia and others who have read and re-read parts of this thesis, and shaped its final form through your careful consideration of my writing and thought. Special thanks to Alexis and Tuulikki who survived a T-house office with me for more than a year. I miss our lunches in the cafeteria and the many good conversations. See you on the “other side”.

The research work of this thesis was financially supported through a position at the Finnish National Doctoral School of Music, Theatre and Dance (2010-2011), and at its successor, the Finnish Doctoral Programme for Music Research (2012). I wish to extend my sincere gratitude to the administrators and boards of these bodies for the opportunity to pursue this work without interruption.

My wife, Tracy, has taken this journey with me, willingly following when I wasn't sure where I was leading. I cannot thank you sufficiently for all the grace and joy you have poured into my life. Your willingness to put others before yourself has been humbling and life-giving to me. Thank you. Annabel and Nathan, I have loved your interruptions to my writing, your visits to my office and the laughter you bring to our house.

Too many members of the community of the International Evangelical Church in Helsinki have been a support and home away from home for us to mention individually. Thank you for welcoming us. We think of you often.

If any sliver of honour is still due to me after everyone else has taken theirs, I wish to lay it at the feet of One who is worthy to receive honour.

Immortal, invisible, God only wise,
in light inaccessible hid from our eyes;
most holy, most glorious, the ancient of days,
almighty, victorious, Your great name I praise.

Table of Contents

Index of Tables

Index of Figures and Illustrations

1 Introduction

This thesis reports on an inquiry into the feasibility of applying a learning style theory to the practising of musicians. As such, it investigates the qualitative variety that exists between the approaches of Western Classical musicians to the task of learning to play notated musical compositions. A mixed methods approach was used to gain understanding of the relationship between perceptual learning style theory and the practising of students in higher music education. The data are taken from a questionnaire study and an observation and interview study, both conducted with students of the Sibelius Academy (now part of the University of the Arts), Helsinki, Finland. In the first study, instrumental students were asked through a paper-based multiple-choice questionnaire to indicate the frequency with which they would use certain strategies to learn a new large-scale work from the standard repertoire. Factor analysis and cluster analysis provided the tools to understand the patterns that emerged from this survey. In the second study, six piano students were each observed in four different practising situations, and interviewed about their strategy selection through unstructured stimulated recall interviews. The piano students each practised two different works from their own repertoire, and each work (with one exception) was observed at an early and later stage of the practising process. Graphic coding of practising behaviours and strategies, and data driven content analysis of the interviews formed the basis of descriptions of each pianists' practising. The descriptions were compared in order to identify differences between the individuals. The claims of perceptual learning style theory, as it has been applied to musical learning, were assessed through interpretation of these two studies.

This thesis is also, however, an account of my journey as a researcher: from a position of acceptance of the theory of perceptual learning styles in learning music to one of scepticism. My introduction to the theory was in the context of teaching at a high school, where its application made a difference in my pedagogical thinking. I therefore had an experiential (but unreflexive) bias in support of the theory at the outset of the study. The shift from support to scepticism happened slowly, over the course of the investigation. The ambivalence in the literature surrounding learning styles in general abetted the situation; depending on who you read, learning styles are either the key to successful learning, or a delusion on a grand scale. Engaging with the different stages of data collection and analysis had a telling impact on the conceptualisation of the role of perceptual learning styles in the study population, and of the theory in general. The account given in this text of the shift from support to non-support is, I believe, an important one for the understanding of variety in the practising of instrumentalists in higher music education, and forms part of a justification for pressing on with the study.

1.1 Context of the study

1.1.1 Empirical context

There has recently been a call to recognise research into higher music education as a field of study in its own right (Jørgensen, 2009). Over 1000 institutions of higher music education exist world-wide (Jørgensen, 2010). The Sibelius Academy in Helsinki, Finland, from which all participants in the study were taken, is one of nine institutions of higher learning that teach a music performance specialisation in Finland. It is one of the largest universities of its kind in Northern Europe, providing instruction for aspiring arts managers, church musicians, composers, performers (classical, jazz and folk), researchers, sound technology specialists and teachers in its programmes.[1] In the academic year ending in 2012 the Academy had an enrolment of 1388 students in 11 departments.[2] In the music programmes throughout the rest of Finland in the same year, 2234 students were enrolled. In the academic year ending in 2011, 283 students graduated from the Academy and 315 students from programmes in the other institutions of higher learning across Finland.[3] There is strong competition for admission to the Academy; in 2012, 1097 aspiring students applied for places at the Academy, of which 180 were accepted.[4] These figures give the Academy a prominent position in the music field of Finland, although the quality of education students experience can not be measured by such numbers alone.

Students at the Academy typically enrol for a 5,5 year combined Bachelor's and Masters degree, in accordance with practice across Europe after the Bologna convention. These studies are punctuated, for performance students in Western Classical music such as those studied in the observation study, by two major examinations. “B” exams take place after the Bachelor degree, usually after 3 years of study. “A” exams take place near the end of the Master's degree, usually after 5 years of study. The “A” exam involves a full recital and concerto performance, while the “B” exam is a smaller recital with a concerto movement. Smaller assessments and other concert engagements are arranged in discussion with or at the discretion of the instrumental teacher, but are not required in order for a student to pass the degree. Although the repertoire options for these examinations is prescribed, students still have a great degree of freedom in the selection and development of their repertoire over the years of study. Many students extend their study in various ways and therefore the timing of these examinations are open to adjustment.

Prior to entering higher music education, students from Finland will have been exposed to music through basic music education which is offered in all comprehensive schools in grades 1-7. But music specialists will typically have enrolled in one of the music high schools that specialise in music instruction, and that are located throughout Finland. Alternatively, or in conjunction, they will have enrolled in one of 90 music schools or 10 conservatories that are spread throughout the country and that are members of the Finnish Association for Music

1 www.uniarts.fi/en/about-us/ accessed on 18 Feb 2013.
2 Personal communication from the enrolment office of the Sibelius Academy, 4 Oct 2011.
3 Statistics Finland, http://193.166.171.75/database/StatFin/kou/yop/yop_fi.asp (Accessed 17 May 2013). However, these numbers may be somewhat misleading due to musicologists sometimes being categorised under the humanities, and some music students being categorised under education. There are thus somewhat more music students than these numbers reflect (Thanks to Juha Ojala for pointing this out).
4 www.siba.fi/en/how-to-apply/bachelors-and-masters-degrees/statistics-about-applications (Accessed 17 May 2013)

Schools[5], or one of the several independent music schools. One of the prominent features of the Finnish education system is that it aims to provide equal opportunities to all students regardless of domicile, and the music schools, conservatories and specialist secondary schools that are spread throughout the country offer largely similar quantity and quality of instruction. (For a more comprehensive review of the state of music education in Finland, see Korpela et al., 2010) Although the Academy is considerably larger than the other institutions of higher learning, and admission is more competitive, the similarity in educational background of the students who come to these institutions makes it possible to generalise from one part of the student body to the rest.

1.1.2 Theoretical context

This study investigates differences between the ways that individuals approach learning and practising musical compositions, as a result of its focus on perceptual learning style theory. Key concepts that will be defined in this section are therefore the notions of learning of musical compositions and of practising strategy. Perceptual learning style theory will be defined and reviewed in detail in chapter 2.

1.1.2.1 Learning of musical compositions

Learning has a broad range of definitions. Gavriel Salomon and David Perkins (1998) have suggested that these can be broadly grouped into individual and social perspectives, although noting that these perspectives are often combined in different ways. The current study focusses on individuals, and the strategies and behaviours that they use to address the task of practising notated musical material. In doing this, it assumes that solo practising forms a substantial a part of learning how to play a musical work, although it cannot be said to be the only part. Social forces also strongly impact on any form of learning, including musical learning. Musicians partake of a complex cultural phenomena, and all their norms, assumptions and practices have been influenced, if not determined, by socio-cultural interactions.

Salomon and Perkins argue that the individual, cognitive, acquisition-oriented perspective, such as this study undertakes, and the social, situative, participatory perspective are both essential views on the same issue. They point out the difference between epidemiology and cell biology as an instructive metaphor for the two perspectives on learning. Neither epidemiology nor cell biology should stand on its own in understanding disease. Each is a process in its own right, with an important contribution to make to the understanding of disease. The two broad perspectives on learning should be understood in a similar light, with the social perspective corresponding to epidemiology, or a top-down perspective, and the individual perspective to cell biology, or a bottom-up perspective. They argue that "individual learning is most sensibly viewed not as learning utterly naked of social contexts, influences, and participations but as learning in which [these factors] have relatively lesser rather than greater presence. Matters of degree and level of analysis are involved" (p. 17).

Pianists (and other instrumentalists) spend long hours alone (Chaffin, Imreh, & Crawford, 2002), often working in highly self-regulated fashion (Nielsen, 2001), in order to prepare music

5 www.musiikioppilaitokset.org (Accessed 17 May 2013)

for public performance. What they do is not devoid of social “contexts, influences, and participations”, but while they are in the practice room, these are not nearly as visible as when they are in their lessons, masterclasses or ensemble practices, or, when they are attending concerts, conversing with colleagues or participating in other social interactions around music. The pianists live and work in a highly encultured milieu, but when they are observed in the practice room, the individual, cognitive and acquisition-oriented nature of learning comes to the fore, rather than the situative and participatory. “There is surely room for two perspectives on the nature of knowing” (Bruner, 1996, p. 8), and in this study one is focussed on over the other.

Within the individual, acquisition-oriented paradigm, questions around *what* it is that musicians are learning, and *how* they go about this process are paramount. Roger Chaffin, Gabriela Imreh and colleagues have given, through a series of publications (Chaffin, 2007; Chaffin & Imreh, 1997, 2001, 2002c; Chaffin, et al., 2002; Chaffin, Imreh, Lemieux, & Chen, 2003; Chaffin, Lemieux, & Chen, 2007; Imreh & Chaffin, 1996), a psychological perspective and account of the work that a concert pianist undertakes in the studio to bring a notated musical composition to the stage, memorised. Through this work they have given an answer to the *what* question. They argue that pianists, like other expert memorists, use a “highly practised hierarchical organisation to retrieve chunks stored in long-term memory in a particular order” (Chaffin, 2002, p. 71). These chunks, which are groupings of information that are treated as a single item in memory, such as fingerings, musical patterns or hand movements. The chunks are activated by performance cues which are usually taken from the information in the chunks, and have come to stand for them. Performance cues form the bulk of what a pianist thinks of and focusses on while performing a musical composition.

Chaffin and Imreh (2002a) argue that the complexity of a musical piece can be reduced to 10 dimensions that the pianist attends to while learning (see Table 1). These are “three basic dimensions (fingering, technical difficulties, and familiar patterns) to produce the notes and four interpretive dimensions (phrasing, dynamics, tempo and pedalling) to shape the musical character of the piece” (p.166). Although some aspects of these basic dimensions and interpretive dimensions are automated, others still require attention during performance, and it is these that are called performance cues. “The performance cues can be organised into three performance dimensions (basic, interpretive, and expressive)” (p. 166). Performance cues guide the performer to which automated or chunked section they need to turn next, and these cues are arranged in a map of the whole piece, that is a composite of cues from each of these aspects. The cues often correspond to musical boundaries, such as the starts of sections or phrases.

Table 1

Ten dimensions that a pianist attends to over the process of learning to perform a musical composition (Chaffin and Imreh 2002a)

Basic: requires attention to simply play the notes	*Fingerings*: decisions about unusual fingerings *Technical difficulties*: places requiring attention to motor skills (e.g., jumps) *Familiar patterns*: scales, arpeggios,chords, rhythms, etc.
Interpretative: shape the musical character of the piece	*Phrasing*: groupings of notes that form musical units *Dynamics*: variations in loudness or emphasis *Tempo*: variations in speed *Pedalling*: use of pedal
Performance: features requiring attention during a performance	*Basic:* familiar patterns, fingering, and technical difficulties *Interpretive:* phrasing, dynamics, tempo, pedal *Expressive*: emotion to be conveyed (e.g., surprise)

Note. There is a general (but not linear) progression from basic to interpretative to performance dimensions over the learning process. Many of the details attended to in the basic and interpretative dimensions become automated; those that are not and that require attention during performance are found again in the performance dimension, where they are called performance cues. Performance cues form the bulk of what pianists concentrate on and attend to during performances.

The hierarchy or retrieval scheme that is formed through the performance cues is not built on procedural (motor) memory, but on conceptual (declarative) memory. There is still a dependence on procedural memory for those parts of the performance that are automatic, and this kind of memory can be relied on to a greater or lesser degree in performance, but the conceptual memory is essential for developing a reliable and creative performance (p. 248). Developing a strong conceptual memory, and especially developing performance cues in the expressive dimension, allows the performer freedom to concentrate on the communicative aspect of performance rather than technical or other difficulties in the composition. The motor movements that create expressive sounds are learned, as well as a complex declarative scheme which enables making the right movement at the right time. The combination of procedural and conceptual memory constitutes the *what* of musical learning, in this view. *How* this combination of memories are established has largely been addressed through research on practising strategies.

1.1.2.2 Practising strategy

Practising strategies have been defined as “deliberate or purposeful processes, originally consciously applied, but normally undergoing automation as a result of development and practice” (Nielsen, 2004, p. 419). They are also “intended or goal-directed” processes (Nielsen, 1999a, p. 276). However, not everything that happens in a practising studio can be understood to be as focussed as Nielsen's definition presupposes. For this reason this thesis will distinguish between the terms behaviour and strategy, with behaviour denoting any kind of action that is

performed in the learning situation, while strategy is reserved for deliberate and goal directed behaviours.

That the application of strategies develop over time can be seen in beginner musicians employing no practising strategies apart from attempting to play through the music once or twice (Pitts, Davidson, & McPherson, 2000). As young musicians gain musical experience, they use a wider variety of strategies, but this development is linked to musical maturity and not to age (Hallam, 2001a). Increased skill level results in an increase in the use of certain strategies. When Linda Gruson (1988) compared 40 piano students and 3 concert pianists, she found that repeating a section longer than a bar, playing hands separately, verbalisation, and increasing the proportion of time spent practising occurred with greater frequency among more advanced pianists. It is a common recommendation that teachers should be instructing pupils in which strategies to use. However, it seems that this instruction should go deeper than merely talking about how to practise. Many young students do not use strategies that they are aware of in their practice sessions (Hallam, 2001a). Even professional musicians sometimes have a misconception about what they are doing while practising (Lisboa, Chaffin, & Logan, 2011). Furthermore, strategy use is linked to interest and motivational factors. This was observed in James Renwick and Gary McPherson's (2002) study. A young clarinettist used a variety of strategies for the piece of music that she clearly enjoyed and was motivated to play, while these strategies were absent in her practice of the rest of her repertoire. So, while instruction and modelling are clearly important avenues for the development of effective practising strategies, other factors, including motivation and interest, play a role.

In addition to the variety of influences on the development of effective strategies, it is also clear that mature musicians select strategies depending on the situation in which they find themselves. A musicians' statement of what the problem is when facing a learning task is dependent on the musical material to be learned, and is continually under revision depending on how chosen strategies address the problem (Nielsen, 2001). There is therefore a difference in the strategies that a pianist might select in order, for instance, to play a Mozart sonata or a Stockhausen Klavierstück. This variety in approach is summarised in Susan Hallam's (2001b, p. 28) statement that,

> there is no single expert way to perform all tasks [...] effective practice might take many forms depending on the nature of the task to be undertaken, the context within which the task is to be learned, the level of expertise already acquired, and individual differences.

Despite the complexity of the process of musical learning, researchers have also noted patterns in strategy selection, and while there is variety in musicians' relationships with musical material and the task of learning, it also seems that they have habitual approaches to music and musical learning that stay stable over time. Yvette Sullivan and Robert Cantwell (1999) found that students who were identified as deep learners (by a modified version of Biggs' Study Process Questionnaire) were more likely to use strategies classified as high-level, such as interpretation, patterning, prioritising and monitoring (see Table 2).

Table 2

A classification of strategies into levels (Sullivan and Cantwell, 1999)

Lower level	Mid-level	Higher level
simple association, rote learning, trial and error, non-response or avoidance, sight-reading, and external recourse	speed alteration, chunking, linking, scanning and research	interpretation, patterning, prioritising, and monitoring

Similarly, Siw Nielsen (2004) found a strong link between self-efficacy beliefs and strategy selection. The higher the self-efficacy belief, the wider is the strategy selection. The distinction between holist and serialist approaches (Pask, 1976) to learning music has been discussed by both Kacper Miklaszewski (1995) and Hallam (1995). Holists tend to approach learning from a integrated perspective on the whole, while serialists tend to approach learning systematically and linearly. Hallam, however, adapted the definition of these terms to holist/analytic and serialist/intuitive to better explain the interview data she analysed. This is to differentiate between those musicians that engage in conscious planning and those that engage in unconscious planning, while maintaining a general holist or serialist approach. In Peter Miksza's (2006) study, brass players identified with low impulsiveness by the Eysenck Impulsiveness Questionnaire for Adults (Eysenck, Pearson, Easting, & Allsop, 1985) outperformed those with high impulsiveness in learning to perform an etude. Based on these studies, some of the descriptors of efficient musical learners seem to be: methodical, motivated, and concerned with matters of interpretation and analysis.

In a study that described variety between approaches, Cecilia Hultberg (2008) noted that the two guitarists she observed preparing for an ensemble tour approached the task of expression finding in different ways. At root was a difference in approach, with one guitarist preferring "to use music notation *directly* in order to develop a preliminary understanding of the music by means of *exploring how it is written*, *understanding* structures, and relating conventions of expression to this." The other guitarist preferred "to use music notation in a more *indirect* way [...] he develops his idea of it by means of *playing* from the score, *listening* to what he plays, and relating conventions of expression to this" (p. 24, italics in original). Hultberg explains that expression finding depends on a combination of a visual orientation (to the score), an aural orientation (to the sounds), a motor orientation (to their instruments) and a physical orientation (through bodily gestures).

Drawing on observations similar to those of Hultberg, of a distinction between different orientations, several theorists (Beheshti, 2009; Garcia, 2002; Miller, 2002; Swanson, 2005) have claimed that these distinctions can be related to a theoretical concept called perceptual learning style (also known as VAK, VARK, VAKT[6]). The theory will be defined in detail in the following chapter, but, put briefly, argues that individuals have observable perceptual modality strengths, and that these affect the ways in which information is remembered. Many

6 The acronyms describe the various modalities assumed to form part of the theory: Visual Auditory Kinaesthetic, Visual Auditory Read/Write Kinaesthetic, Visual Auditory Kinaesthetic Tactile.

instrumental teachers have come across students who, for example, read well but have difficulty singing, or who play everything well after hearing a demonstration, but find it hard to sight read fluently, or who are technically facile, but seem to struggle with playing in an ensemble. Some theorists attempt to explain these differences in terms of perceptual learning style preferences, implying that habits of perception determine a students' engagement with learning and music making. Investigating these claims in the context of higher music education is an aim of this study.

1.2 Rationale and focus of the study

As a theoretical starting-point, and topic for investigation, the study uses perceptual learning style theory. Perceptual learning style has recently been advocated as an instructional option in textbooks (eg. Campbell, Scott-Kassner, & Kassner, 2006), articles in music teaching periodicals (eg. Garcia, 2002; Swanson, 2005), and articles in academic journals (eg. Beheshti, 2009). It is popular in public discourse surrounding education in general (an internet search will reveal a mass of information and opinion), despite some fierce research-based opposition to the theory (Krätzig & Arbuthnott, 2006; Pashler, McDaniel, Rohrer, & Bjork, 2009). The claims of perceptual learning style have far-reaching pedagogical implications, and are usually accompanied by guarantees of successful learning or teaching, should the theory be conscientiously implemented. These are important claims to critically investigate. For instance, a recent textbook on music education of children (Campbell, et al., 2006) mentions one of the perceptual learning style models, together with a number of other theories of development and instruction, such as left and right hemisphere, constructivism, stage and phase theories, and multiple intelligences (among others), advocating their adoption to the teaching of music. No indication is given on how these various theories interact, nor is consideration given to what research backing these theories have in application to music teaching or learning. This thesis aims to contribute to this discussion by thoroughly and critically investigating perceptual learning style theory as it relates to practising.

A number of researchers have investigated aspects of perceptual learning style theory as it relates to aspects of musical learning (eg. R. E. Dunn, 2008; Korenman & Peynircioglu, 2007)[7], but as far as can be ascertained, this has not been done in a naturalistic investigation in the context of practising, which is a much more complex activity than aspects of musical learning such as remembering rhythms or listening to musical excerpts. This complexity is an important aspect of this study, and has the potential to confound the effects of perceptual learning style theory, with important implications to its suitability as a tool to understand variety. Only Lisa Korenman and Zehra Peynircioglu (2007) and Jennifer Mishra (2007) have investigated perceptual learning style in higher music education students and this thesis is, as far as I have been able to ascertain, the first study to investigate whether perceptual learning style is observable in the practising of this cohort. Issues around the stability of the perceptual learning style concept and the effect of intensive long-term training on the use of perception are important topics that can be discussed in the light of findings that support the identification and

7 Robert E. Dunn should not be confused with husband and wife pair Rita and Kenneth Dunn, although they are all involved in research on learning styles, and will appear repeatedly in this thesis.

use of perceptual learning style in young children (Calissendorff, 2006; R. E. Dunn, 2008; Persellin & Pierce, 1988).

This study contributes to the understanding of *how* individuals go about learning notated musical material by describing and theorising some of the variety of approaches that musicians use in this process. It is my opinion that teachers should, ideally, consider the way that individuals learn and not just proceed without such consideration, and although there is not a golden causal thread between individual differences and perfect teaching, there may be pedagogical hints and ideas that are formed in the investigation and understanding of individual differences. This study further provides a critical review of the claims of perceptual learning style, a view I have not encountered much in the literature on music and learning style. The implications are important for adherents of the theory, as it points to several difficulties in the definition of the theory and in its possible applications.

1.3 The research task

This research aims to explore the following question:

> *Which aspects of perceptual learning style theory are in evidence in the learning behaviours and strategies of music instrument students in higher music education when they learn notated musical material?*

The question is investigated from a macro and micro perspective. The macro perspective is obtained through use of a questionnaire on strategy use and selection constructed with perceptual learning style theory as background. The questionnaire was presented to a large sample of music instrument students in higher education. The micro perspective is obtained through observation and interview of piano students in higher music education in a variety of stages of learning notated musical material. Each of these studies is motivated by a sub-question, respectively:

> *1) Are there patterns in the ways that music instrument students in higher education describe their practising behaviours and strategies, and how do these patterns relate to perceptual learning style theory?*
>
> *2) What differences can be observed in the practising of individuals and in their descriptions of this practising, and how do these differences relate to perceptual learning style theory?*

1.4 Structure of the thesis

The rest of this thesis follows a traditional structure. Chapter 2 will review the literature on perceptual learning style, offering a critical perspective on its definition, origin and application to musical learning. Chapter 3 gives an overview of the methodological and ethical choices made in investigating the research question. The next two chapters give the results of the two studies that comprise this project, and offer a discussion of the results related to each study. Chapter 4 introduces the two statistical methods used, factor analysis and cluster analysis, and

compares the findings of using these analytical tools on the questionnaire data to the claims of perceptual learning style theory. Chapter 5 offers an analysis of the observation and interview data gathered from the six pianists, describing the variation that can be observed between the ways that they approach and talk about their practising, and relating these variations to perceptual learning style theory. Chapter 6 offers a discussion of the findings of the two studies as they relate to each other and to other relevant research, and an evaluation of the study as a whole.

2 Perceptual learning style

In this chapter, the concept of perceptual learning style will be defined and critically assessed. A brief overview of the conceptual field of learning style is given (2.1) prior to a definition of the main tenets of perceptual learning style and a critical evaluation of these (2.2). The possible historical precedents of the theory are traced through reference to a number of theorists who have used related concepts or theories (2.3), and research on the theory within musical learning is reviewed (2.4). Finally, the suggested characteristics of the ideal learner types according to perceptual learning style are given, together with a challenge to some of the assumptions based on current research in other fields (2.5). The implications of all of this are briefly discussed (2.6).

2.1 Learning style as a concept

Research on individual difference and learning style was not at first intended to be applied to musical learning, but grew out of some educational researchers' dissatisfaction with intelligence and ability as a valid measure of individual difference (Grigorenko & Sternberg, 1995). Since its inception in the 1960's, however, research on learning style has been both diverse and fragmented, offering many different models in many different fields of application. Many researchers do not take a larger view of the field, but situate themselves in a niche. For example, two of the most widely cited learning styles researchers, David Kolb and Rita Dunn, do not refer to each other's work at all, even though they were simultaneously developing and publishing their theories during the 1970's and 80's (Desmedt & Valke, 2004). The same can be said of many other learning style theorists, even sometimes of those who work with the same model, as will be shown later in this chapter. In some cases, it seems that developers of instruments to identify learning style are interested in the economic benefits of selling their instruments and methods, and there is a tendency to trademark and carefully delimit this work from that of other researchers (Coffield, Moseley, Hall, & Ecclestone, 2004a, p. 144). This leads to an emphasis on differences rather than a search for commonalities.

The delimiting of models from each other is apparent in the range of definitions that are given for what learning style is. Anthony Gregorc (1982) discusses style as the outward appearance of internal channels through which the human mind receives and expresses information. Anthony Grasha (1990, p. 106) suggests that “learning styles are the preferences that students have for thinking, relating to others, and for various classroom environments and experiences.” Rita Dunn et al. (2009, p. 137) suggest that learning style is “the way in which individuals begin to concentrate on, process, internalise, and retain difficult academic information.” For Ellen Grigorenko and Robert Sternberg (1995, p. 205), “styles are not abilities, but rather how these abilities (and the knowledge acquired through them) are used in day-to-day interactions with the environment.” Richard Riding (2002, p. 8) defines cognitive

style as “an individual's preferred and habitual approach to organising and representing information.” In light of the wide variety of definitions, Karen Butler (1987) argues that learning style is (or should be) only a generic term by which we mean to describe individual differences in learning. What is apparent from these definitions are differences between conceptions of learning, ranging from simple information retention to taking account of more complex environmental interactions. Further, it is also apparent from several definitions that there is a strong relationship between strategy and style, with style being evident in the strategy selection of individuals.

Several attempts have been made to review and organise the disparities in the field. Lynn Curry's (1983) review has been widely cited, but is now dated, as is that of James Keefe (1985). More recent reviews by Grigorenko and Sternberg (1995) and Riding and Indra Cheema (1991) also double as motivations for their own models of learning style. The most recent and comprehensive review is that of Frank Coffield, David Moseley, Elaine Hall and Kathryn Ecclestone (2004a; 2004b).

Coffield et al. identify over 70 models of learning style, and give a thorough and critical review of 13 of the most influential models. While they do find some positive aspects in the use of learning style theories and instruments (such as increased self-awareness and metacognition, better language to describe learning, and the possibility that thinking about learning style may be catalytic for further change in individuals, organisations or even systems) they are also very critical of the concept of learning style in general, and of most of the models of learning style. They criticise the lack of theoretical coherence in the field, and the overlap between many models that each measure something slightly different. There are vast differences in the quality of the models and the instruments that purport to measure them, with several instruments not meeting accepted psychometric standards. Many of the models are decontextualised from both subject matter and social and cultural differences. Furthermore, while many proponents of learning styles advocate matching of materials and instruction to learning style preference, others advocate mismatching and constructive friction as a means of growth.

Table 3

Classification of learning style theories (Coffield et al, 2004a)

Learning styles and preferences are largely constitutionally based including the four modalities: VAKT.	Learning styles reflect deep-seated features of the cognitive structure, including 'patterns of ability'.	Learning styles are one component of a relatively stable personality type.	Learning styles are flexibly stable learning preferences.	Move on from learning styles to learning approaches, strategies, orientations and conceptions of learning.
Dunn and Dunn; Gregorc; Bartlett; Betts; Gordon; Marks; Paivio; Richardson; Sheehan; Torrance.	Riding; Broverman; Cooper; Gardner et al.; Guilford; Holzman and Klein; Hudson; Hunt; Kagan; Kogan; Messick; Pettigrew; Witkin.	Apter; Jackson; Myers-Briggs; Epstein and Meier; Harrison-Branson; Miller.	Allinson and Hayes; Herrmann; Honey and Mumford; Kolb; Felder and Silverman; Hermanussen, Wierstra, de Jong and Thijssen; Kaufmann; Kirton; McCarthy.	Entwistle; Sternberg; Vermunt; Biggs; Conti and Kolody; Grasha-Reichmann; Hill; Marton and Säljö; McKenney and Keen; Pask; Pintrich, Smith, Garcia and McCeachie; Schmeck; Weinstein; Zimmerman and Palmer; Whetton and Cameron

Note. Theories that assume more stability, and thus a greater biological precedent for learning style, are to the left, and include the perceptual learning style concept, while more flexible approaches are to the right.

Coffield et al. group learning style models into families according "to the extent which the developers of learning style models and instruments appear to believe that learning styles are fixed" (2004a, p. 10). This grouping is depicted in Table 3. They do not specifically review the perceptual learning style theory, but do place it in the far left with other models that are largely constitutionally based, corresponding with claims by some perceptual learning style theorists that style is mostly biologically determined with some social influence (R. Dunn & Griggs, 2003; Sprenger, 2003) although not all theorists agree with this assumption (Fleming, 2006a). Perceptual learning style theorists do, however, assume stability of their concept, and usually also transferability across different domains. The issue of stability of the construct impacts this thesis, since the developmental aspects of musical learning and strategy use are important considerations in current research on practising and strategy, and will be an issue that is returned to in the discussion of results. Returning to the review in discussion, perceptual learning style carries many of both the strengths and weaknesses that Coffield et al. identify in the larger field of study. Lack of clear definition of terms and concepts, developers of models working alone without reference to each other, unverified instruments, de-contextualisation from subject matter and social and cultural effects, and an emphasis on categorisation and labelling of individuals are also issues that characterise perceptual learning style theory.

2.2 Defining perceptual learning style

2.2.1 Sensory modalities

Perceptual learning style theory is based on the concept of sensory modalities. Walter Barbe and Raymond Swassing (1979, p. 1) define modality as "any of the sensory channels through which an individual receives and retains information." Modality theorists maintain that sensory information is received by the brain from the various senses which is then 'sorted' by the thalamus, that sends information to the various sensory cortices, from where important information is encoded for action or memory (Sprenger, 2003, p. 31-33). This movement from sense to sensory cortex constitutes a sensory channel. So, when information enters through the eyes, and is processed by the visual cortex, an individual is thought of as using the visual modality. Learning, on this view, is what happens when information is accessed through the senses and stored in the brain. I have called this view of learning *information processing,* and use this concept in the analysis of the observation and interview data in Chapter 5.

Three modalities are usually recognised to affect learning: visual, auditory and kinaesthetic. These three have been decided on by taking the classic five senses (sight, sound, touch, taste and smell), and leaving out taste and smell as largely irrelevant to learning information, especially in a school context (see eg., Fleming, 2006a, p. 1). In addition, the sense of touch is expanded to form the kinaesthetic modality, which is used as an umbrella term to include the tactile and proprioceptive senses and the idea of learning by "being actively engaged and doing" (Rundle & Dunn, 2008, p. 2), which moves the concept from the arena of sense to that of action. If it is defined in this way it cannot convincingly be argued to still be a sensory modality. Neurologically it is possible to identify many somatosensory modalities[8], each with its own neuronal pathways, but these work together seamlessly and may be experienced as a single sensation (Dougherty, 1997), which might give some defence to the assumption that there is one kinaesthetic modality, at least if this is assumption based only on experience. However, the motor system, which incorporates a range of differentiated and hierarchically arranged control systems, is separate from the somatosensory system although there is close coordination between the systems (Knierim, 1997). If the kinaesthetic modality is assumed to rely on both these systems, it cannot be understood to be a sensory modality in the same way that the auditory modality is, since it requires action and not just information gathering. In the visual system it is possible to identify a dorsal tract responsible for information on location and distribution of objects, and a ventral tract responsible for recognition of characteristics of objects, including the recognition of writing (Tallis, 2003, p. 59). One tract processes the "where" of visual stimulus, while the other processes the "what" (Dragoi, 1997). Similarly, evidence exists for a "what" and "where" differentiation in auditory processing (Ahveninen et al., 2006; Alain, Arnott, Hevenor, Graham, & Grady, 2001). Thus, it is physiologically problematic to speak of *a* visual modality channel, or *an* auditory modality channel, and differentiation should be made between the two functions in each modality. It is also problematic to speak of the kinaesthetic modality, when this incorporates not only sensory activity but also movement and doing.

8 The major somatosensory modalities are pain, temperature, touch and proprioception, each of which can be divided in to sub-modalities and sub-sub-modalities (Dougherty, 1997).

Differences exist between various conceptualisations of perceptual learning style. Marilee Sprenger (2003) and Barbe and Swassing (1979) acknowledge three modalities (visual, auditory and kinaesthetic), while Neil Fleming and David Baume (2006) and Harry Reinert (1976) add a read and write preference to these three; Fleming (1995) explains that this distinction accounts for differences in processing graphic or pictorial and text-based visual information. Hannaford (1995) acknowledges three modalities, but adds hemispheral dominance. Rundle and R. Dunn (2007) classify individuals using 5 perceptual elements in their Building Excellence (BE) Survey: Auditory, Visual-picture, Visual-text, Tactile-kinaesthetic, and Verbal-kinaesthetic. These definitional variations between the perceptual learning style models seem to be the result of variations in emphasis rather than variation in basic assumptions. The variations seem to exist in order to address inadequacies stemming from oversimplification in the three modality model, which underpins each of the permutations.

Research into multimodality has, furthermore, questioned the strong separation of modalities into channels (Bertelson & De Gelder, 2004), arguing that there exists an "interweaving of different sensory impressions through which sensory components are subtly altered by, and integrated with, one another" (Stein & Meredith, 1994, p. xi). According to these researchers, reading a book, for example, is not only a visual activity, but also involves many of the other senses, such as tactioception (the feel of the book), proprioception (how the book is held), audioception (what the pages sound like) and olfacception (what the pages smell like). Although the *information* is presented visually and most likely processed visually in the ventral tract, the other senses play an important part in the whole experience. So, while sensory pathways such as described by learning style theorists are also accepted in neurological research, these should be understood with greater complexity than suggested, including a more careful delimitation of different pathways and some 'fuzzy edges' to these pathways.

2.2.2 Modality dominance

Perceptual learning style theorists further maintain that some people develop or have a sensory dominance. This implies that information from one modality is processed faster and remembered better than information from another one. Carla Hannaford (1995) argues that while experiences shape our perception of the world, our innate neuronal 'wiring' also has an influence on the dominance of one modality over another. Perceptual learning style is therefore understood as a combination of societal adaptations and innate possibilities, but usually with a stronger emphasis on the innate. The modality dominance pattern is balanced for most people, with all the modalities functioning equally, but some individuals have very strong dominance in a particular modality, with the effect that they process information primarily through that modality, at the expense of information from other modalities (Fleming & Baume, 2006). This sensory dominance makes it possible to create learning style profiles of particular students (Fleming, 2006a).

2.2.3 Modal instruction

As a result of modality dominance and the possibility to profile the modality dominance of students, and because these are assumed to be at least in part innate, it is advocated that teachers should be aware of the perceptual learning style profiles of their students, and present new and difficult material to them in the format which accommodates their profile best (R. Dunn &

Griggs, 2003). This is especially urged for students who are struggling in the academic context, since it is assumed that this struggle is largely the result of a sensory mismatch, which may end up in a negative spiral of learned helplessness (Diener & Dweck, 1978). When individuals with strong dominances encounter material that is not in their preferred modality, they are assumed to have to work much harder to assimilate this information (R. Dunn & Griggs, 2003).

However, the matching hypothesis (that a teacher should adapt materials and teaching methods to suit the pupil) has come under strong criticism recently, with a recent review claiming to have found no evidence for this hypothesis (Pashler, et al., 2009). The review uses a very narrow criterion for what constitutes evidence, which would likely be disputed by advocates of learning style, but offers a sobering picture of the state of research into this basic assumption of learning style theory. John Hattie (2009) in his massive synthesis of meta-analyses related to school achievement, also notes, firstly, that wide discrepancies exist in the current research on learning style and, secondly, that even the successful research points to learning style teaching having an effect size of only 0.41 – indicating only a marginal improvement over the effects associated with a teacher teaching without such an approach. Individualised instruction fared even worse in his review, with an effect size of 0.23 making it "barely more effective than the traditional lecture approach" (p. 198).

2.2.4 Identification measures

The possibility of having a perceptual learning style without being aware of it is assumed in perceptual learning style theory. Therefore the use of learning style identification instruments is advocated. They help individuals understand their own preferences in learning (so, eg. Fleming & Mills, 1992) and thus also decide on strategies to implement in learning or studying situations. Perceptual learning style is usually assessed either through a self-report questionnaire, or through some kind of assessment of performance. In this section, examples of each of these kinds of instruments are discussed, with a view of understanding their modus operandi.

2.2.4.1 Self-report identification instruments

The Building Excellence (BE) survey (Rundle & Dunn, 2007, 124) includes a perceptual profile among other areas that together form their learning style construct. Out of one hundred and twenty items in the survey, twenty deal with perception. The format for all the items in this survey is a statement, such as, "When learning, I remember best when I hear someone talk about the topic", with which the respondent has to agree or disagree using a 5 point rating scale. All of the items concerned with perception are positive statements about habitual best practice in a learning situation. The survey is taken online, and each item also includes two illustrations that, typically, illustrate each of the extremes of the item, such as a picture of an ear or the same picture with a cross through it.

The VARK (Visual Aural Read-Write Kinaesthetic) questionnaire (Fleming, 2006b) consists of 16 multiple-choice sentence completion tasks. Each sentence has four possible endings, corresponding to each of the perceptual modality categories in Fleming's definition. Respondents are encouraged to choose all the answers that reflect their actions, even when this means more than one answer per sentence. The 16 sentences deal with common tasks and

events that people in the developed world would typically face, such as giving directions, visiting the doctor, using the internet. The questionnaire can be taken online or as a pen and paper test. An example of one of the tasks is,

> You are helping someone who wants to go to your airport, town centre or railway station. You would:
>
> a) draw, or give her a map.
> b) tell her the directions.
> c) write down the directions (without a map).
> d) go with her.

Such self-report instruments assume that it is possible to gain an understanding of perceptual preferences through a very limited (less than 20) number of questions. They also assume that combining the strategies and preferences an individual has in different situations give a clear description of their perceptual preference across all of these situations. The wording of some of the items in BE leave a lot to be desired (see Coffield, et al., 2004a, p. 126), while VARK makes a number of cultural and economic assumptions that limit its usefulness to a minority of the world's population (Leite, Svinicki, & Shi, 2010).

2.2.4.2 Performance-based identification instruments

The Edmonds Learning Style Identification Exercise (ELSIE) (Reinert, 1976) consists of a list of fifty commonly occurring and short words. Respondents hear a recording of each of the fifty words spoken with 10 second intervals between each word. They are asked to indicate on a response sheet whether their first response to hearing each word is a mental image of the object or activity, a mental image of the word spelled out, a fleeting kinaesthetic sensation (either physical or emotional), or, receiving meaning from the word without any visualisation. Examples of the words used are: pool, long, strange, happy. Words are included in the list for their possible bias to one of the modality groups. The exercise is designed to be administered to a group of people in one sitting.

The Swassing-Barbe Modality Index (SBMI) (Swassing, Barbe, & Milone, 1979) presents the respondents with three different memorisation tasks. Each task consists of a series of geometric shapes, the order of which has to be recalled after a brief memorisation period. The three tests differ in respect to the presentation modality of the shapes. In the first test respondents see pictures representing each shape, in the second they hear the shape name, and in the third a set of moulded shapes are hidden from view but respondents can feel the shapes with their fingers. Respondents start with a short sequence of shapes and each subsequent task adds one more shape, ending with nine shapes in the longest sequence. The test is taken individually with an assessor who, in addition to marking the answers, also has to observe the respondent in memorisation and try to ascertain their modality preference.

An issue I see arising from the use of these methods is the undefined relationship between immediate response to a word and learning (in the case of ELSIE) and between short term memory for shapes and words and learning (in the case of the SBMI). Although each is measuring some kind of performance, it is not clear whether this performance relates to learning, even if learning is defined as information processing.

2.2.4.3 Validity of instruments

Learning style instruments have varying rates of psychometrical and statistical validity, ranging from no data for most of the instruments that are freely available on the internet, to marginally acceptable data for instruments like the SBMI and the BE Survey. But even when using the instruments where validity *has* been established, discrepancies have been observed between the classification based on the instrument and an individual's performance in learning tasks (R. E. Dunn, 2008; Krätzig & Arbuthnott, 2006). This discrepancy can be understood as being the result of a number of factors, ranging from the way that the questionnaire is answered or the task performed, and the amount of introspection that a respondent is willing and capable to make, to the nature of questionnaires as closed worlds that define their own terms and conditions. Learning is usually wider and more incoherent than the logical structuring that a questionnaire or simple learning task presupposes. The link between a preference identified using these instruments and the outcomes of learning thus needs to be carefully investigated. This does not mean, however that questionnaires are entirely unhelpful, merely that the user should approach them with a measure of self reflection if they are to be of any help (Fleming & Mills, 1992).

2.2.5 Summary of matters pertaining to the definition of perceptual learning style

Three of the main assumptions of perceptual learning style theory – 1) the concept of separate, clearly defined modalities, 2) the ideal of matching instruction, and 3) the use of instruments to identify individual differences – should be understood in more complex ways than is often presented in writings on the topic. This significantly weakens the theory, to the point where many are advocating for its abandonment (Krätzig & Arbuthnott, 2006; Pashler, et al., 2009; Riener & Willingham, 2010). However, many practitioners, including authors in music education, insist on the practical usefulness of the perceptual learning style theory and defend it, often with passion. The question of whether the theory stands up to scrutiny when applied to musical learning informed the initial decision to investigate it in this research project. The pertinence of doing this might be questionable after such a sustained critique as presented here. This study was motivated in part by the questionable nature of the theory, and a desire to investigate the validity of the claims empirically.

2.3 Historical precedents to perceptual learning style theory

Perceptual learning style theory emerged in educational discourse aimed at practitioners in the late 1970s. Several books and articles were published describing the theory and its applications to the classroom (Barbe & Swassing, 1979; R. Dunn & Dunn, 1978; Keefe, 1985; Reinert, 1976). However, when reading these books and articles, it soon becomes evident that there is a want for historical grounding and information on the origins of the theory. There is very little description of the historical, scientific or philosophical underpinnings of the theory, and no cross-referencing between authors who are essentially writing in the same field. In part, this could be the result of writing to a practitioner-based audience, but even those writing in academic journals are typically quiet about previous research. This is also true of the more contemporary authors (Sprenger, 2003), although Fleming does give an overview of the development of his version of the theory (2006a). In what follows, a number of historical

precedents that may have influenced the original perceptual learning style theorists are discussed. The relationships between the theories and perceptual learning style are necessarily conjectural, although some of the theories discussed below have been suggested by later authors as influences on the development of perceptual learning style. The aim here is to present similarities and differences between the theories described and perceptual learning style theory both in order to show the range of thinking around perception, and to try and identify possible influences on the development of the theory as it currently stands.

2.3.1 Grace Fernald

The first, and earliest, possible influence I have located is found in a book on remedial teaching. Grace Fernald (1943) describes her remedial work in reading, writing and mathematics at a clinic school at UCLA. She documented in detail some 15 out of more than 100 case studies where her working method had success. She primarily worked with children whom she called of "normal intelligence" but who had mild to severe reading difficulties. Fernald reports that the root of reading difficulties is an emotional block caused by an inability to form mental images of the words through vision alone (p. 147). This she remedied using a tactile and verbal approach that utilised the child's interests and likes. When a child came to her clinic school, they were encouraged to explore topics that interested them, using media that they enjoyed, such as drawing. They were then asked to add labels to their creative work, and to write stories about the topics they are working on. This encouraged them to learn how to write the words they needed. When a child wanted to learn how to write a word they were given a card on which the word was written in large script: this they traced with their fingers while pronouncing the word in order to form a mental image. When then proceeding to write the word they were not allowed to trace from the card, or look at the card while writing, but had to use the mental image they formed. Fernald writes that

> most cases of reading disability are due to the blocking of the learning process by use of limited, uniform methods of teaching … one of the main blocks is the use of the extremely visual method of presentation with the suppression of such motor adjustments as lip, throat, and hand movements (p. 176).

Fernald maintained that between two months and two years of work with her method would bring children to their age level in reading ability, and eliminate the further need for tactile and verbal techniques. Thus, her technique is intended as an intervention that ceases and not as a permanent classification of the student as a kinaesthetic, auditory or visual learner. The children that came to her were not bound to always use the same methods for every subject that they studied, as is prescribed in the case of perceptual learning style, and were expected to move on from the remedial situation.

In a review of 30 years of publications using Fernald's technique, Collin Myers (1978) cites studies that both support and critique the technique. Methodological design differences between studies he cites make it hard to compare results, but Myers cautions that the technique might only work for some children and cannot be a blanket prescription. He cites one study that compared different remedial techniques and found that over a 10 month period technique use made no lasting difference. This implies that caring intervention is more important than any specific technique, and that the greatest benefit of using a specific technique is for the

confidence and conviction of the teacher. The students benefit because the teacher is motivated and enthusiastic.

2.3.2 Jerome Bruner

One of the names that has been linked with perceptual learning style theory, that of 'representational theory' (Beheshti, 2009; Gault, 2005), derives from the work of Jerome Bruner (1966). Bruner argues that an individual's ability to master a domain of knowledge is dependent, among other things, upon the *mode of representation* of the knowledge. He identifies three ways in which to represent knowledge, and calls these enactive, iconic and symbolic. Enactive representation describes “a set of actions appropriate for achieving a certain result”, iconic representation describes “a set of summary images or graphics that stand for a concept without defining it fully”, and symbolic representation describes “a set of symbolic or logical propositions drawn from a symbolic system that is governed by rules or laws for forming and transforming propositions” (pp. 44-48). Bruner views representation as part of a process rather than as basis for a typology and argues that the general trend is for individuals to move from enactive to iconic to symbolic representation in their intellectual development (Bruner, 1964).

However, Bruner also notes that individuals differ in “massive degree” from each other, and suggests that if a curriculum is to be effective it should “contain different ways of activating children, different ways of presenting sequences, different opportunities for some children to 'skip' parts while others work their way through, different ways of putting things” (Bruner, 1966, p. 71). This comes close to the main formulation of perceptual learning style, although it should be noted that iconic and symbolic representation do *not* correspond to the visual and auditory modalities. The visual modality could process information in both iconic and symbolic representations, while the auditory modality can attend to many things that are not necessarily symbolic, such as noise. This is a significant differentiation between Bruner's conceptualisation and perceptual learning style theory, meaning that Bruner's theory was either distorted, misunderstood or that it played no part in influencing perceptual learning style theory.

2.3.3 Allan Paivio, Alan Baddeley and Graham Hitch

Models of cognitive processes that were published in the early seventies might have affected learning style theorists. Allan Paivio (1971) defined a dual coding mechanism which distinguishes mental imagery, which is non-verbal and usually visual, from verbal symbolic processes. His work directly influenced the visualizer-verbalizer cognitive style dimension (Rayner & Riding, 1997). Alan Baddeley and Graham Hitch's (1974) working memory model (see Ericsson & Kintsch, 1995) proposes a visuospatial sketchpad and a phonological loop in the mind. Each of these deals with information, as their names suggest, of a visual or spatial nature and of an auditory or linguistic nature respectively. These two processes are controlled by a central executive.

These models are still current in some psychological research (see Mayer, 2005 for a model that combines them), but have the weakness of ignoring the role of the body, both in gathering information, and in processing it. But it is not unimaginable to suppose that the idea of different modality strengths could be derived from this work, nor that the concept of individual differences could be incorporated easily into these models. A major hurdle is that these models

are primarily accounting for linguistic or phonological processes rather than all hearing, as is suggested by the auditory modality as defined in perceptual learning style theory. Moving from a conception of a phonological loop to an defining an auditory learner is a broadening of scope that may distort the original models.

2.3.4 Howard Gardner

The early formulations of multiple intelligences by Howard Gardner has also been suggested as an origin of the perceptual learning style theory (Behesthi, 2009), despite the fact that Gardner's first major publication in multiple intelligences post-dates the major learning style works by some years. Furthermore, Gardner is very clear that his conception of different intelligences are not linked to modality. In *Frames of Mind* (1985) he argues that linguistic intelligence is separate from the auditory modality, since deaf children of hearing parents will develop gesture languages that display similar semantic and syntactic properties found in hearing children (p. 86), and similarly, that spatial intelligence is separate from the visual modality since very young blind children are able to navigate and use maps (p. 186). Instead, *each* of the intelligences he argues for draw on *all* the modalities, although some intelligences rely more heavily on one modality or the other, and are disadvantaged at the absence of a specific modality. In this he is closer to Bruner's definition of modes of representation than to perceptual learning style theory. He does suggest, like Fernald, that children with reading difficulties might do well to explore other symbol systems, such as music notation or maps, prior to reading text, and that extreme difficulty might be remedied by recourse to a tactile-kinaesthetic approach, but stops far short of classifying learners into kinaesthetic, auditory or visual learners.

2.3.5 John Grinder and Richard Bandler

A final possible source for the concepts of perceptual learning style theory is found in neuro-linguistic programming, which is a theory and method for conducting psychological therapy sessions. Fleming (2006a) mentions this theory as influential in the development of his version of perceptual learning style, although he distances himself from neuro-linguistic programming as such. In the seminal work of this field, John Grinder and Richard Bandler (1976) maintain that individuals receive information from the world around them through three major 'input channels' (visual, auditory and kinaesthetic), and that this information is used to represent the individuals' experience of the world in a representational system for each of the modalities. They identify the preferred representational system (PRS) in individuals through their use of language, through eye movements, and through self-report (Sharpley, 1984). Grinder and Bandler note that none of the systems are better than the others, and also note that a person might have more than one system, and might alternate between them. They apply this conclusion to the therapy situation, and advocate that therapists should match the PRS of their clients in order to communicate more effectively. They, like the early theorists of perceptual learning style, do not give any indication how their understanding of PRS developed.

The assertions that PRS should be used for better communication has not found much empirical support, and neuro-linguistic therapy (and especially the PRS aspect of it) is now considered by some as “cult psychology” (Roderique-Davies, 2009) or “pseudoscience”

(Devilly, 2005). In an early review on the claims of neuro-linguistic programming, Christopher Sharpley (1987, p. 105) found that:

> data collected in 44 studies clearly indicate an overwhelming finding that (a) the PRS cannot be reliably assessed; (b) when it is assessed, the PRS is not consistent over time; therefore (c) it is not even certain that the PRS exists; and (d) matching clients' or other persons' PRS does not appear to assist counsellors reliably in any clearly demonstrated manner.

Neuro-linguistic programming and perceptual learning style are almost identical in the conceptualisation of the nature of modal dominance, and in the prescription of matching as a way of addressing modal dominance. This places a major question mark over the reliability of perceptual learning style theory. If the PRS aspect of neuro-linguistic programming does not aid counsellors in communicating more effectively, will the same conception help teachers communicate more effectively?

2.3.6 Summary of historical precedents

Of the five possible historical precedents to perceptual learning style presented here, only one, neuro-linguistic programming, contains all of the most important elements of perceptual learning style theory. To have derived the theory from any of the others would have involved significantly modifying the theories in directions that the formulators of the theories did not support. Of course, theory should be modifiable by definition, but in the interest of transparency such modifications should be available for scrutiny by the academic community. It is a glaring weakness of the perceptual learning style concept that its origins are shrouded in mystery, and that most of its major proponents choose not to reveal the influences on their thought, nor even to acknowledge other people working in the same field.

If neuro-linguistic theory is indeed the source of the perceptual learning style theory, then serious doubts about the believability and applicability of the theory need to be entertained, or a significant amount of work done to show that perceptual learning style is a viable description of the ways that individuals learn and of the ways that instruction should take place. The lack of transparency with regards to the precedents of perceptual learning style theory has, however, not hampered the application of the theory to various fields of education, including music education. The next section reviews research on and applications of the theory in music.

2.4 Research on perceptual learning style in music

Research on perceptual learning style in music faces a domain-specific difficulty, since to play a musical instrument involves each of the musician's perceptual modalities intensely. Imagine a pianist reading a musical composition from a score. With her eyes she is concentrating on the score and on the peripheral vision of her hands on the keyboard. With her ears she is listening to the sounds that are made, and comparing them to the sound that her mind imagines she should be making, based on a large store of previously experienced sounds. She is executing thousands of small and detailed muscle movements, and she is acutely aware of the sensation of her fingertips on the keyboard, and of her feet on the pedals. She is also making large body movements in time with expressive moments, underlining them and giving impetus

to the phrasing. Such total involvement in the sensory experience seems to preclude any kind of classification of the experience based on divisions between the senses. The pianist might conceivably argue that her playing was entirely visual, just reading the score, or that it was entirely aural, just listening to the music, however, Dominic Massaro (2004, p. 154) argues that "the perceiver might have a unimodal experience even though multisensory integration contributed to the experience [...] we cannot trust a modality-specific experience as implying that only that modality played a role." Perhaps this is why several of the studies reviewed below only investigate one aspect of music or musical learning.

A number of authors have given conceptual models to how perceptual learning style could be applied in the music studio or classroom, and argue both from their reading of learning style literature and their teaching experience (Beheshti, 2009; Everett, 1997; Garcia, 2002; Gault, 2005; Miller, 2002; Swanson, 2005). A general conclusion from reading these articles is that the best way to engage each student is by introducing concepts through the modality that matches the student's preferred modality. However, this is challenging in a group setting, and thus Beth Miller (2002) argues that teachers in primary school music classrooms should aim to introduce concepts using various sensory tools, and spending a significant amount of time exploring various aspects of one concept. She notes, however, that simply doing activities in various modalities does not mean that understanding will result, since students will not necessarily make the connection between the activity and the concept to be learned. Yayoi Everett (1997) argues that in sight singing and dictation, the skill of transferring information from one modality to another is essential. For instance, in sight singing the aim is to transfer visual information into a kinaesthetic response. This usually happens through mediation of a mental aural representation. She suggests that working towards the integration of the three modalities in the aural classroom is essential. Susanna Garcia (2002) similarly argues that in piano teaching, the teacher should introduce material in the primary modality but then also use others, requiring students to master and integrate each of the modalities.

In a carefully designed observational study of the listening behaviours of primary school children, Robert E. Dunn (2008) found clear evidence of the existence of modality preferences in musical attention. His participants listened to music with either visual, kinaesthetic or no reinforcement. He found that individuals responded differently to these three presentations, with their attention to the music either being aided, distracted or not affected by different reinforcements. Dunn further found that his classification of individuals' perceptual learning style through this careful observation was very different from the classification of individuals by the SBMI (Swassing, Barbe & Milone, 1979). There was a mere 25% correspondence between the two methods of identification. Dunn puts this down to the unreliability of the SBMI, but it could also be the result of students learning or responding in different ways in different domains. In any event, his study places a question mark over using learning style identification instruments in the music classroom, but without disqualifying the perceptual learning style theory. In an earlier study, Diane Persellin and Catherine Pierce (1988) found that primary school children remembered a short rhythm better when it was presented to them in their preferred modality, either aurally, through flashing light or by tapping on their shoulder.

When investigating the relationship between music memorisation strategy and perceptual learning style in college level musicians, Mishra (2007) found weak correlations between learning style preference and memorisation strategy as defined by two self-report questionnaires, with only visual learners seeming to prefer visual memorisation strategies. The majority of participants did not report using aural memory as a preferred strategy. Korenman

and Peynircioglu (2007), however, when investigating the effect of presentation mode (Visual or Aural) and learning style preference on the memorisation of musical and verbal material in an experimental setting, found that learning style had a significant effect on memorisation of short sentences and musical phrases for college level students. Subjects who identified themselves as visual learners through a self-report measure learned both musical and verbal material faster when presented visually than the subjects who identified themselves as auditory learners, and vice versa. The authors argue for the identification of learning style early in musical training, and for the use of materials that cater to the preferences of the students. So, while memorisation seems to be aided by presentation modality, it seems that music students tend to not use a variety of strategies in their memorisation, tending to stick to visual means.

Annabell Zikmund and Glen Nierman (1992) presented primary school children with melodic and rhythmic conservation-type exercises that test the ability to recognise (conserve) patterns in different contexts, and investigated the effect of modality-specific reinforcement on the children's performance. Subjects were grouped according to modality preference through a self-report questionnaire. Two control groups, visual and kinaesthetic, heard only the music, while a visual experimental group received visual reinforcement, and a kinaesthetic experimental group received reinforcement through movement. The experimental groups performed better than the control groups in the conservation-type exercise, but it is unclear whether this is the result of the modality of the reinforcement, or the effect of the control group having no reinforcement while the experimental groups had reinforcement. Dianne Falkner (1994) found that there were significant correlations between third-grade children classified with high musical aptitude and kinaesthetic and visual learners. Students classified with medium musical aptitude also displayed a significant relationship to visual learning. It is somewhat surprising at first that students involved in music are not primarily identified as auditory learners (see also Mishra, 2007), and do not prefer using aural memory, but, as Janet Mills and Gary McPherson (2006, p. 160) note,

> many children exposed to a traditional approach to music instruction begin learning notation from the very first lessons. Without being taught to link the sound of musical patterns with notated patterns these children will probably learn to rely on sight vocabulary, going directly from the visual image to the fingering required to execute this on their instrument.

In an intensive grounded-theory study of pre-school children learning to play violin in a group lesson, Maria Calissendorff (2006, p. 89) found evidence suggesting that learning was “highly individual, varying from child to child.” One of the areas of variance was that of perception, with children responding differently to the same stimulus, and finding individual strategies to learn to play, either preferring touch or sight or sound as a primary sense. Calissendorff's categorisation of the differences between the students she observed is very close to that of the Dunn and Dunn model. Bruce Wood (2007), who observed a similar situation to Calissendorff (young children learning to play violin in a group) also noted differences between students, and described two students who differ on a range of approaches and preferences. One of the differences he noted is that one seemed to have a strong verbal preference, carefully listening to instructions, while the other preferred activity and visual communication. These differences tended to lessen over the course of instruction, as both students gained confidence in playing. Nicole Molumby (2004) documented five lessons with higher music education flute students in a group repertoire class. The lessons were designed to accommodate different perceptual learning styles, and used a variety of approaches, including various movements,

drawing and imagery exercises. She concludes that incorporating learning styles into a group lesson is a "positive and effective approach to teaching standard flute repertoire" (p. 139). It is debatable whether it is the perceptual aspects of the lesson plans that she has devised, or simply the attention that has gone into planning each that has made these interventions "positive and effective."

One difficulty in drawing conclusions from this body of work is that it uses different learning style identification instruments, which might mean that different concepts are being measured, given that not many of the instruments have adequate psychometric properties. However, to summarise, in careful observational studies Dunn (2008), Calissendorff (2006) and Wood (2007) each observed clear differences between young students, which affected their interaction with others and with the learning material. It is not clear how this finding will extrapolate to older populations, such as the one investigated in this study. In experimental studies Persellin and Pierce (1988) and Korenman and Peynircioglu (2007) both found that, when presented with short melodic or rhythmic phrases, the presentation modality affected the retention of that phrase, for both young and college level students respectively. The difference between short term memory and long term memory, and the differences between the complexity of the tasks presented in the experiments and those attempted in a studio when a large-scale work are learned are not accounted for by these results. A further complication is that even though the main tenets of the perceptual learning style theory have weaknesses, as shown above, yet the published research on this topic in music seems to largely support the theory. It might be that only those studies that show clear results are published, with conflicting results left unpublished, but still, from the available research, at least some aspects of musical learning are affected by the way that individuals use perception.

Adapting this information to a classroom teaching situation is daunting, since it requires knowing and catering for each student's preference, or, at the least, thinking about presentation. In this context Setareh Behesthi (2009) argues that in a one-to-one situation, application of perceptual learning style theory is much less complex and therefore becomes much more feasible. Therefore, the question: How can modality preference be identified in musicians?

2.5 Identifying modalities in musicians

Some authors (Beheshti, 2009; Garcia, 2002; Mixon, 2004; Swanson, 2005) have attempted to convert modality types into the musical domain beyond the normal brief definition of what a visual, auditory and kinaesthetic learner is. The vignettes in the text box below presents a synthesis of their descriptions, which are largely similar. The vignettes were used as one of the sources for constructing the questionnaire in the interest of testing the theory as stated, but there are serious theoretical difficulties with some of the assumptions presented in the vignettes. Two areas where a significant amount of research has been conducted, sight reading and memorisation, feature prominently in the descriptions. Research findings from these two areas are briefly discussed below, offering a critical assessment of some of the claims made by learning style theorists.

2.5.1 Visual learners

Visual learners are described as people who retain information that is seen, and retain it in a visual format. They prefer reading sheet music over improvisation or playing by ear, and tend to be good sight-readers. Marks made on the sheet music, especially in different colours, and graphic representations help these learners to concentrate and remember. The visual aspect of demonstration is an important part of their instructional preference, and mirrors and video recorders help them to compare their own performance with those of their models. They might be neat, meticulous, ordered and enjoy focusing on details, which makes them accurate players, and which would also make them excel in theory and analysis. They tend to struggle with memorisation.

2.5.2 Auditory learners

Auditory learners are described as people who retain information that is heard, and especially remember using words. They enjoy discussion, explanations and lectures and easily process verbal information. They like playing by ear and making up songs, but do not read well. Sonority is very important, but also humming or sub-vocalisation as a means of expressing a imagined sonority. Using audio recordings is an important part of their instructional preference, as is modelling (especially vocal modelling) and demonstrating the desired sound. They are continuously looking for new pieces, attracted to different genres, styles and interpretations, and listen to a lot of music. They memorise well because of their ability to remember sound.

2.5.3 Kinaesthetic learners

Kinaesthetic learners are described as people who retain information when they have moved or touched in the learning process, they are hands-on learners who learn by doing. They enjoy moving, and tend to focus on technique and skill, especially playing fast. They enjoy the feeling of playing, don't mind repeating a phrase or exercise many times, and slow motion rehearsal is very effective. They are comfortable with their instruments. They need to move and might play while the teacher is speaking, or seem restless a lot of the time. Demonstration, repetition, emotional engagement and movement are important features of their instructional preference. They memorise tactually, and as a result struggle to change fingerings or movements.

These summaries are based on Beheshti, 2009, Garcia, 2002, Mixon, 2004, and Swanson, 2005.

2.5.4 Sight reading

It is claimed in these vignettes that visual learners are good sight readers, while auditory learners are not good readers. While it is true that individual differences in the abilities of advanced musicians to sight read exist, Andreas Lehmann and Anders Ericsson (1996) show that sight reading is a form of expert activity that has been developed in individual musicians

through deliberate practice, or through engaging in activities that force skill development, like accompaniment, rather than an innate ability. The predictors of sight reading success in their study was amount of accompanying experience and size of accompaniment repertoire. Richard Kopiez and Ji In Lee (2008) identify twenty-three predictors of sight reading ability in their study. Of these, trilling speed, sight reading expertise acquired before the age of fifteen, speed of information processing and inner hearing predicted 59.6% of the variance in sight reading ability. Other researchers who have studied the predictors of success in sight reading have found that audio-spatial skills and technical proficiency (Hayward & Gromko, 2009), rhythmic sight reading ability and performance ability (Elliott, 1982), and text reading ability, rhythmic pattern discrimination, spatial-temporal reasoning and styles of visual perception (Gromko, 2004) all also have an effect on the ability of musicians to sight read. This range of predictors of sight reading ability are not limited to the visual modality, but include auditory and kinaesthetic aspects, such as inner hearing and trilling speed.

In an earlier study, Kopiez and Lee (2006) showed that the influence that predictors exert on sight reading accuracy is also dependent on the difficulty of the material to be read. So, for easy material, general pianistic expertise is the strongest predictor of success, but as difficulty increases, psychomotor speed, speed of information processing, inner hearing and sight reading expertise become stronger predictors of success. At the most difficult level, sight reading expertise remains important, but psychomotor speed becomes the strongest predictor of success. Thus, the notion that sight reading (or even just reading) might be solely affected by someone's visual learning style seems somewhat naïve. The number of factors influencing expert sight reading paints a much more complex picture. It might still be argued, however, that the initial interest and motivation to participate in sight reading could be a result of a visual learning style, but this should be carefully separated from the development of expertise in sight reading, and the suggestion that someone is a good sight reader because of some innate capability only.

2.5.5 Memorisation

The vignettes describe auditory and kinaesthetic learners as good memorisers, while visual learners are assumed to struggle with this aspect of learning. Expert memory is differentiated from other types of memory by three principles: the meaningful encoding of novel material, the use of a well-learned retrieval structure, and rapid retrieval from long-term memory (Chaffin & Imreh, 1997). Memorisation ability and skill thus also seem to develop with experience in playing. Aaron Williamon and Elizabeth Valentine (2002) investigated the practising of pianists, ranging from beginner to pre-expert. They found that more able musicians used the structure of the music to structure their practising to a greater extent, and that if a musician used the structure of the music early on in their practice, this correlated with the quality of their performance. As practising progressed, musicians increasingly made use of the structure of the music to guide their practising. However, in Jane Ginsborg's (2002) study, more experienced singers did not necessarily memorise better than less experienced singers. This suggests that memorisation ability is not just a product of musical expertise, but is a separate skill. Lorna Jakobson, et al. (2008) show that highly trained pianists have an advantage over non-musicians for delayed free recall of verbal and visual material. This suggests that musicians also develop more general memory function though musical memorisation training.

Chaffin (2007) found that performance cues often correspond to musical boundaries, such as the starts of sections or phrases. Williamon and Tobias Egner (2004) also confirmed that

pianists use structural bars as memory cues to help them in their retrieval of complex musical material. They collected EEG and ERP data from pianists who were asked to recognise whether visually presented bars occurred in a composition they had memorised for the purposes of the study. Structural bars were recognised faster and with greater accuracy than non-structural bars.

Taken together, this research suggests that memorisation largely rests on forming some kind of understanding of the structure of the piece, and forming cues which guide the musician through this structure. This skill is learnt and improves with gaining expertise. Could it be that visual learners are worse than kinaesthetic learners in memorising as suggested by the learning style theorists? It might be that there is an initial attraction/aversion to memorising, but current research suggests that skill in memorisation is learned and developed. Thus this claim should be rejected on the basis of the research presented here. This does not mean, however, that memory is free from perceptual influence. Ginsborg (2004) argues that musicians rely on four kinds of memory: Kinaesthetic, Aural, Visual and Conceptual (also see Imreh & Crawford, 2002). She argues for a mixture of sensory and conceptual memory as the most stable and reliable, but allows that there might be differences in how individuals prefer to memorise. Indeed, research shows that individuals use different strategies to memorise. This was also reflected in Hallam's (1997) study of professional musicians, where a range of attitudes toward and strategies for memorisation were described. These strategies ranged from purely automated to conceptual in nature.

2.5.6 Summary of the identification of modalities in musicians

In research on both sight reading and memorisation, the developmental aspect of gaining skill is clearly emphasised. Both these activities are understood to be learned through engagement in the specific practice, and not as the result of an innate ability. That there might be an innate ability that motivates the work and lays a ground for this process to start cannot be disproved, but one should be careful to draw causal relationships between different processes. It is evident that perceptual learning style theorists have not clearly defined the construct, and are adding elements of variability that are not related to the construct into their definitions, possibly in an effort to make it educationally viable. It does not follow that once one has classified someone as a visual learner and another as an auditory learner, that all differences between them are then necessarily a result of their perceptual learning style.

Consider the claim, again from the vignettes, that visual learners would be focussed on details, resulting in them being accurate players. This seems to conflate a number of influences: attention to visual detail, discipline in practising, and motor control. While the first influence might be a result of having a visual learning style, the other two seem more related to self-regulation and to the kinaesthetic learning style respectively. If learning style were to be a viable construct, it would need to be very carefully defined and delimited from other forms of variability. Whether this is at all possible remains to be shown.

2.6 Implications

This review has noted that a number of assumptions in perceptual learning style theory, as defined by a variety of authors discussed, might be overly simplistic. The notion that our senses function completely independently from each other in separate channels was challenged, and an

understanding of the multimodality of experience was suggested. Individuals may often experience sensory information as stemming from a single modality, but there are subtle influences of the other senses present at all times. Further, the matching hypothesis, that instruction should be adapted to fit the preference of the student, has been questioned, both from a lack of convincing research and from teachers who note that it is practically challenging to achieve this. The matching hypothesis is further weakened when considering that various learning style instruments may be defining different constructs; which result should teaching be based on? The review has also challenged the notion that learning style could be said to account for an individual's skill level in a certain domain. While perceptual preference or dominance might influence choices in these matters, involvement in the activity and expertise gained as a result are much stronger influences on building skill levels.

Nevertheless, the review has highlighted a number of researchers who have positively identified perceptual dominance and its effects on musical learning of various kinds. There are clear differences in studies that investigate short term memory for musical elements, and also between young students who are learning to play an instrument. With more advanced students there are some differences in short term memory, but these are blurred when it comes to descriptions of their memorisation. The notion that individuals differ from each other in how they use perception seems to be empirically supported, although the notion that instruction should be adapted to suit this has much less support. Whether the distinction made on the basis of modalities holds up in the practising of advanced musicians has not been investigated, and is one of the aims of this thesis.

It remains a fascinating question why, given these difficulties with the perceptual learning style theory, it keeps such a strong support base, and seems to be effective for many teachers. Hattie (2009) argues, as a result of his comprehensive review of thousands of research papers studying teaching interventions, that increasing the rate of feedback between teacher and student, and student and teacher, has one of the largest effects on student achievement in the school context. One of the ways that perceptual learning style theory *can* function is to start a conversation between the teacher and student regarding what works in the student's learning. This most likely results in improvements both in their relationship and in their joint ways of working, and this inbuilt reflection and feedback may account for a large portion of the support that the perceptual learning style theory garners. However, when the theory is used as a rigid classification tool, and only that, this will certainly be to the detriment of both relationship and work. Perceptual learning style may also function as a base on which to build self-efficacy, through emphasising that learning is possible to all and that it is a matter of finding the right strategies and behaviours. These positive effects may be why the theory continues to gain support, although its effectiveness may be for reasons that its supporters have not considered, and despite serious theoretical flaws.

Using a variety of perceptual stimuli and approaches in teaching music will in most cases be beneficial to the student, and although perceptual learning style theory is insufficient as it stands and is in need of clearer definition and delineation, it still offers a heuristic tool for teachers to think through perceptual variety in teaching and what it might mean (Odendaal, 2010). There has been a tendency for Western Classical music instruction to be visually driven because of the importance of notation in the tradition (Mills & McPherson, 2006, p. 160), and other strategies might open up to teachers and musicians when they approach the task using such an heuristic tool. Seeking what works best for a particular student and striving for variety in teaching approach is something that any good teacher will do in the course of their work. Most learning

style models offer a structure within which various options can be tried. Given the lack of evidence for any measurable benefit in matching particular materials and approaches with a specific learning style, it would be ill-advised to embark on an extensive analysis of students and application of these ideas, but if they are used to inspire variety and to reflect on other avenues of teaching concepts, this can be encouraged.

3 Research Methods and Participants

The previous chapter used existing research to highlight some of the definitional difficulties surrounding perceptual learning style theory. For some readers, the argument presented there would be enough to dismiss the theory entirely. In this study, however, the discrepancies between the argument presented and those of advocates of the theory motivated an empirical inquiry to ascertain which aspects of perceptual learning style theory can be described in the practising of students in higher music education. Furthermore, as described in the introduction, the critical view developed in the previous chapter took some time to be clearly formulated. During the research process there was uncertainty surrounding the theory, but not yet enough to dismiss it completely. The data gathering presented here had a strong influence on my understanding of the theory.

A sequential mixed-methods approach was chosen to provide a range of perspectives, in order to add clarity and validity through triangulation between the perspectives. The methods of questionnaire for the first study, and observations and interviews for the second study, were chosen to allow broad comparisons between individuals and groups of individuals together with in-depth perspectives on the work of specific individuals. In the planning stages of the study an experimental approach was considered, but rejected in favour of a more naturalistic observation study. Experimental studies have the weakness of focussing on limited tasks, and are useful for answering focussed questions, but not for gaining an understanding of how something like perceptual learning style functions in the day to day practising of musicians.

In the rest of this chapter, mixed-method research is briefly introduced (3.1) followed by a discussion on the methods used in the questionnaire study (3.2) and the observation study (3.3). This is followed by a discussion of ethical matters pertaining to the research project (3.4).

3.1 Mixed methods research

As with the two perspectives on learning identified in the introduction (the cognitive, acquisition-oriented and the situative, participatory perspectives) it has been common to describe two general families of research methods, quantitative and qualitative, with a recent addition of mixed-method approaches sharing some characteristics of both families (Creswell, 2002). These families have typically been associated with one or the other forms of learning, with qualitative researchers tending to prefer the situative and participatory understandings, while quantitative researchers have tended to focus on the cognitive and acquisition-oriented understandings. This methodological divide is, however, as misleading as the divide between the perspectives on learning. Manfred Bergman (2008, p. 14) has recently argued that

> the members of these two families vary tremendously within their own family to such an extent that it is difficult to identify a unique set of qualities that encompasses the characteristics of one family of methods, and that is clearly distinctive from the characteristics of the members of the other family.

The current research draws from a range of research methods that have been typically assigned to one or the other families, by using statistical analysis of a questionnaire in the first study, and coded micro-analysis of video taped observations of practising sessions, and qualitative content analysis of unstructured interviews in the second study.

The motivation for selecting these methods, apart from the need for triangulation, lies in the post-positivist epistemology that forms the basis of this research. This perspective is summarised by John Creswell (2002, p. 8) into 5 points: 1) knowledge is conjectural and evidence is imperfect and fallible, but this does not imply that everything goes, since it is; 2) possible to conduct research, which is a process refining or abandoning a theory, that may have an impact on; 3) knowledge, which is shaped by data, evidence and rational argument. 4) One of the aims of such research is to explain a situation or causal relationships while; 5) reducing bias from methods and conclusions is an essential aspect of competent inquiry. Creswell goes on to argue that holding a defined epistemology will lead a researcher to the use of a specific methodological family, but Bergman (2008) argues that epistemology, data collection and data analysis should be carefully separated. He argues that it does not follow that a certain epistemology should always use the same data collection and analysis methods. The mixed methods approach is often used in an attempt to reduce bias by comparing results from different perspectives, which aligns well with a post-positivist epistemology but does not presuppose a predisposition only to quantitative method, as Creswell suggests, since a range of methods are accommodated by the approach.

In the rest of this chapter, the methods used in this research project are discussed under two headings. First is a description of the questionnaire study (3.2), including the aim of the study, a brief theoretical discussion on using questionnaires, followed by the design and final construction of the questionnaire, the sampling strategies, and a short section detailing a justification of the analytical methods. Detailed descriptions of the analytical choices, and validity and reliability are discussed in Chapter 4. A description of the observation study follows (3.3), including the aim, a brief theoretical discussion on stimulated recall as method, descriptions of the participants, interview procedures, and the analysis procedures for both the observations and interviews. The chapter concludes with a discussion of ethical considerations in this research project (3.4).

3.2 Questionnaire study

3.2.1 Aim of the questionnaire study

The aim of the questionnaire study was to identify whether there are patterns in the ways that music instrument students in higher education describe their practising behaviours and strategies, and to relate these (possible) patterns to perceptual learning style theory. The questionnaire specifically asked about the frequency of the use of practising strategies and behaviours that were employed to learn new large-scale standard repertoire works, and the

analysis attempted to identify patterns in the selections of the sample population. It was hypothesised that, since the questionnaire was constructed around perceptual learning style theory, the patterning that emerged in the analysis would support the categories of perceptual learning style.

3.2.2 Criticisms of questionnaire research

A survey is a systematic investigation of a group of people, through observation or interview. As such it has a number of characteristics, chief of which is standardisation, getting "consistent answers to consistent questions" (Sapsford, 2007, p. 7). One of the least time-consuming and simplest ways of going about this is through the use of questionnaires that are answered by closed-ended rating scales. There are, however, a number of criticisms of this approach, both epistemological and practical.

Chief of the epistemological criticisms is that A) this method draws on "mildly-positivist" assumptions about knowledge and reality. Alan Buckingham and Peter Saunders describe these as: 1) scientific knowledge has to be grounded in sensory experience of things; 2) terms are only labels for things and don't reveal more than experience can; 3) all science should follow the same method: observation and testing; 4) science should be value free (2004, pp. 19-20). However, as Bergman (2008) has argued, it does not follow that epistemology and method should be perpetually linked. It is entirely possible, for instance, to conduct a survey without the assumption that it is value free, since it is not even clear that it is possible to be value free in any form of research (Williams, 2010). The post-positivist assumptions described by Creswell can as easily be a starting point for using questionnaires as the "mildly-positivist" assumptions described by Buckingham and Saunders.

Two further objections are that B) questionnaires are instruments of power and domination and that C) they suppress the voice of those who respond to them, putting numbers to their experiences. Buckingham and Saunders (2004, p. 35) point out that this is not necessarily the case, and that while these objections should be considered, it is possible to construct questionnaires (or other forms of data gathering) without falling into either of these traps. In the current research this is a pertinent issue, since I have already shown that the theory on which the questionnaire is built is theoretically unsound (although this was less clear at the time of construction). However, for this reason the questionnaire in its final form did not force the respondents into choosing a specific perceptual learning style preference, but rather asked about the frequency of their use of certain behaviours and strategies. In doing this it offered a heuristic tool for the respondent to use with regards to their own practising without strongly pushing the theoretical agenda, and allowed me an opportunity to see if the theory could be identified from the patterns in which questions are answered. So, although there were still issues of power and voice, an attempt was made to mollify their effects, and to present an exercise that could also be beneficial to the respondent.

Further objections centre around the assumption inherent in self-report measures: that what people report on after introspection is true. Ralph Rosnow and Robert Rosenthal identify some challenges to this assumption: D) anxiety may result in evasive or biased responses; E) people may rightfully choose to withhold information; F) some people are unable to give accurate self-assessments, generally overestimating themselves (2008, pp. 97-98). The first objection is typical in situations where sensitive and/or possibly damaging information is being requested,

as in some psychological measures. This was not deemed to be an issue in the current study. The other two objections are factors in any research design involving self-reflected human response, and is also an issue in the second study where stimulated recall interviews are used. The inclusion of observation data into that study was an attempt at bringing another perspective in order to allow for comparison between the self-report and what can be observed. There is thus some check for this difficulty: if the central results of both studies are similar, that shows a level of trustworthiness in the respondents' self-assessment. Furthermore, the studies are about behaviours and strategies that form a central part of the daily praxis of the musicians involved. A considerable portion of each week is spent practising or thinking about practising (Ericsson, 1997; Jørgensen, 1997). These studies are not asking about insignificant details, such as the colour of the cars that passed them on the way to school this morning, but about activities and behaviours that are both important to them, and engaged in regularly.

A further objection lies in the G) fallibility of human memory. Daniel Schacter (2001, pp. 4-5) argues for seven areas of memory imperfection, of which three are relevant to the use of questionnaires: human memory is transient, memories get mis-attributed to sources, and are biassed through current experience. However, these problems are common to all human remembrance, and are thus issues in any form of research involving human interaction, including the self-report interview technique used in the second study. Drawing from various data sources is the most practical solution to the imperfection of human memory. In the current study this takes the form of allowing comparisons between what is said by many, what is said by an individual, and what that individual is seen to do. It is important, in the light of this issue, not to treat the questionnaire data as reliable accounts of actual historical practice, but rather as idealised perspectives revealing some of the ways that respondents think about their practising.

Another way of addressing these issues is through ensuring the validity and reliability of the questionnaire as far as possible. Typically, three types of validity are of central concern in a questionnaire study. Rosnow and Rosenthal (2008) define these as i) content, ii) criterion and iii) construct validity. Content validity is attained when the items represent the kinds of material (or content areas) they are supposed to represent (p.139). Criterion validity is attained when the test is correlated with one or more outcome criteria (p. 140). Construct validity is the measure to which the test has the ability to discriminate what it is measuring (p. 141). The validity of the questionnaire used in this study will be discussed in more detail in the discussion of results, as it is a central argument in that discussion.

Taking the epistemological and practical objections into consideration still leaves Buckinham and Saunders to conclude that it is possible to test theories on the basis of insight gained into people's actions, attitudes and attributes after asking them questions and recording their answers systematically. The results of research of this kind are not necessarily determined by the theory. Even when a questionnaire is dependent on theory, it is possible that results may challenge the starting points of the research, as will be seen later in this study. The testing of theories can validly be done through statistical procedures without necessarily mindlessly tabulating or disregarding individual distinctiveness (2004, pp. 35-36).

3.2.3 Development of the questionnaire

3.2.3.1 The influence of learning style identification instruments on the questionnaire

At the outset of the research project the questionnaire was intended to mimic existing learning style identification instruments such as ELSIE (Reinert, 1976), the SBMI (Swassing, et al., 1979), VARK (Fleming, 2006b), or BE (Rundle & Dunn, 2007). These instruments utilise either self-report or some measure of performance and have been described in some detail in the literature review (section 2.2.5).

The first pilot of the questionnaire, using members of the doctoral seminar in Music Education at Sibelius Academy (n=11), was an attempt to include aspects of both performance-based and self-report methods in order to design an instrument that identifies perceptual learning style in musicians. The SBMI is no longer published, and no copies could be sourced for the purposes of this study. Furthermore, the instrument requires individual administration, which would have reduced the sample size considerably. No way could be conceived of incorporating the method used by the instrument into a group setting. An attempt was thus made to emulate the method of ELSIE in the first pilot study. This failed because of a number of issues, including:

- The way a word is read influences one's response to it. It is unclear how this was controlled in the administration of ELSIE. Reinert (1976) describes pre-recording all his words, but no mention is made of voice tone variation across words and how they affect response. The wording of the responses was furthermore difficult to understand for some of the Finnish first language speakers. Accent and pronunciation differences between different cultures should also be considered in the administration of this instrument.

- What happens when a respondent has more than one reaction simultaneously? The model does not account for it. Neither does it account for possible other reactions that might include a visual, auditory or kinaesthetic response, but where this is not the primary response.

Thus, since neither of the existing performance-based methods were viable, and because of a move away from designing a learning style identification instrument to designing a questionnaire that can be used to investigate the relationship between strategy use and perceptual learning style, it was decided that self-report would offer the most reliable results for the purposes of this study. The questionnaire was redesigned, drawing on current research about practising. The second pilot, using a redesigned questionnaire, was run with attendees at the Nordplus Intensive Course for Masters Students in Copenhagen, Denmark (n=4). In the first two pilot studies, respondents also gave verbal and written feedback on their understanding of items, and commented on the theoretical implications of the questionnaire. These first two pilots used English questionnaires.

A third pilot used both an English and a Finnish version of the questionnaire. The Finnish version was translated from the English by a professional translation company that has

experience in translating texts with musical terms. A group of opportunistically sampled students from Metropolia University of Applied Sciences and the Helsinki Conservatoire (n=23) formed the sample. (These two institutions share a building.) Preliminary analysis of this sample (Odendaal, 2011) indicated a common stock of strategies, such as playing slowly, reliance on notation, focus on technically difficult sections, and an aversion to writing, apart from writing on the score itself. A Chi-squared test showed that 33 of the 47 main items were answered in significantly similar ways with heavily skewed responses. The remaining 15 items allowed for more differentiation to be made between individuals. These items largely involved non-playing strategies, such as the use of visualisation, silent rehearsal, and vocalisation.

Some minor revisions of the wording of three items followed after this analysis. Although it was apparent from this preliminary analysis that some questions did not allow for differentiation between individuals, these were not excluded from the final questionnaire. This decision was made because the questionnaire was not very long (it generally took less than 10 minutes to answer), nor very demanding, and since the preliminary analysis was based on such small numbers: these items could prove to be more important with a larger or more differentiated sample (Hill & Lewicki, 2007, p. 8).

3.2.3.2 The influence of research on perceptual learning style and strategy use on the questionnaire

In order to have appropriate descriptions of practising behaviours and strategies as they relate to perceptual learning style theory, existing theory and research was used in constructing the questionnaire. Firstly, the theoretical literature on learning style and music (Beheshti, 2009; Garcia, 2002; Mixon, 2004; Swanson, 2005) describes characteristics of the ideal visual, auditory and kinaesthetic learner (summarised in the vignettes, see section 2.5). Some of the least problematic characteristics listed there were adapted to be included in the questionnaire. Secondly, some researchers on practising and learning strategies provide lists or examples of specific strategies and learning behaviours that musicians are observed to use, or say that they use (among others: Hallam, 2001a; Holmes, 2005; Hultberg, 2008; Miklaszewski, 1995; Nielsen, 2008; Sullivan & Cantwell, 1999). From these lists, items that seemed to describe some identifiable aspect of perceptual modality use were identified and adapted to be included in the questionnaire. Thirdly, items from Mishra's (2007) Musical Memorisation Inventory, which attempts to identify modality use in memorisation, were also adapted and included.

This process resulted in 47 items that address specific modalities or mixtures of modalities in the final version of the questionnaire (see Appendices A and B). These items were balanced in the ways that they seemed to focus on visual, auditory or kinaesthetic responses or behaviours, with 15 or 16 items in each category. Each item was given a descriptive code based on this loose classification (such as V1, A5 or K16), but because such a classification is problematic, these codes were only used as labels and not to drive the analysis.

Respondents to the questionnaire were asked to imagine that they are starting to learn a new large-scale work from the classical or romantic era. The limitation in style period was added because it was assumed that different style periods pose different demands on the learner, and this might affect which strategies are applied. Also, all students are required to play repertoire from this style period, and will have had experience in learning these kinds of works. Asking respondents to imagine rather than recall means that they described their ideal practice

situations rather than (partial) recall of what happened previously. Large-scale presupposes a certain level of difficulty, although this is not explicitly defined. Respondents were asked to respond to each item, indicating the frequency with which they would use such a strategy or behaviour using a 6 point rating scale (never, very rarely, rarely, occasionally, frequently, always). Although this is a vague scale, and open to interpretation, it was felt to give as accurate data on the attitudes of the students as a more specific scale involving defined time frames would, without putting undue strain on conscientious respondents. The questionnaire does not measure actual historical data on the practising of individuals, but rather attitudes and opinions, and for this purpose the vague scale was deemed sufficient.

Although the questionnaire was designed to conform to and to investigate perceptual learning style theory, it was decided to obscure the purpose of the questionnaire somewhat, in order to avoid the possibility of respondents trying to answer in ways that they suppose the theory dictates. The theory is popular and well known, and many respondents might have had an opinion on how to classify themselves, and what that might mean for their practising. It was decided to try and avoid this bias as much as possible, thus the theory was not mentioned on the questionnaire, nor in the introductory talks. Nine distractor items regarding organisation of time and resources were added, giving the questionnaire the appearance that it is about practising in general rather than about perceptual learning style. The 56 items were presented in randomized order over two pages in order to further obscure the organisation of the questions, to help improve validity, as clustering similar items together may again lead to a bias in answering (Schriesheim & Denisi, 1980).

On a third page some demographic information was also requested, including the primary and secondary instruments played (if any), the primary and secondary styles or genres played (if any), current degree and year of study, years of learning, age, and number of teachers. The cover page introduced the research project, clarified the voluntary nature of the questionnaire, and provided contact details for further requests and communication. The Finnish and English versions of the questionnaire can be seen in Appendices A and B.

In the questionnaire, some items share the same stem but each a different modality focus. For instance, one stem was, “One of my aims is to...” followed by aims that describe different perceptual foci. Four such groups of questions were included in the questionnaire. They typically consist of three items, but one group had five items, thus a total of 14 items were constructed in this way[9]. These groups were used in the cluster analysis (section 4.2.2), and also in a separate factor analysis (see Appendix F). The remaining 33 items were not necessarily conceptually related in the same way, although there were some items that shared either a similar theme or behaviour[10], and others that were logically exclusive with another item[11]. These pairings were not, however, specifically considered in the statistical analysis.

3.2.4 Sampling

The theoretical population that this study focussed on and hopes to generalise to is Western Classical musical instrument students in higher education in Finland. The study population was the Western Classical musical instrument students of the Sibelius Academy, Helsinki. Putting an

9 V1, V11, A2, K3 and K4; V3, A1 and K2; V14, A16 and K1; and V2, A12 and K12.
10 V7 and V8; V9 and V10; A4 and A5; A7 and A8; A9 and A11
11 V5 and V6; A13 and A14; A10 and K9

exact figure to this sample is somewhat difficult. According to the admissions office of the Sibelius Academy, in the academic year ending in 2012 the orchestral and piano departments together had 415 students, all of which were instrumentalists studying western classical music. The church music department was largely classically and instrumentally oriented and had 101 students in Helsinki. The music education department accepts students from any musical background, and this background is not specified in the records I had access to. The department had 231 students. The arrangement and composition department had 56 students, most of whom were classically trained instrumentalists. Thus the total amount of western classical instrumentalists in the Academy was somewhere between 415 and 874 for the academic year ending in 2012.

The sampling frame consisted of targeted samples within the Academy. Given that electronic surveys often yield lower response rates from student groups than paper based surveys (Sax, Gilmartin, & Bryant, 2003), it was decided to follow a paper-based strategy. It was felt that students would be more willing to give time to answer a questionnaire when they have personal contact with the researcher. I also offered a small gift in thanks to those who participated. Several avenues for finding instrumentalists to answer the questionnaire were pursued. One of these was that teachers of instrumental pedagogy and general pedagogy were approached via email to offer time in their classes for students to answer questionnaires. This was met with mixed responses. Some teachers graciously offered 10 minutes of their teaching time, while others, understandably, requested that I introduce the research but that the questionnaire itself be completed outside of teaching time. This second set of classes yielded a much lower response rate. Two data collection sessions took place at the end of the academic year ending in 2011 and four others in the beginning of the academic year ending in 2012. In total, this avenue yielded 58 responses.

Another avenue was the orientation period for new students at the beginning of the academic year ending in 2012. The questionnaire was briefly presented and then handed to a group of mostly first year students. The organisers continued with their own program when they felt that enough time had been devoted to this task, even though this was prior to anyone finishing the questionnaire. Students thus continued answering while a presentation was being given. This presented a significant challenge to the validity of the data, since it means that students had a divided attention for answering at least some of the answers. Visual inspection of the questionnaires seem to indicate that respondents carefully considered their answers despite the possible distraction, with several corrections evident in the written questionnaires. This is assumed to mean that respondents had indeed read and thought about the questions, and not just randomly selected how to answer them. 91 responses were gathered from this group.

A further sampling avenue opened through the orchestral activities at the Academy. The orchestral manager agreed to place questionnaires on the orchestral musicians' music stands together with their sheet music, and to request the students to answer the questionnaire. This was done with the baroque orchestra, the symphony orchestra, the wind orchestra and the student orchestra in the spring term of 2012. Time pressures prohibited many students from answering, because rehearsals took place in the evenings or over weekends, and students were not willing to stay after the rehearsal to answer the questionnaire. It might also have been better for the researcher to be present. Only 16 responses were gathered from this group.

In total 165 responses were gathered. The refusal rate is hard to estimate, since many respondents, for example, both play in an orchestra and attend a instrumental pedagogy class,

and so some respondents might have refused to respond more than once, or may have answered the questionnaire in one setting and thus did not need to in another. In all, the questionnaire was presented an estimated 390 times to individuals, although several of these were duplicate presentations. This suggests a response rate of about 40%, which is deemed acceptable. In comparison, Linda Sax, Shannon Gilmartin and Alyssa Bryant's (2003) large scale survey noted a response rate of between 17 and 24% for different university campuses. In a study with a similar population, Ginsborg, Williamon and Gunther Kreutz (2009) had response rates of 10,6% and 29,7% for two different colleges of music.

In the current study, responses were digitised by an independent coder, and each response checked for consistency by the researcher. The six level rating scale was given numeric equivalents ranging from 1 for never to 6 for always. To start analysis, those respondents who were not self-identified as classical instrumentalists were removed from the response pool. These were 8 singers[12], 6 folk musicians, 12 music education students who were specialising in either popular or jazz music, 4 music technology students and 4 jazz musicians. None of these groupings were large enough to form a statistical analysis unit, and the students belonging to these groups were too disparate in their interests and foci to unite into an analysis unit. This left 131 students from 4 departments, who together represent 15% of the total number of students from those departments (see Table 4). This gives a confidence interval of 7.9 at the 95% confidence level.

Table 4

Number of responses to the questionnaire received, and analysed

Department	**Number of students in the department**	**Number of questionnaires received**	**Number of questionnaires included in analysis**
Church Music	101	13 (12.9%)	13 (12.9%)
Classical	463	101 (21.8%)	101 (21.8%)
Composition and Theory	56	3 (5.4%)	3 (5.4%)
Education	254	26 (10.2%)	14 (5.5%)
Folk Music	85	6 (7.1%)	0
Jazz	55	4 (7.3%)	0
Music Technology	36	4 (11.1%)	0
Singing	76	8 (10.5%)	0

12 Although, in Finnish, singers can also be said to play (sound) their instruments, they were excluded from the analysis because the questionnaire was intended for use by instrumentalists. Some items might not be answerable by singers.

3.2.5 Analysis

Perceptual learning style theory predicts that a visual learner would answer more visual items positively, an auditory learner would answer more aural items positively and a kinaesthetic learner would answer more kinaesthetic items positively. This trend, if it exists, can be revealed through statistical analysis. This trend is also based on the assumption that perceptual learning style can be identified through the strategy use of individuals. Since the questionnaire did not posit clear dependent and independent variables, but rather assumed that individuals will answer groups of questions similarly or dissimilarly, factor and cluster analysis were selected as analytical tools, rather than regressions or other analyses of variance.

Factor analysis aims to reduce the number of *variables* by positing an underlying variable based on the similarities and differences between the answers of the respondents and to detect structure in the relationships between the variables (Hill & Lewicki, 2007, p. 265). In the case at hand, factor analysis would shed light on whether there is a common visual, auditory or kinaesthetic variable behind the responses to items of the questionnaire.

Cluster analysis, on the other hand, aims to highlight similarities and differences between *respondents* on specific variables (Green, Carmone, & Smith, 2011). Cluster analysis would help identify whether, for instance, individual respondents answer different items classified as visual in similar ways. It further enables us to see whether, for example, all the respondents that answered the similarly to one visual item, will also answer similarly to other visual items.

Unlike classic regression analyses, neither of these methods provide strong measures of reliability, such as p scores, and both depend to a large extent on the judgement of the researcher for final interpretation. In this regard they are somewhat similar to more qualitative research techniques, for the burden of proving the validity of the interpretation lies with the researcher rather than with the statistical procedure. In the discussion of results the decision making process is spelled out to allow the reader to decide if the conclusions drawn from the analysis can be supported by the analytical method. Issues of validity are discussed in the chapter 4.

3.3 Observation study

3.3.1 Aim of the observation study

The aim of the observation study was to describe the differences that can be observed between the practising of individuals and their descriptions of this practising, and to relate these differences to perceptual learning style. To be able to make this comparison, the practising of six pianists was recorded using a video camera on four different occasions each for about 20 minutes (except Rosalyn, see below) and each pianist was interviewed immediately after each session, using the video recording to stimulate recall of their behaviours, strategies and intentions. They were asked to practise two different pieces, and each piece was observed at two different stages in its learning development. In an ideal research situation, they would each have taken the same unfamiliar works to learn, and would each have been observed at the same stages of development. However, it was not possible to impose these restrictions on the participants, since they were under pressure to learn and perform their own repertoire, and could

not sacrifice additional time to learn repertoire for a research study. Furthermore, motivational factors impact on strategy selection (Renwick & McPherson, 2002), and it was felt that if the pianists were allowed to play music of their own choice, which they were preparing for their own purposes, this would give the most naturalistic observations of their work, and disrupt their progress the least. In the end, pragmatic decisions on the part of the participants, informed by discussions with the researcher, dictated repertoire choice and time of observation.

Pianists were selected because I am trained as a pianist, and was thus familiar with some of the conventions of piano playing. While there is something to be said for the perspective an innocent observer brings (see, for instance, the apporach of Clot, 2009), the familiarity of piano was important to me as novice researcher. It was further important to have participants who played the same instrument, as there may be inter-instrumental differences in practising behaviour and strategy (Gaunt & Hallam, 2009; Jørgensen, 1997; Kemp, 1997). Pianists are also one of the most numerous groups in the student population, making the task of finding six willing and available volunteers somewhat easier.

Having four observations of two works allowed, firstly, for clarity on which behaviours and strategies were specific to a problem, and which were more generally applied in several situations. Perceptual learning style theory predicts that visual learners will consistently use visual strategies more than the other types, auditory learners aural strategies, and kinaesthetic learners kinaesthetic strategies. Comparing different practice situations allowed this prediction to be investigated. It also allowed, secondly, for the pianists to become comfortable with the situation and the researcher. Stimulated recall was chosen as an interview technique to allow the participants to explain some of their own behaviours and strategies, and to focus the interview on recently completed actions rather than general principles of practising or events that may not be as fresh in their memories, although the discussion often turned to more general principles as participants elucidated what they were seeing, or trying to describe.

3.3.2 Stimulated recall as method

Stimulated recall has become a popular research method, and has been used within research on music as a means of investigating the thought processes involved in, for example, lesson interaction (Rowe, 2009), interpretation seeking and rehearsal (Hultberg, 2008), practising (Nielsen, 1999b) and compositional process in both classical and popular traditions (Pohjannoro, 2013; Söderman & Folkestad, 2004). It is considered to aid naturalistic observation, by which is meant observation of thought processes and decision making in the context in which they occur most often, and with minimal interruption of that process (Lyle, 2003). The intended research situation is typically videotaped in the space where the activity normally takes place, and this is followed by a semi-structured or unstructured interview where the video is reviewed and discussed by the researcher(s) and participant(s) with a view to making explicit thought and decision making processes (Rowe, 2009). For the purpose of investigating the practising habits of musicians, this method is considered to be more effective than think-aloud protocols, where participants are required to stop the activity and explain their thought processes. Think-aloud protocols tend to interrupt the flow of the activity, thereby possibly negatively affecting the research situation (Lyle, 2003), although it has been effectively used by, for example, Chaffin, et al. (2002). Both think-aloud and stimulated-recall protocols depend on participants who are able to explain their thought processes.

As with any research method, there are strengths and weaknesses inherent in the research design, and the researcher needs to be aware of such prior to conducting the research. John Lyle (2003) reviews publications about stimulated recall and notes a number of threats to validity of the research design. They are: 1) the participant might experience anxiety about seeing themselves from an outsiders perspective; 2) the participant might be reacting to the video rather than to their memory of the activity, thus the video might be supplementing incomplete memories; 3) the visual cues offered are not from the perspective of the participant and this might affect recall of thought processes; 4) the participant might try to confirm apparent research hypotheses rather than recalling thought processes; 5) the participant might attempt to create explanations about the link between seen actions and intentions. Lyle (*ibid*. p. 865-866) goes on to suggest a number of 'best practice' precautions that can be taken to minimise the effect of the threats to validity.

> It is necessary to reduce anxiety; limit the perception of judgemental probing; reduce the intrusion into the action; stimulate rather than present a novel perspective/insight; make the retrospection as immediate as possible; allow the subject a relatively unstructured response; and employ an 'indirect' route to the focus of the research.

W.S. De Grave, Henny Boshuizen and Henk Schmidt (1996) note that in their study the presence of the video recorder did not unduly affect the naturalistic setting, and that the conducting the stimulated recall session within minutes of completing the focus group discussion kept the participants "involved in the cognitive process" of the research situation (*ibid.,* 336). However, in the context of regular recording for music teaching purposes, Milton Schlosser (2011) notes that there might be situations where viewing a 'bad' performance can have a long term negative impact on the student, and that the teacher needs to be aware of this possibility, and address the negativity immediately. This danger is present to a lesser extent in the research situation and in the recording of practice sessions, since practice sessions do not usually carry as much emotional weight as the major concerts and performances that Schlosser is addressing, but nevertheless is something that I needed to be aware of, and willing to address, were it to arise. Thankfully this was not an issue in the present study.

3.3.3 Participants

The six pianists who were observed and interviewed for this study were all students of the piano music department of the Sibelius Academy, Helsinki, Finland. From within that cohort this group was opportunistically sampled. Three of the participants were suggested by their teachers after a request from the researcher to several staff members for suggestions of participants. The other three were approached directly by the researcher because not enough volunteers were sourced through the first approach. All received a description of the nature of the research and their involvement, together with their rights, in writing (Appendix C). This information was also discussed with each at a preliminary meeting at which meeting dates and repertoire choice were agreed upon. Each were promised and given movie tickets as a thank you gift. Although the sample was opportunistic, it was also fortuitously balanced in terms of gender, with three male and three female participants who ranged in study time from first year to final year students. They were taught by three teachers (see Table 5). Three of the participants were born and raised in Finland, one was born outside Finland, but spent a considerable time of her formative years there, two participants had come to Finland from elsewhere in order to study at the Sibelius Academy.

Table 5

Gender, phase of study, teachers and repertoire of the six participants in the observation study

Participant	Gender	Phase of study	Teacher	Repertoire
Carlos	Male	One year to B exam	X	Clementi and O'Byrne
Khatia	Female	Preparing for B exam	Z	Bach and Franck
Martha	Female	One year to A exam	Y	Beethoven and Dutilleux
Maurizio	Male	Preparing for A exam	X	Bach and Beethoven
Rosalyn	Female	Preparing for A exam	Y	Beethoven and Brahms
Vladimir	Male	First year	Y	Beethoven and Ravel

The six pianists practised a range of different pieces for the observation sessions, and several of the pieces were at different stages of development. Chaffin and Imreh (2002b) describe stages in the practising process. They call these 1) scouting it out, 2) section by section, 3) technical work, 4) putting it together, 5) polishing, and 6) maintenance. Mishra (2005) suggests three stages, 1) preview, 2) practise, and 3) over-learning. She offers several sub-divisions for each stage of practice. There is a rough correspondence between the stages proposed, with Chaffin and Imreh's stage 2 to 5 collapsed into Mishra's stage 2. The first and last stages of each could be considered equivalent. For the purpose of classifying the works observed in this study, a very broad three stage classification will be used. Distinguishing between the finer details of the stages is difficult, and each observation session will simply be labelled as early, middle or late. These stages correspond loosely to both Mishra's and Chaffin and Imreh's. This classification is given in Table 6, but prior to that each work and salient details about the preparations and time frames are discussed for each participant.

For two of the four observation sessions, **Carlos**[13] worked on Muzio Clementi's (1752-1832) Sonata for piano Op. 50 No. 3 in G minor *"Didone abbandonata: Scena tragica."* For the other two sessions he worked on Breffni O'Byrne's (1988-) Op. 1 "*Rhapsody: On an Irish Song."* Carlos had learned and performed the Clementi work some three years prior, and was starting to re-learn it. Prior to the first observation of this piece he had played through it once and had spent some time thinking about the piece. The second observation of this work occurred slightly less than two months after the first, and about two weeks after he had made a video recording of it as an entry to an international piano competition. He encountered the O'Byrne piece after the composer (a friend of his) showed him parts of it, and decided to learn it for the same competition. He had played through the piece "once or twice" prior to our first session in order to gain a general orientation of the piece. The second observation took place three months later, two weeks prior to the first round of the competition[14].

For two of the four observation sessions, **Khatia** worked on Johann Sebastian Bach's (1685-1750) Prelude and Fugue in C# Major from Book 1 of *The Well-Tempered Clavier.* For the other two sessions she worked on the *Symphonic Variations* for piano and orchestra by César Franck

13 The names of the participants have been changed to ensure anonymity. Each participant was given the opportunity to select the first name of a pianist/musician that they admire, to be used as their pseudonym.

14 See Appendix H for an exact tabulation of the date and length of each observation and interview.

(1822-1890). The first observations of her practising of each of the pieces were made when she had already learned the music quite well and was able to play sections of the pieces from memory, and the second observations were made one week before she was due to play both pieces in a public examination, one month after the first observations.

During the four observations **Martha** was practising the second movement of Ludwig van Beethoven's (1770-1827) Sonata Op. 28 in D major, and Henri Dutilleux's (1916-) "Le jeu des contraires", the last of his *Trois Préludes* for piano. Observations were made of the very first practice session of each of the pieces and then again 3 months later for the Beethoven and 2 months later for the Dutilleux.

Maurizio showed me the first movement of Ludwig van Beethoven's Sonata Op 111 in C minor and the Prelude and Fugue in B flat minor from Book 1 of Johann Sebastian Bach's *Well-Tempered Clavier* in the four observation sessions. The first session of the Bach was the first time he had attempted the fugue, while the first session with the Beethoven was his third day of learning the movement. He had worked on it for about 4 hours in the days prior to our session. The second session of the Bach took place some 3 months after the first, and about 2 weeks before he was due to perform it in an international piano competition. The second session of the Beethoven took place some 4 months after the first and took place five days before he was due to perform the piece in a concert.

Due to health reasons **Rosalyn** and I met for only three observation sessions. She showed me her work on Ludwig van Beethoven's Fourth Piano Concerto in G Major Op. 58 and on Johannes Brahms' (1833-1897) *Variations and a Fugue on a theme by Händel* Op. 54. For the Beethoven we looked at her very first session attempting to play it. Some time after this session, she developed an injury that prevented her from practising for some time. Partly as a result of this, she changed her recital repertoire and dropped the Beethoven from her practising roster. For the first session of the Brahms she could already play through a large part of the composition, although not from memory. She agreed to show me the Brahms again, despite having decided that she was not going to perform the work. She had already memorised the Brahms after having practised it for about two months, but had stopped working on it for "a few weeks" already when we had the second session. The second observation of the Brahms took place some 3 months after the first.

Vladimir showed me Maurice Ravel's (1875-1937) "Alborada del Grazioso," the fourth movement of *Miroirs* (1905), and Ludwig van Beethoven's *32 Variations* in C minor, WoO 80 in the four observation sessions. Our first session with the Beethoven was also Vladimir's first attempt to play it, but prior to our first session with the Ravel he had been working on the movement for "two weeks, three weeks maybe." The second session with each of the pieces took place slightly more than a month after the first. Due to a technical fault, most of the first Ravel interview was not recorded. I had made notes immediately after the interview, but these are sketchy and incomplete when compared to a full transcription. Thus the data analysed in Vladimir's case are for four practice sessions, but three interviews. He found the second session with the Beethoven extremely frustrating. He was not able to achieve much of his goals and got increasingly agitated, often slapping the piano or exclaiming in frustration. Had we not agreed to a 20 minute practising session, he would have stopped altogether, taken a different piece to work on, or started to work in a very systematic way with a metronome.

Are these sessions comparable? Are they not so different in intention and stage of development that this precludes any comparison to be made? My opinion is that this depends on the purpose of the comparison. If effectiveness of strategy use is considered, then these sessions are not comparable. But that is not the intention here. Neither is it to give a complete description of all the strategies employed in the work on one piece, nor of the complete approach to practising of one individual. The intention is, rather, to see the range of strategies used in a variety of circumstances, and to see if a pattern emerges from comparing these that corresponds to the predictions of perceptual learning style.

Table 6

Broad classification of the stages of work of each of the pieces practised during the observation sessions

Participant and work	**Early**	**Middle**	**Late**
Carlos Clementi[15]		First session	Second session
Carlos O'Byrne	First session		Second session
Khatia Bach		First session	Second session
Khatia Franck		First session	Second session
Martha Beethoven	First session		Second session
Martha Dutilleux	First session	Second session	
Maurizio Bach	First session		Second session
Maurizio Beethoven		First session	Second session
Rosalyn Beethoven	First session		
Rosalyn Brahms		First session	Second session
Vladimir Beethoven	First session		Second session
Vladimir Ravel		First session	Second session

3.3.4 Observation and interview procedure

The observation recordings took place in the practice rooms or recital rooms of the Sibelius Academy. I booked larger rooms to allow enough space for recording. Sessions were recorded with a commercially available digital video recorder mounted on a tripod. The tripod was placed slightly behind the pianist and as far away to the side as possible, to be out of the line of immediate sight. The shot was framed to allow for the full body of the pianist to be visible when seated at the piano. I was present to start the recording, and then left the room, to return after 20 minutes. The recording was immediately transferred to a laptop computer from which it was played back for the interview. The interview was then recorded using the same video recorder. Some of the interview recordings had quite poor sound quality, because the level of the music coming from the laptop was sometimes louder than the voices of the pianists. This affected the transcribing process, with the ends of sentences, or short comments, sometimes

15 Although Carlos had already performed this work, and both observations could therefore be said to be over-learning, his approach to practising in the first session corresponded to the kind of work that is done in the middle phase of work for the other participants.

masked by the sound coming from the computer. Trial and error resulted in better placement of the camera to ensure clear sound, but a directional microphone placed near to the mouths of the researcher and participant would have aided clarity.

The sessions were introduced with a statement like the following:

> As we watch this recording of your practice session, please comment on how you used your senses, describe what you were looking at, listening to or doing. Feel free to note anything that is interesting to you to discuss. We can also stop the video at any time.

The video generally, however, ran without interruption. The interviews proceeded in an unstructured manner, with pianists commenting whenever something caught their attention. I tried to probe their comments by asking questions, in order to clarify and deepen my understanding of what they did and said. However, in general, I attempted to allow the participants to dictate the conversation, based on what was interesting to them. This meant that there were often long silences, which I sometimes felt I had to break by asking a question such as "what are you doing here?", or "what are you paying attention to here?" In the first sessions with each piece, the following questions were also usually asked, either before or during viewing of the recording.

> Have you listened to this piece before? How many times do you think you have heard it? Do you know it well?
>
> Have you looked at the score for this piece before?
>
> Have you attempted to play this piece before?

The theory of learning styles was not presented to the pianists explicitly, only that my interest was in their use of their senses. I did not mention the theory in my explanations, nor in the introductory letter. This was specifically done to avoid the pitfall of participants telling me what they think I wanted to hear (Vesterinen, Toom, & Patrikainen, 2010, pp. 188-189). Perceptual learning style is a popular theory, and many people will have an opinion about how to describe themselves in terms of the theory. This opinion may, of course, be warranted but I wanted the theory, if it existed, to emerge from the comments and behaviours of the participants rather than from my suggestions. To further avoid this kind of circularity the data for this study are considered to come from two sources: that of the practice session and that of the interview. These two data sources are related, although our discussions were often tangential to what was happening in the recording at that exact moment. A participant may have made a statement about what they are doing in a particular moment, but often this sparked further explanation on the part of the participant, or questions on the part of the researcher. The comments of the participants were considered to be valid statements of their intentions and understandings, but close analysis of the recording of the practising session gave a different understanding than the interview (see Lisboa, et al., 2011).

3.3.5 Analysis

Analysis of the observations and interviews followed the typical qualitative analysis pattern suggested by Matthew Miles and Michael Huberman (1994, pp. 10-11) of data reduction, data display and conclusion drawing and verification.

3.3.5.1 Data reduction of interview material

The interviews were each transcribed verbatim and each checked using the HyperTRANSCRIBE© software program. Both transcription and checking was done by the researcher, because transcription was understood as part of the analysis process (Silver & Patashnick, 2011). Transcription does not just transpose the interview from audio to text, but is a process involving many decisions that are influenced by theory and prior understandings (Skukauskaite, 2012). Inflection, intonation, pauses and other non-verbal communication is often lost during transcription, and although methods for including these have been devised (for example Skukauskaite, 2012) they come at a heavy time or monetary cost (Markle, West, & Rich, 2011). This research did not focus on the interactions between researcher and participant as such, and therefore the transcription did not include such details as inflection, intonation or pauses, but only tried to give a textual account of the words spoken. Hesitations (umm), acknowledgements (uhu) and other such noises were generally left out of the transcription. Although this presents a bare account of what transpired in the interview, as a researcher I became very familiar with the inflections, intonations and pauses of the interviews after the repeated engagement with the material. The meanings constructed, although not made explicit through transcription, were implicitly understood through this repeated engagement.

The transcribed interviews were then coded using the HyperRESEARCH© qualitative research software program. Although HyperRESEARCH© allows for theory building and testing on the basis of assigned codes, these features were not used in the analysis procedure. Descriptive coding was used to organise and make accessible information about various topics addressed in the interviews. Although codes were developed on the basis of what the participants spoke about, this was a theorizing process involving interpretation and organisation of the transcribed data into a theoretical frame (Bong, 2002). This research investigates perceptual learning style theory, and therefore my attention when coding was focussed on comments about perception as defined by the theory. Coding was treated as a way of systematically reading the transcribed texts, and ensuring rigour in following the threads of each participants views. As such, codes were also assigned to units of meaning that did not immediately suggest any perceptual element, although the theory was always in the back of my mind while coding. Codes were allowed to overlap, since several topics were often discussed in a single sentence. In Figure 1, a screenshot from Rosalyn's first interview, where we are reflecting on her practising of the Beethoven concerto, this preponderance of codes dictated by the theory can be seen. Although 'exploration' and 'organisation of practice' occurs as codes, the rest of the codes describe aspects of the conversation that could fit into perceptual learning style theory's definitional scope.

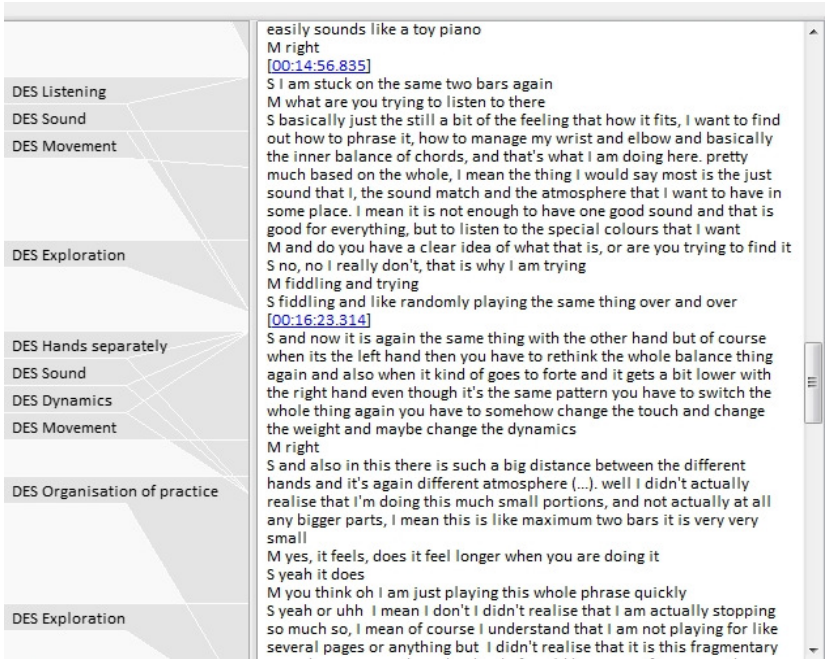


Figure 1
A screenshot of a coded interview transcript taken from the first interview with Rosalyn. M refers to minä (me in Finnish, interviewer) and S to sinä (you in Finnish, interviewee). Assigned codes are in the left panel with the grey areas indicating the extent of the text coded.

Coding was an iterative process, codes were compared between individuals and recoding occurred as a result of new insight drawn from a different interview. This approximated, but by no means achieved, the goal of constant comparison (Corbin & Strauss, 1990). By the end of the coding process, 45 descriptive codes had been used, covering a range of topics addressed in the interviews, such as: aims, balance, dynamics, emotion etc. Five other codes, labelled 'interpretative' had also been used: change of modality focus, performance cue, selective attention, variability of approach, and variability of modality use. These were not categories abstracted from the codes, but rather markers for what seemed to be significant comments in the flow of the discussions. They were points where participants referenced material that was theoretically important, and that needed clarification or theorisation in the next phase of analysis.

3.3.5.2 Data reduction of audiovisual observation material

The use of video data for research processes has been possible for more than 100 years, but has not developed widely acknowledged analysis procedures in the same way that text-based data has (Knoblauch, Schnettler, & Raab, 2006). This is reflected in Chaffin and Imreh's (2002b) need to devise a method for analysing the more than 30 hours of video taken of Imreh's preparation of a Bach composition for memorised performance. The current research followed a

similar approach to that which they devised, and which may also be comparable to Miklaszewski's (1989) and Nielsen's (1999a). Using a spreadsheet, the activity of each recorded practice session was graphically plotted. Each unbroken segment of work was plotted on a row of the spreadsheet by colouring one square for each half a bar (or one beat in the case of triple metres) played. These coloured squares combined to form horizontal lines representing unbroken sections of work. In the two pieces where the meter changes constantly (the Dutilleux and O'Byrne) an appropriate division of roughly half the bar was chosen for each bar, depending on the musical texture. In the cases where only a part of half a bar was played, this was still coded as a half bar by colouring a block. Each block was given a colour depending on which hands were used to play, and on whether simplification or variation of the written music was employed. The relative tempo of playing was also indicated by marking the squares where the tempo was considerably slower than the target tempo of the whole session. When a hiatus occurred and work was either restarted or continued, plotting was started on the next row down. Stumbles, such as repeated notes or slight pauses were not considered a hiatus unless they were repeated, and broke the flow of the section of work. Thus, the spreadsheet, if read from top down and from left to right, gave a graphic overview of the whole practice session.

In Figure 2, an example of this kind of coding is given, taken from Maurizio's first session with his Bach fugue. The numbers in the first row represent bar numbers. The red blocks represent playing with the right hand only, and the yellow blocks with the left only. Black blocks represent playing hands together. Green blocks represent places where either the rhythm or the texture of the written music was changed, with a comment on what was changed. Lines where no blocks are coloured represent a pause in playing of more than 3 seconds. Blocks that have 'slashes' (/) in them represent places where the tempo was considerably slower than the general tempo of the session. In this example, he had already practised the first ten bars of the piece with right hand only for about 3 minutes. He thus plays through this section with right hand only, with a hiatus in the middle. This is followed by a pause of more than 3 seconds, after which he works mainly on the last two bars of the section a couple of times, including playing only the bottom voice of the right hand part. He then works on the left hand from its first entry, tries bar 10 (the third entry of the theme) with hands together and goes on to work on bars 11-13 with some slow practice of those bars, repeating a short section several times, and then trying out the continuation of the phrase. Then he plays the alto voice (which is played by the left hand and taken over by the right) as a whole, and then runs through the right hand from the beginning to bar 10.

Legend:

Red – right hand alone
Yellow – left hand alone
Green – simplification or variation
Black – hands together
/ – considerably slower than session tempo

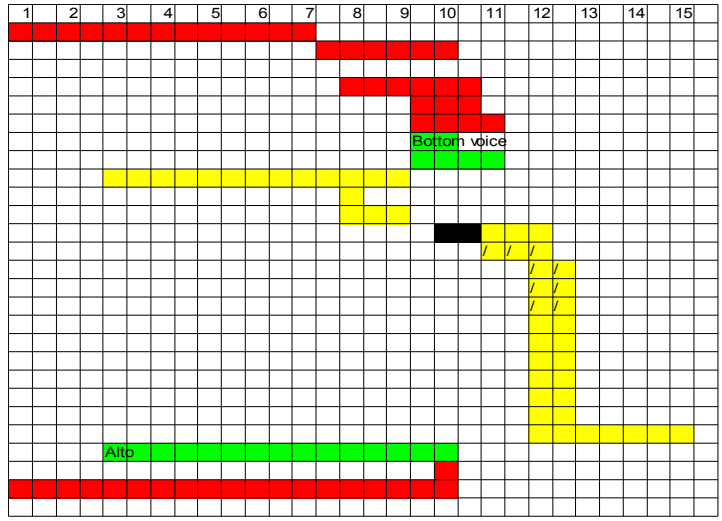


Figure 2
Graphic plotting of a section of Maurizio's first session with the Bach fugue. Read from top to bottom and left to right it gives a depiction of practice over time. Bar numbers are given in the top line. Each block represents half a bar, or part of half a bar.

In addition to this graphic description of the playing, comments about the observable behaviours in each unbroken practice segment were made in two columns to the left of the plotted sections. The columns were labelled movement and looking. In the movement column all the movements the participants made during a section of work were described, apart from those associated with playing the piano in an upright and still position. The looking column was used to note where the participant was looking (if it was possible to discern), especially if this was different from the score or the keyboard. In some instances it was possible to discern whether the participant was looking at the score or the keyboard, and the frequency of the shifts between them were also noted. A third column, labelled silence, documented the length of pauses longer than 3 seconds.

In Figure 3, these columns are given for a section of work from Khatia's second session with the Franck. The movement column notes any movements she made, many of these occurred during the short breaks she took from playing to adjust the metronome. She is mostly looking at her hands, but often glancing up at the sheet music. The codes in the looking column refer to looking at hands (H), reading (R), and the number of times there is an alternation between these. The codes are ordered, with the place of longest fixation standing first. Thus, H R 12 means that she is mostly looking at her hands, but looks up at the score 12 times in this section of work. It was not always possible to discern such detail from the videos, but where possible, it was included. Khatia also looks at the metronome twice in this section of work.

Movement	Looking	Silence	Time
Metronome on, Tapping foot		:05	
	H R 12		03:38
Metronome faster		:03	
Tapping foot	H R 5		04:29
Metronome faster		:03	
	H		05:11
Change seating position, metronome faster, tapping foot		:08	
Halfway through: switch off metronome, start tapping foot, change pages	H		05:49
	Look at metronome		07:06
	Look at metronome		

Figure 3
Coding of a section of Khatia's second session with the Franck. The movement column contains descriptions of movements made other than sitting still and playing. The looking column details where she looked (H – hands, R – reading, number of alternations). The silence column gives the length of any silence in seconds. The time column gives a time marker based on the video recording.

This coding of the video data allowed a visual overview of each session, and a quick reference to the behaviours that took place in each session. Each session was also plotted as a timeline of work and silence. Further examples of the graphic display coding of the video data and time-line plotting of playing vs. not playing are given in Appendix I.

3.3.5.3 Data display

A vignette was composed of the practising of each of the participants. Miles and Hubermann call these within-case displays (Miles & Huberman, 1994, p. 90 ff.) and suggest that they aid the progression from description to explanation. The vignettes attempted to give as full a description of the understandings that I had gained from coding the audiovisual observation data and the interview data as possible. They were intended to be as representative of the practising and views of each participant as possible within the constraints imposed by limited observation and interviews. The vignettes related aspects that were specific to one session with behaviours that were consistent across them. They took account of both the interview and observation data, matching them where they corresponded, but largely treating them as separate data sources, and building on the overall understanding that had by this stage developed through repeated and prolonged engagement with the data. These vignettes were sent to the participants to allow for comment, but unfortunately only one participant responded to this request. She was very happy that the vignette described her views and approaches accurately. The vignettes of all the participants are given in Appendix J.

3.3.5.4 Conclusion drawing and verification

Prior to what has been described above, halfway through the data collection process, a presentation of preliminary results (perhaps more like hunches) was made to the research seminar I have been part of at the Sibelius Academy. Preparing this presentation crystallised some ideas around the interpretation of the interview and observation data, although it was based only on transcriptions, and not coding or other forms of analysis. These preliminary conclusions formed the basis of the further analysis process, and were tested, adapted and refined through the more specific processes described above. Data reduction, display and conclusion making were, thus, interrelated processes that occurred throughout the data collection and analysis phases, rather than distinct stages of work as might be deduced from the descriptions in the foregoing pages.

Drawing on the understandings arrived at through the process of interviewing, transcribing, coding and composing the vignettes, a cross-case display (Miles & Huberman, 1994, p. 172 ff.) was made that compared the participants in table format. This table compared in a more concrete way the differences between participants that had already been identified through the research process. The process of tabulation was theory-driven and sought out differences between individuals on the basis of perceptual learning style. Where participants differed in any way that could be related to the theory, these differences were tabulated. A theory-driven approach was chosen over a more grounded approach to focus the study and to allow comparison to the questionnaire study. Numeric tabulation of the frequency of behaviours or comments was not employed, rather a more qualitative ranking of differences. Although numeric values could be attached to some of the areas of the table, for others this was not possible. The categories used in the descriptions of Chapter 6 were developed through this process, and the final forms of the table are given in Tables 18, 19, and 20.

The classification of differences was, as the rest of the research process, informed by a conception of perceptual learning style. By this stage of the process my working assumption had become that perceptual learning style was a poor predictor of the variation in the approach of the participants, and the tabulation confirmed this to a large extent. Verification of the conclusions arrived at through this process occurred by returning to the transcribed interviews and observations to check assertions, and occasionally to the source data for these transcriptions. This was done to relate conclusions arrived at to the words and actions of the participants and to try and ensure that the process of increasing abstraction described here has not distorted the conclusions reached in the final phases of analysis.

3.4 Ethical considerations

The Sibelius Academy has no ethics review board, and responsibility for the ethical conduct of the research lay with the researcher. Each of the research methods have their own ethical considerations, and will be addressed in turn, based on the recommendations of Louis Cohen, Lawrence Manion and Keith Morrison (2007).

For the questionnaire, participation was only by informed consent. Prior to handing out interview forms, the researcher and research project were briefly introduced, and the right to withdraw or not to complete explicitly stated. Several people in the groups addressed made use of this right, and declined to participate, often leaving the venue prior to the handing out of the

questionnaires. The information on the researcher, the nature of the project and the rights of the participants were also explicitly stated on the cover page of the questionnaire (see Appendices A and B for a Finnish and English version of the cover page). In the construction of the questionnaire, its non-maleficence was considered: the questionnaire asks no sensitive information. Additionally, since the questionnaire was presented in situations under staff control, it was made clear in the cover letter that what is disclosed in the questionnaire would not in any way affect the opinions of the staff of the academy. There would be strict anonymity after completing the questionnaire, and confidentiality as to the contents of specific questionnaires. No information that can be linked to a specific person was made known to anyone except the researcher (p. 318).

In securing the participants for the observation and interview sessions, informed consent was again sought and verbally obtained. The nature of the research, rights and responsibilities of participation and data security was presented in an introductory letter (Appendix C) and discussed at a preliminary meeting. Strictest confidentiality was maintained in the process, only the researcher knows the identity of the participants, and no biographical information that can be linked to a specific person was included, apart from the works they studied. In including this information there is an aspect of traceability, and people who know the participants well, especially those participants who play rare works, may be able to identify them. The interviews were conducted on the participants' terms, with minimal probing from the researcher, and none of a sensitive nature (p. 382).

Cohen, Manion and Morrison (p. 410-411) treat observation as *in situ*, rather than recorded, but some of their comments still bear discussion. The danger of selective attention on the part of the observer was counteracted by the rigorous coding process which ensured that every segment of the videotape was intensively scrutinised. An independent checker also randomly checked samples of the coding of the video and interview data for consistency. There is in every observation session the danger of reactivity – that participants would change their behaviour when they are being observed. This was counteracted by the researcher not being present for the observation session, although the video recorder was, and occasionally the participants would glance at it, indicating an awareness of its presence. Some comments were also made in the interviews regarding the strangeness of the situation, and how for some it took time to get used to working while someone was going to look at that work. Practising is usually private, and is only made public in performance settings. There was a tension, especially when the first encounter with a piece was observed, between the mundaneness of sight reading, figuring out fingerings, notes and rhythms, and the performative aspect of the situation. This caused some discomfort in the earlier sessions for some. Rosalyn commented in the first interview “it feels very funny, so it took me at least 5 minutes to get going.” This is one of the reasons for having multiple observations, to allow for the participants to develop a measure of familiarity with the research situation. Another aspect of the same issue is that once seated, the participants felt that they should continue until the 20 minutes were over. For Vladimir, this meant suffering through a difficult and frustrating practice session when he would have moved to something different were he not being recorded. The negative effects of this were, however, no different to what he would have experienced if there was no research situation. We discussed this during the interview, and it was my observation that he left the interview in a similar state of mind to what he started the observation.

4 Results I – Questionnaire study

In this chapter, results from the questionnaire study are presented. The aim of analysing the questionnaire data was to investigate whether there are patterns in the ways that music instrument students in higher education describe their practising behaviours and strategies, and to ascertain how these patterns relate to perceptual learning style theory. Analytic methods that identify patterns were used, specifically factor and cluster analysis, allowing investigation into the relationships between variables and between individuals.

In the rest of this chapter, results from these two analyses are discussed, both in terms of the analytic decisions made, patterns that emerged, and how they relate to perceptual learning style (4.2). First, however, a general overview of the demographic section of the questionnaire is given (4.1). The chapter concludes with a discussion of the findings of the two analytical methods (4.3).

4.1 Descriptives

Analysis of the demographic section of the questionnaire showed that respondents ranged from 18 to 43 years of age, with mean age of 22.60 (SD = 3.96). The distribution of age was skewed by two outliers who were both in their forties (see Figure 4). However, Finland has the highest graduation age across disciplines in a comparison of higher education in 12 European countries, with a mean age of 29 (Schomburg & Teichler, 2006, p. 39). Therefore the distribution of age was considered reflective of the population of higher education students in Finland and the outliers were included in the analysis because it was not thought to adversely affect generalisation to the wider population of music students in higher education in Finland.

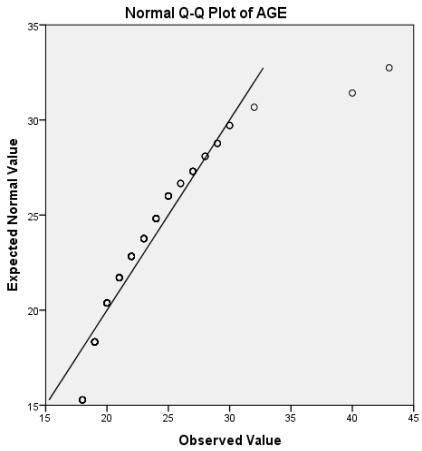


Figure 4
A Q-Q plot of the distribution of Age in the questionnaire data (n=131) showing the two outliers.

The respondents included in the analysis had been taking music lessons for an average of 15.02 years (*SD* = 3.65). A second instrument was played by 87 (66.4%) respondents. An additional type of music such as folk (7 respondents), jazz (7 respondents) or popular music (36 respondents) was played as a secondary genre by 51 (38.9%) respondents. One respondent played all above-mentioned genres with classical as primary genre. 98 (74.8%) respondents were in the Bachelor phase, 30 (22.9%) in the Masters phase and one in the doctoral phase.

The distribution of the primary and secondary instruments is given in Table 7. Instruments that have broadly similar physical characteristics were grouped together. Although it is acknowledged that there are important differences between playing, say, piano and harpsichord, or, violin and viola, for the purposes of investigating perceptual learning style theory through practising strategies, these differences can judged to be outweighed by the similarities in body position, score position, sound source position and general approach to sound production. Piano or harpsichord (n=34) and violin or viola (n=30) as primary instruments formed sub-groups that are large enough to be used in statistical analysis. The other instrument groupings were unfortunately too small to use in statistical analysis as groups that share similar characteristics, but for comparative purposes, a third sub-group was formed by combining all woodwind and brass instruments (n=30), although the physical characteristics of this grouping are acknowledged to be widely divergent. The comparison achieved with this group is treated with great circumspection. As a secondary instrument piano or harpsichord was by far the most popular, followed by voice. See section 4.2.1.2 for the impact of instrument type on the variation seen in the questionnaire.

Alpha reliability coefficients were calculated from both Pearson's correlation matrix (Cronbach's alpha) and the polychoric correlation matrix (Ordinal alpha) (Gadermann, Guhn, & Zumbo, 2012), and were deemed acceptable, with Cronbach's alpha in the range of .82-.84 and Ordinal alpha in the range of .84-.85 for each of the 47 main variables that were answered with

multiple choice. No items were thus excluded from analysis on the basis of reliability. The dataset was fairly complete, with only a few missing variables, and thus listwise replacement of missing data was used in all the analyses. None of the items had normal distribution, however (Kolmogorov-Smirnov test of normality, df 115, $p<.001$). Excluding outlying answers did not alter the non-normal distribution, which was mainly related to the highly skewed nature of the answers to most items, and only resulted in further outlying answers being identified. Furthermore, outliers should only be excluded on firm theoretical grounds (Hill & Lewicki, 2007, p. 21), and perceptual learning style would predict a wide range of answers on each item, thus this was not deemed a worthwhile exercise. While exploratory principal components analysis assumes normal distribution, it does not depend on it, since it does not calculate a p score.[16] Non-normal distribution affects generalisability negatively, but patterns in the data can still be explored regardless. Cluster analysis makes no assumptions about the underlying distribution of the data (Norušis, 2011, p. 376). Other basic descriptive statistics (maximum, minimum, mean, standard deviation) for each of the variables is given in Appendix D.

16 See the discussion on this topic on www.talkstats.com/showthread.php/17326-Normality-assumption-for-PCA

Table 7

Distribution of primary and secondary instruments of questionnaire responses included in analysis

Instrument	Frequency as Primary Instrument	%	Frequency as Secondary Instrument	%
Piano/Harpsichord	34	26.0	48	36.6
Violin/Viola	30	22.9	7	5.3
Cello/Double Bass	14	10.7	1	0.8
Flute	8	6.1	0	0
Clarinet/Oboe/ Saxophone	7	5.3	1	0.8
Bassoon	5	3.8	0	0
Trumpet	2	1.5	0	0
Horn	6	4.6	0	0
Trombone	1	0.8	0	0
Percussion	2	1.5	1	0.8
Guitar/Bass	4	3.1	7	5.3
Kantele	4	3.1	0	0
Organ	9	6.9	1	0.8
Tuba	1	0.8	1	0.8
Accordion	3	2.3	1	0.8
Conducting	1	0.8	0	0
Voice	0	0	18	13.7
Drumkit	0	0	1	0.8
Total	**131**	**100.0**	**87**	**66.4**

Note. The Piano/Harpsichord and Violin/Viola grouping were big enough to use as sub-groups for comparative purposes, and a third group was created using all woodwind and brass players.

4.2 Structure of the data

4.2.1 Factor analysis

A factor analysis was conducted on the 47 main variables, based on the responses of all 131 students. Factor analysis aims to classify variables into larger factors or components (Hill &

Lewicki, 2007, 265). It achieves this by consolidating the variance in a dataset by finding communalities between the variables based on a covariance/correlation matrix. Perceptual learning style theory predicts that individuals who share common perceptual learning styles will answer the items of the questionnaire in similar ways. This similarity would be revealed through a factor analysis, where the correlations between these items will cause them to be joined into components. The components describe underlying variables that account for the variation in the items that contribute to the components.

In factor analysis, a number of decisions need to be made that may have significant impact on the outcome of the analysis. These are: which extraction to use; how to calculate the matrix from which the extraction is made; the number of components to extract; the cutoff point for considering contributing variables; and whether to rotate the factor solution, and which rotation to use.

There are several methods of extracting factors, but when a large number of variables (>40) are analysed, the extraction method becomes less important, since most extractions will give similar results. For this dataset communalities averaged .51 which is not too low, but motivated the use of a principal components extraction (Gorsuch, 1983, pp. 122-123). Principal components extraction fits the aim of finding underlying variables that might suggest a visual, auditory or kinaesthetic component to the questionnaire. An orthogonal (Varimax) and oblique (Promax) rotation were also calculated. Calculating both allows the researcher to identify what the relationship between components is, and also acts as a means to confirm which components are important (*ibid.*, p. 188).

With ordinal data, it is preferable to use a polychoric correlation matrix, since the more common Pearson's correlation matrix is built on the assumption of a continuous underlying variable, which may or may not be the case with ordinal data (Gadermann, et al., 2012). The polychoric correlation matrix calculated from the data in this research project was, however, not positive definite, precluding further analysis using the matrix. In polychoric matrices, some or all of the eigenvalues are sometimes negative because they are calculated one correlation at a time rather than simultaneously (Rigdon, 1997). Using the Pearson's correlation matrix offered a less biased option than attempting to change the eigenvalues or performing a ridge adjustment of the matrix (both possible, but costly, adjustments of a not positive definite matrix) (Rigdon, 1997).

Components that have an eigenvalue ≥1.0 were considered, resulting in 29 components: too many to interpret and with many crossloadings. A scree plot was calculated (Figure 5) and showed “elbows” at the 5th component, and again at the 9th (Hill & Lewicki, 2007, p. 269). Based on this, two analyses were run, one where the number of factors was limited to 5, another where it was limited to 9.

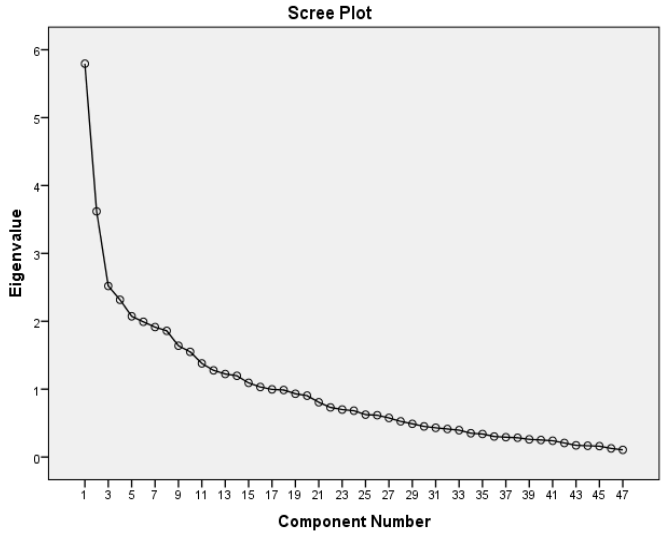


Figure 5

A scree plot of the questionnaire data showing elbows at the 5th and 9th components.

The principal component structures of both the initial extractions and the rotated solutions in the 5 component solution were weak, with loadings below .7. The rotated 9 component solution had somewhat higher loadings, although by no means a strong component structure. In addition, the extractions accounted for only 34.73% of variance in the 5 component solution, and a slightly better 50.49% in the 9 component solution. Although the 9 component rotated solution is discussed in the rest of this chapter, the resultant component structure is quite weak.

In selecting a cutoff point for factor loadings that are considered to contribute strongly to each component, researcher judgement is again called for. Inspection of the factor loadings showed that if factor loadings ≥.5 are considered, a clear (with few crossloadings of variables on several components) and interpretable (components with contributing variables that can be theoretically explained) component structure emerges. It is accepted in exploratory factor analysis to use loadings as low as .3 (Sur, 2006), so this is an acceptable level to use. Furthermore, after computing both the Varimax and Promax rotations, the same contributing variables above .5 were found in the rotated solutions, but some variation occurred in contributing variables below .5. The complete Varimax and Promax matrices produced by SPSS can be seen in Appendix E. Retaining those factors (and contributing variables) that are common to the two rotations results in a stronger factor structure, and one that should be more replicable in a new sample (Gorsuch, 1983, p. 206).

Deciding whether the sample size is sufficient for drawing generalisations is somewhat difficult given the range of advice given in the literature. For example, Gorsuch (1983, p. 332) recommends respondents to number at least 100 or to have at least five respondents for each

item in the questionnaire, whichever of the two is larger. This suggests a sample size of around 250 respondents for this questionnaire. Robert MacCallum and colleagues, on the other hand, have suggested a more situational approach to determining the appropriate sample size (MacCallum, Widaman, Preacher, & Hong, 2001; MacCallum, Widaman, Zhang, & Hong, 1999). They argue that when loadings are high (over .7) and factors are well determined (more than six indicators per factor), even very small samples can yield generalisable results. As the communalities get lower, factors become vaguer, or the number of factors extracted increases, a higher number of respondents is needed to draw inferences to the population. In the current study, the communalities average .51, which is moderate. The factors are also not as well defined as suggested, with between two and four indicators per factor. When following the guidelines of MacCallum and colleagues, it can be concluded that this study would probably need between 100 and 200 respondents, but closer to 200. So, despite the discrepancy, on both counts the number of respondents is somewhat low, which means that the generalisability of the findings of this analysis is somewhat limited.

In the rest of this section, each of the components is described, together with the variables that contribute to this description, and their factor loadings from the 9 component Promax rotation. The Promax rotation was chosen above the Varimax rotation because it became evident that the components extracted were not independent from each other, as a Varimax rotation assumes, but that they were obliquely correlated with each other. This allowed for higher-order components to be extracted, based on the relationships between the lower-order components. These higher-order components are discussed after the section dealing with the lower-order components below.

4.2.1.1 Interpretation of the components

Component 1 – Movement imagery

Central to this component is thinking through the movements that will be made during playing without actually performing them (K6 and K4) together with employing visual imagery of hands and fingers (V4 and V11). The association between these items suggests that visual imagery of the hands and fingers are integrally linked with the experience of movement, and should thus not be understood as visual only. The initial extraction of the component explains 12.32% of variance with an eigenvalue of 3.86 for the rotated solution.

Table 8

Component 1 – Movement imagery

Contributing variables	**Factor loadings**
K6 I stop playing and think through the movements I will make while playing.	.75
V4 I close my eyes in order to see my instrument and fingers/hands in my mind's eye.	.60
K4 One of my aims is to be able to think through the movements I will make while playing.	.58
V11 One of my aims is to remember what my fingers/hands look like when playing the piece.	.56

Component 2 – Research

The items in this component (V15, V9 and V13) all refer to research conducted as part of the learning process: reading, comparing editions and analysis through graphing. They are all predominantly visual activities, although comparing editions and analysis may involve some aural imagery together with visual activity. The initial extraction of the component explains 7.70% of variance with an eigenvalue of 3.42 for the rotated solution.

Table 9

Component 2 – Research

Contributing variables	**Factor loadings**
V15 I read a lot of information about the piece I am playing.	.73
V9 I consult several editions of the piece and compare similarities and differences.	.69
V13 I draw graphic representations of the piece to make the structure clear.	.57

Component 3 - Simplification

The two items with the strongest loadings in this component both involve speaking (A6 and A15) but the other items involve writing with colours, and silent rehearsal. The commonality between the various strategies here seems to be a simplification or clarification of difficulties. Each of the modalities is represented in this component. The initial extraction of the component explains 5.36% of variance with an eigenvalue of 3.65 for the rotated solution.

Table 10

Component 3 – Simplification

Contributing variables	**Factor loadings**
A6 I speak the rhythm of sections that I find difficult.	.83
A15 I count out loud to help me figure out difficult rhythms.	.67
V8 I use colours to mark my sheetmusic.	.55
K1When I am struggling with a passage it helps when I make the movements of playing the passage without making a sound.	.51

Component 4 – Reflection apart from playing

The three positive items in this component (V5, V14 and A3) emphasise work done apart from playing. There is a mixture of auditory and visual modalities. The negative loading on V6, playing rather than analysing, emphasises the opposition between study apart from the instrument and study at the instrument. The initial extraction of the component explains 4.93% of variance with an eigenvalue of 2.92 for the rotated solution.

Table 11

Component 4 – Reflection apart from playing

Contributing variables	**Factor loadings**
V5 I figure out how the piece is structured by looking carefully through the score away from my instrument.	.76
V14 When I am struggling with a passage it helps when I sit away from my instrument and study the passage carefully.	.52
A3 I play sections of the piece and then listen to those passages in my head without playing.	.50
V6 I figure out how the piece is structured by playing and not by analysis.	-.72

Component 5 – Scouting out

The two variables with the highest loadings involve watching and/or listening to other performers (V10 and A4). Together with K10, looking for technically difficult parts, these items are each concerned with getting to know the piece, either musically or technically. The initial extraction of the component explains 4.41% of variance with an eigenvalue of 2.71 for the rotated solution.

Table 12

Component 5 – Scouting out

Contributing variables	**Factor loadings**
V10 I look at video recordings of other performers playing the same piece I am learning.	.65
A4 I listen to audio recordings of other performers playing the same piece I am learning.	.63
K10 I try to find the parts that are technically difficult in order to focus on them.	.59

Component 6 – Musical shaping

The two items with the highest loadings are about phrasing and dynamics, and auditory imagery (A10 and A16). Both of these involve listening, although there is a kinaesthetic and possibly visual aspect (through inspecting the score) to paying attention to phrasing and dynamics. There is a negative loading on item K9, suggesting that the kinaesthetic aspect is sidelined for the purpose of musical shaping through listening and auditory imagery. The initial extraction of the component explains 4.24% of variance with an eigenvalue of 2.35 for the rotated solution.

Table 13

Component 6 – Musical shaping

Contributing variables	**Factor loadings**
A10 I try to pay attention to phrasing and dynamics from the first reading.	.75
A16 When I am struggling with a passage it helps when I listen through the passage in my mind by imagining the sounds.	.57
K9 I focus on technical demands in the early stages of practising, and work on musical shaping at a later stage.	-.57

Component 7 - Distraction

Each of the three variables in this component deals with distraction, and each focusses on distraction in a different modality. The initial extraction of the component explains 4.07% of variance with an eigenvalue of 2.54 for the rotated solution.

Table 14

Component 7 – Distraction

Contributing variables	**Factor loadings**
V2 I find it hard to concentrate on my playing when I see movement in the room.	.75
A12 I find it hard to concentrate on my playing when I can hear other music playing.	.63
K 12 I find it hard to concentrate on my playing when the physical environment (seating, temperature, lighting) is not comfortable.	.56

Component 8 – Metronome use

Using a metronome is here linked to playing automatically, which may be one of the aims of using a metronome. Often metronomes are used to build finger speed through highly repetitive practice. The initial extraction of the component explains 3.96% of variance with an eigenvalue of 2.47 for the rotated solution.

Table 15

Component 8 – Metronome use

Contributing variables	**Factor loadings**
A13 I use a metronome while I am playing.	.78
K3 One of my aims is to be able to play the music automatically, without too much thought.	.50

Component 9 – Vocalisation

Each of the variables that load strongly on this component are about vocalisation. Singing, speaking and humming all externalise thought processes. Vocalisation can be variously understood as an auditory behaviour (where hearing what is said is more important than saying it) or as a kinaesthetic behaviour (where the speaking is more important than hearing what is said), or, most likely, some mixture of the two. The initial extraction of the component explains 3.49% of variance with an eigenvalue of 2.46 for the rotated solution.

Table 16

Component 9 – Vocalisation

Contributing variables	**Factor loadings**
A7 I sing melodic material from the piece to myself when I am not playing.	.68
A9 I talk to myself about details when I am working.	.52
A8 I hum melodies and/or rhythms to myself while playing.	.51

4.2.1.2 Relationship between perceptual learning style and extracted components

The nine components described here can each be interpreted with some degree of clarity, but this interpretation does not highlight a single modality for each component. There are three exceptions where a single modality is more prominent than the others. Component 6 highlights listening (but may also involve movement) and Component 2 highlights reading and looking (but may also involve aural imagery). Vocalisation in Component 9 can be understood as either auditory or kinaesthetic or a blend of these, depending on the perspective taken. While some individual components could thus be thought to be focussed on the visual and auditory modalities with some other influences, there is none that suggests the kinaesthetic modality. The prominence of a single modality in these three components is overshadowed by the contribution of other modalities, casting doubt on their interpretation as representing modality groupings. The component extraction does not offer strong support in favour of the perceptual learning style theory, especially when each of the other components contain a mixture of modalities.

4.2.1.3 Relationship between instrument type and extracted components

The variation found in, for example, Component 1 could be thought to result from differences in the instruments played, especially when there is a difference between whether the hands and the instrument can be readily seen, or are typically looked at while playing. To what extent does instrument type affect the variation described in the components? This effect was investigated using a Kruskal-Wallis test, with primary instrument sub-groups as grouping variable. The Kruskal-Wallis test does not assume normal distribution. Three instrument sub-groups were used, 1) piano or harpsichord, 2) violin or viola, and 3) woodwinds and brass. Each of these sub-groups had 30 or more members, although listwise replacement of missing variables reduced this to n=32 for sub-group 1, n=26 for sub-group 2, and n=23 for sub-group 3. This test was conducted for each of the 47 variables, and related to the variation in the components identified above.

In Component 1, there was a significant difference by instrument group for item K4 (One of my aims is to be able to think through the movements I will make while playing) $\chi^2(2, N=81)$ 8.532, p=.014 and item V11 (One of my aims is to remember what my fingers/hands look like when playing the piece) $\chi^2(2, N=81)$ 6.532, p=.038 (Figure 6). In Component 2, there was a significant difference by instrument group for item V13 (I draw graphic representations of the piece to make the structure clear) $\chi^2(2, N=81)$ 9.438, p=.009 (Figure 7). In Component 3, there

was a significant difference by instrument group for item A6 (I speak the rhythm of sections that I find difficult) $\chi^2(2, N=81)$ 9.209, p=.010 (Figure 8). In Component 8 there was a significant difference by instrument group for item A13 (I use a metronome while I am playing) $\chi^2(2, N=81)$ 9.928, p=.007 (Figure 9). Finally, in Component 9 there was a significant difference by instrument group for item A8 (I hum melodies and/or rhythms to myself while playing) $\chi^2(2, N=81)$ 7.011, p=.030 (Figure 10).

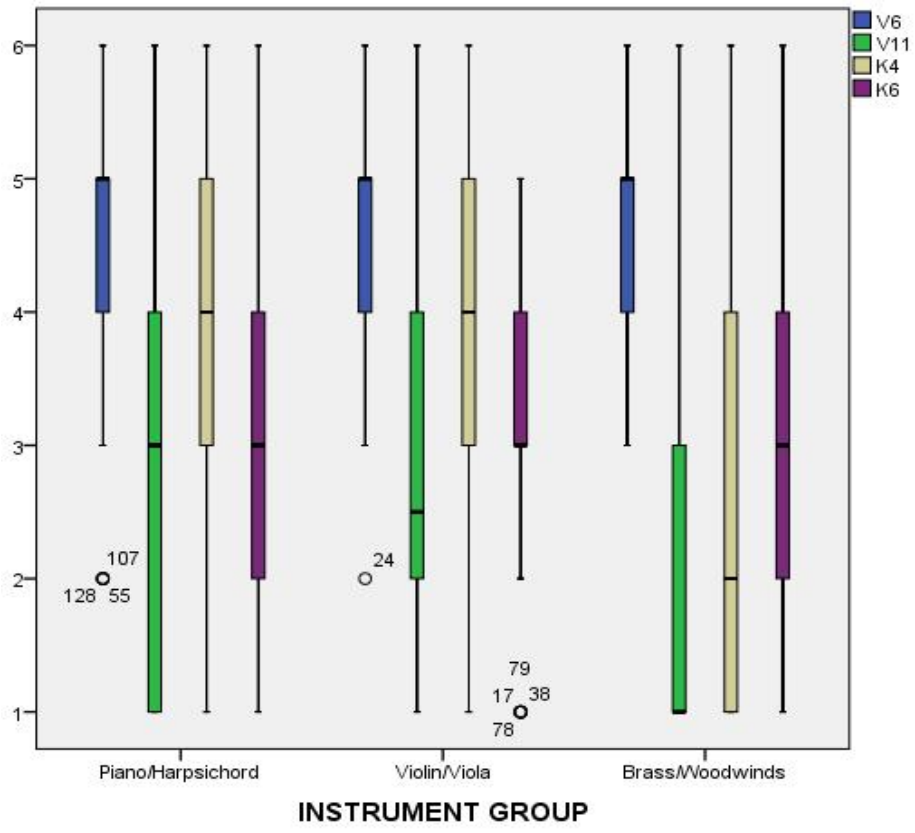


Figure 6

Boxplot comparing the responses by instrument groups piano/harpsichord, violin/viola, and brass/woodwinds to items from Component 1 (V6, V11, K4, K6). Differences between upper and lower means were significant for V11 and K4.

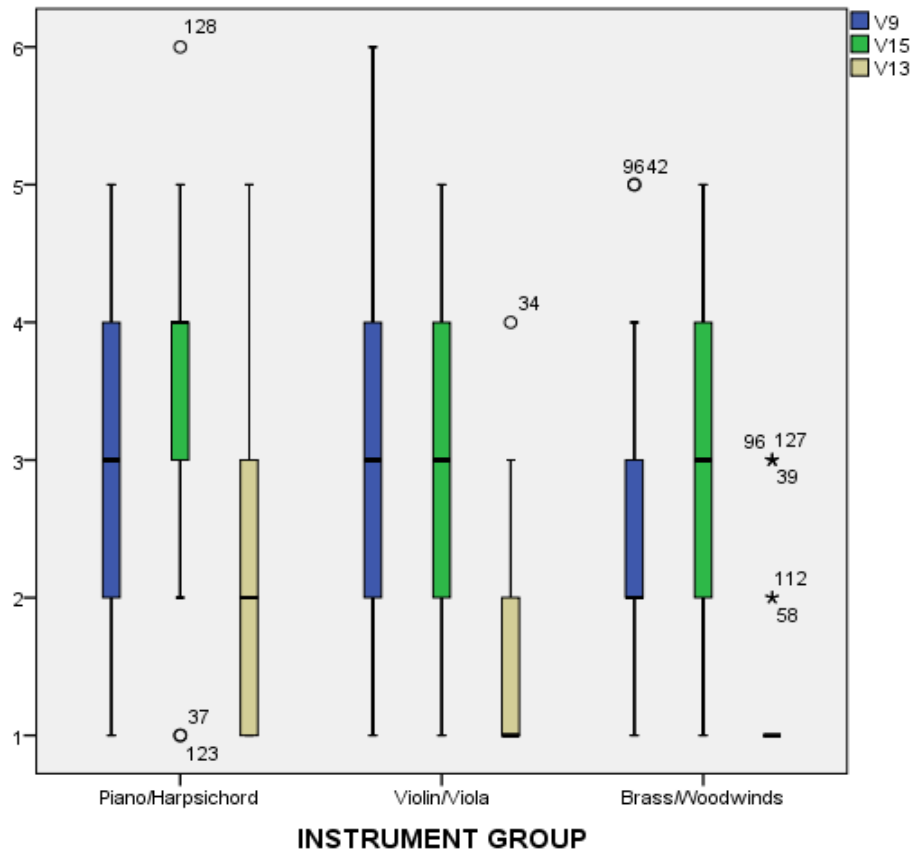


Figure 7

Boxplot comparing the responses by instrument groups piano/harpsichord, violin/viola, and brass/woodwinds to items from Component 2 (V9, V13, V15). The difference between upper and lower means was significant for V13.

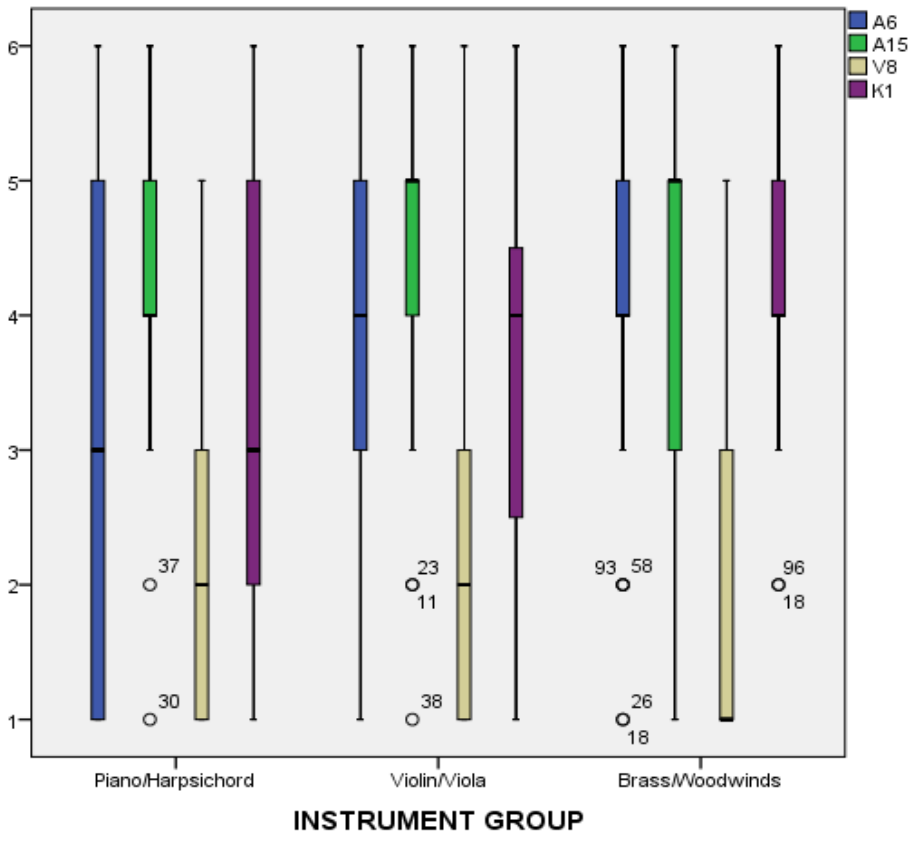


Figure 8

Boxplot comparing the responses by instrument groups piano/harpsichord, violin/viola, and brass/woodwinds to items from Component 3 (A6, A15, V8, K1). The difference between upper and lower means was significant for A6.

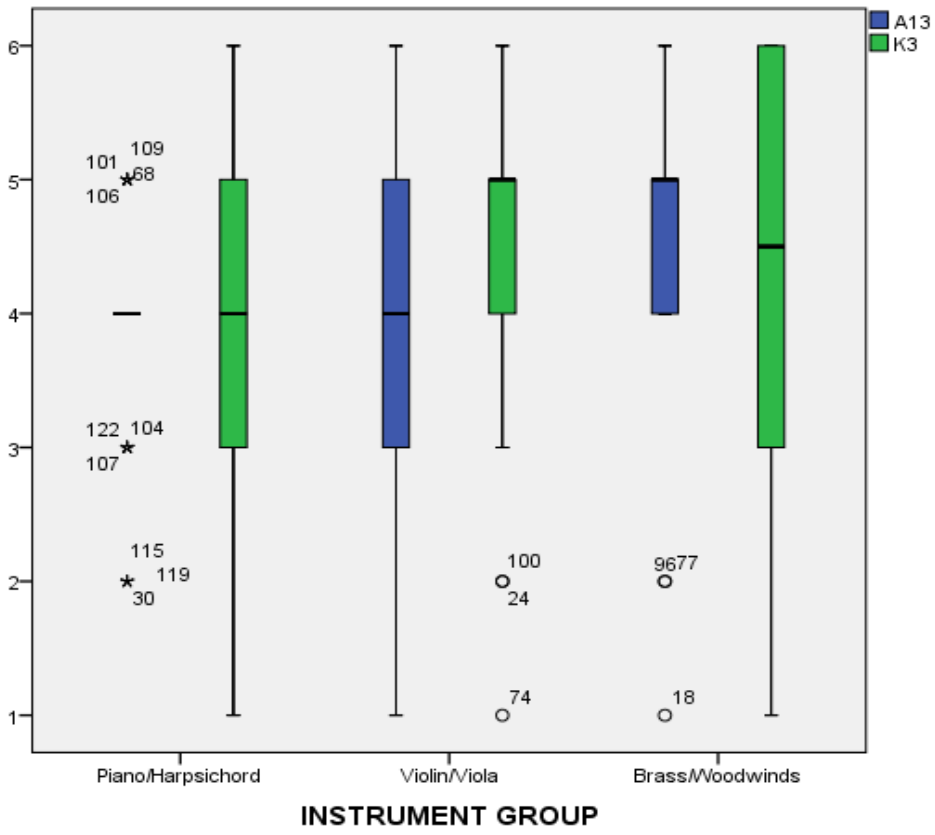


Figure 9

Boxplot comparing the responses by instrument groups piano/harpsichord, violin/viola, and brass/woodwinds to items from Component 8 (A13, K3). The difference between upper and lower means was significant for A13.

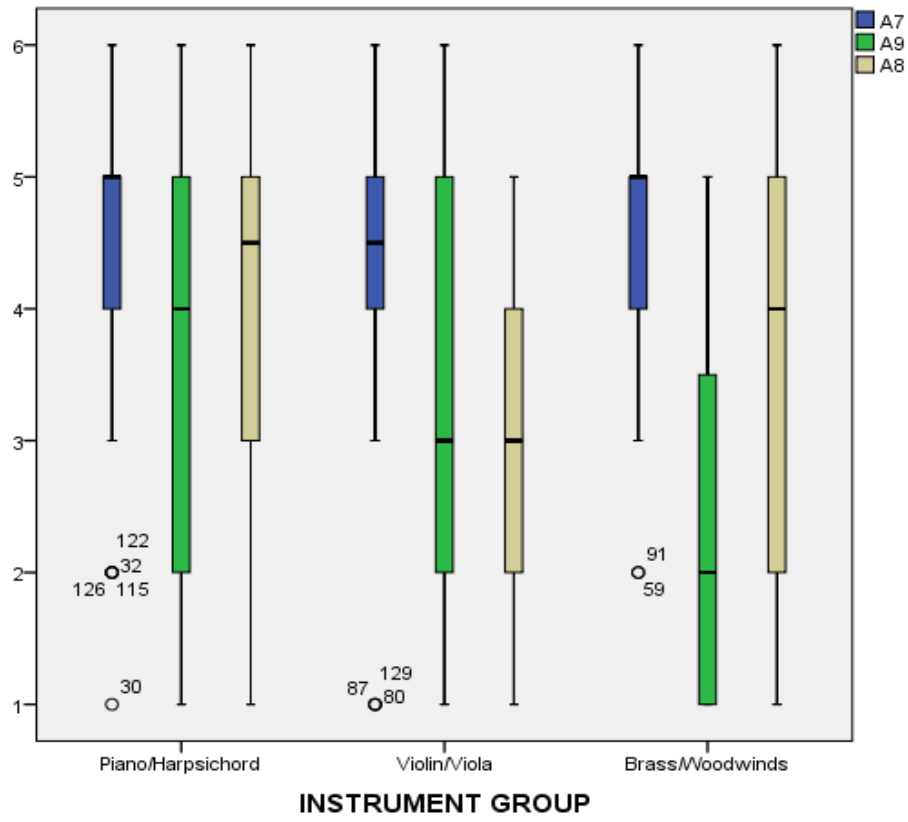


Figure 10
Boxplot comparing the responses by instrument groups piano/harpsichord, violin/viola, and brass/woodwinds to items from Component 9 (A7, A9, A8). The difference between upper and lower means was significant for A8.

There was very little difference between the piano or harpsichord and violin or viola groups. In only one item, A8, did a significant difference occur between these two groups. All other significant differences occurred between one of these two and the composite woodwinds group. The differences may thus stem from the haphazard conflation of instruments in this group, rather than from any inter-group differences. The differences occurred in 5 out of 9 components, and affected only 6 out of the 29 items that describe the most variation in the questionnaire. The effect, while noticeable, is thus not a main influence in describing the variation in the questionnaire.

Interestingly, significant differences occurred not only in those items where a physical difference between instruments would suppose it, such as in V11, but also in those where physical differences between instruments seem to make no difference, such as V8, V13 or A13. These differences should, however be investigated more carefully in a different study, since the instrument groupings used in this analysis may mask other inter-instrumental differences, such

as between woodwinds and brass, or between individual instruments in the various groupings. This does, however, point to an interesting area of investigation.

4.2.1.4 Higher-order components

The Promax rotation showed that the components are oblique rather than orthogonal, meaning that there are correlations between the components extracted through factor analysis. A correlation matrix drawn from the correlations between components allowed for the calculation of higher-order components (Gorsuch, 1983, p. 239). Four higher order components, accounting for 73.20% of variance between the lower-order components, were extracted. These higher-order components should not be understood as more important than the lower-order components, despite such an implication in calling them higher and lower. Rather they should be understood as shedding new light on the relationships between the lower-order components, and thus aiding the interpretation of the analysis. They should also be understood to be less accurate and generalisable than the lower order factors, because of the higher level of abstraction involved through greater distance from the data (Gorsuch, 1983, p. 240).

The first of the higher-order components combined Component 1 (movement imagery .76) and 4 (reflection apart from playing .68), with a negative loading on Component 7 (distraction -.70). Components 1 and 4 both involve strategies that take place when not playing, while Component 7 deals with distraction from playing. This higher-order component thus seems to emphasise the tension between work done at the instrument and work done away from the instrument, regardless of the modality of that work.

The second of the higher-order components contrasted Component 2 (research .83) with Component 8 (metronome use -.78). This higher-order component describes the tension between an intellectual approach involving research of various kinds, and a physical approach that can even be mindless at times.

The third of the higher-order components contrasted Component 5 (getting to know .90) with Component 6 (musical shaping -.79). Both these components seem to have the early stages of getting to know a work as a focus, but a slight difference is that Component 5 seems to approach this from a sonically external (use of recordings) and technical perspective, while Component 6 approaches it from a more internal sonic and non-technical perspective.

The last higher-order component contrasts Component 3 (simplification .73) with Component 9 (vocalisation -.75). Both these components have several vocalisation items. In component 3 the items are both rhythmical vocalisations, whereas in Component 9 two of the items are melodic.

What the higher-order components seem to emphasise are some tensions in the work of a classical instrumentalist as they approach the learning task. These are defined by this analysis as: work at the instrument vs. work away from the instrument; an intellectual, research based, approach vs. a physical approach; work on technical aspects vs. work on expressive aspects; work on rhythmic material vs. work on melodic material. While these are perhaps not surprising as outcomes of a study on the practising of classical musicians, it is remarkable when considering the care that went into formulating the perceptual aspects of the questionnaire. The perceptual modalities seem to disappear into these higher tensions, and are not highlighted as

important divisions in the ways that respondents answered the questionnaire. Instead, the first three higher-order components each seem to describe some polarity of action and reflection or of an external and internal approach. Together they may be describing aspects of personality such as introversion and extraversion (see Kemp, 1997) or impulsivity and reflectivity (see Miksza, 2006) or differences in approach to learning such as analytic and intuitive (see Hallam, 2001b).

4.2.1.5 Summary of the factor analysis

The factor analysis did not highlight perceptual learning style as a principal influence on the variety of answers to items of the questionnaire. Instead, it showed that there is the possibility of an influence by instrument group and personality type. These are somewhat more salient in the analysis than perceptual modality, but would need further investigation through appropriate research instruments, and are not held up as findings of the study as such. This is due to the influence of a number of factors on the analysis of the data: 1) researcher influence in deciding the nature of the analysis, 2) a smaller-than-recommended sample size, and 3) non-normal distribution.

Firstly, factor analysis rests on mathematical relationships between variables, but the interpretation of those relationships are left entirely to the researcher, who seeks to find patterns that are both theoretically justifiable and computationally valid. In this process the researcher makes decisions that someone from a different theoretical position might dispute. It is conceivable (although unlikely) that someone could run a similar type of analysis on this data and conclude that perceptual learning style is indeed supported, although I have done my best to impartially assess the evidence and have decided to the contrary. In this sense the factor analysis could be understood as much as a philosophical or theoretical argument as a statistical measure. I have tried to show at each point why certain decisions were made, and that they were made based on accepted principles, but the analysis still rests on my *post hoc* interpretations of relationships.

Secondly, as discussed above, the sample size of this study is somewhat smaller than would be ideal, and this affects the generalisability of the analysis. This limiting factor affects the confidence of the claims that can be made, although, given the concurrence between this result and the results to be discussed in the following chapter, I do not think that a larger sample would have given widely divergent results from what is presented here. However, it is good to bear in mind that some discrepancy might exist between the results as discussed here, and what happens in the larger population. This could be remedied by one of two measures: either making the sample larger or reducing the number of items in the analysis.

With regards to getting a larger sample, the current sample was reached through repeated and varied measures, and so it is unlikely that a larger sample could be gathered unless a further study population was found (such as another university or college), or some strongly motivating incentive offered to lure respondents. Neither of these were deemed plausible for this study. The other option is to analyse only some of the items, as suggested by MacCallum, et al. (1999). Such an analysis *was* run with the 27 items that have commonalities above .5, but this did not yield substantially different results from the analysis presented before; apart from a change in the order of the extracted components, and fewer variables loading in several of the components. A third analysis was also run using only those items that clearly differentiate

between modalities (the same ones used for the cluster analysis, below). This also did not yield a result that can be interpreted along the lines predicted by perceptual learning style. The principal components and the factor loadings of contributing variables of these two analyses can be inspected in Appendix F. So this gives confidence in the analysis already presented, and suggests that a larger sample would probably not substantially change the results presented here, apart from perhaps adding or removing an item from the existing components.

Thirdly, the data used for this analysis has a non-normal distribution, and while it was possible to extract components using this data, the distribution places a further question mark over the generalisability of the components. The highly skewed nature of the responses to most items is, in itself, an interesting challenge to the perceptual learning style theory, which supposes that on any aspect of learning that can be differentiated by modality use, there will be a spread of opinion as to its usefulness. This is clearly not the case in the data analysed here, with many items being answered similarly. This further strengthens the conclusion that perceptual learning style is not influencing the variation observed in the responses to the questionnaire. The issue of generalisability, however, means that any positive conclusions reached from the analysis of the questionnaire would need to be tested in further studies.

Bearing in mind the three caveats discussed above, this analysis does not support the idea that the primary underlying variables in this questionnaire are auditory, visual and kinaesthetic. While the analysis shows underlying variables that could be understood to focus on a single modality, these are outweighed by the majority of other underlying variables where modalities occur together. This indicates some disjunction between the questionnaire and the theory. It can be posited that: (1) there is a problem between the respondent and the questionnaire, in other words the respondents did not understand the questionnaire, and answered with guesses (face validity); (2) there is a problem between the questionnaire and the theory, in other words items on the questionnaire do not adequately represent the theoretical constructs (construct validity): or (3) there are other variables involved that are not addressed by the questionnaire, and that in fact have a larger influence than perceptual learning style on the variation between individuals. These three issues will be addressed in greater detail in the conclusion of this chapter. Before that a different angle of analysis will be presented, looking at the respondents rather than the variables, to see if a similar pattern emerges.

4.2.2 Cluster analysis

Cluster analysis is not, strictly speaking, a statistical procedure, but rather a collection of algorithms that compare individuals, using well established similarity measures (Hill & Lewicki, 2007, 125). There are several methods that can be used to make this comparison, and each will give a different cluster solution, leaving a lot of leeway for interpretation by the researcher, and making it imperative to choose appropriate methods for the data (Norušis, 2011, 377). For the purposes of this analysis, an agglomerative hierarchical clustering with average linkage between groups (also known as UPGMA) based on the Chi-squared measure was used. This method works equally well with data that forms “clumps” and with data that forms “chains” in the dendrogram plots (Hill & Lewicki, 2007, 129), making it more flexible when the nature of the data are unknown. No standardizing measure was used, since the variables are ordinal, and distances between levels of responses cannot be accurately quantified.

Dendrograms were plotted to visually clarify the relationships between subjects. Since these are unusual statistical tools, a brief description is given on how to read them. A zoomed-in example is given below, since some of the details are hard to read when the whole dendrogram is presented. In the dendrogram shown below (Figure 11) and in the others (Figures 12, 13, and 14) the numbers on the left each represents one respondent. The number starting with S is the identification name I gave each respondent while the number without the S is the case number given by SPSS. The horizontal lines indicate the strength of the relationship with shorter lines meaning that the answers of the respondents are very similar to each other, while longer lines indicate less similarity. Vertical lines between these horizontal lines indicate a relationship between individuals or groups. The points where branches form are called clades. In the example, S147 and S157 answered closest to each other on the set of variables under investigation. S152, S078 and S140 each answered a bit different from the first two, but similarly enough to be distinguished from the next group, S012, S129, S143, S105, and so on.

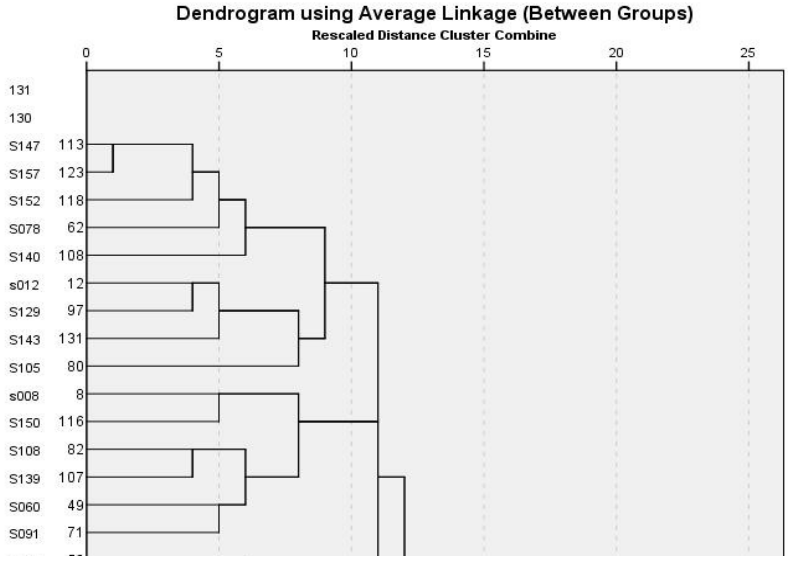


Figure 11

A zoomed-in example dendrogram showing two different identification labels on the left of the plot, and the relationships between the answers individuals gave on the specified variables. Shorter horizontal lines indicate close relationship, while longer lines indicate less close relationships. Individuals are grouped according to similarity, and the differences between groups can be read in the same way as those between individuals.

4.2.2.1 Clustering of ideal and real data compared

In order to show the hypothesized distribution according to perceptual learning style, two sets of artificial data were generated. Both sets of artificial data had three items, representing visual, auditory and kinaesthetic modalities, and had the same sample size as the real dataset. In the first set of generated data, about a third of the "respondents" answered "always" to the visual item and "never" to the other two. The same was done for auditory and kinaesthetic "respondents". The dendrogram in Figure 8 represents this situation. It is clear that there are three groups, and within each group the individuals are very close (short horizontal lines). The groups, however, are some distance from each other (long horizontal lines). The second set of generated data was similar to the first, except that now each of the groups was divided in half, and half of each group answered "sometimes" in one of the other categories. The dendrogram in Figure 12 represents this situation. Again, it is clear that there are three groups, but that each group is divided in half, with that division representing those who answered "sometimes" and those who answered "never".

Figure 12

Dendrogram plotting ideal visual, auditory and kinaesthetic responses to an item. "Individuals" who responded similarly are grouped close together with very wide differences between the three groups.

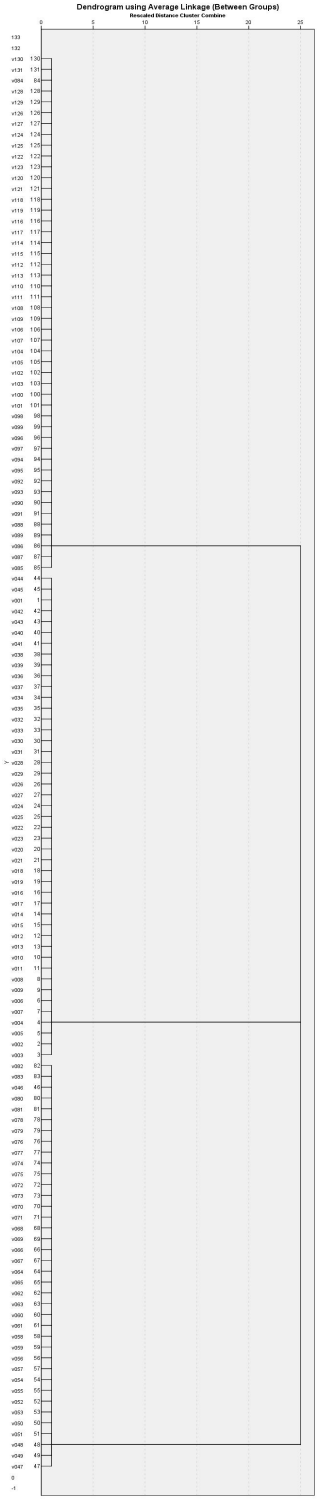


Figure 13

Dendrogram plotting ideal visual, auditory and kinaesthetic responses to an item, with a blended category added. As in the previous example, "individuals" who responded similarly are grouped close together, with a clear triple division, but with each of the three branches divided into two.

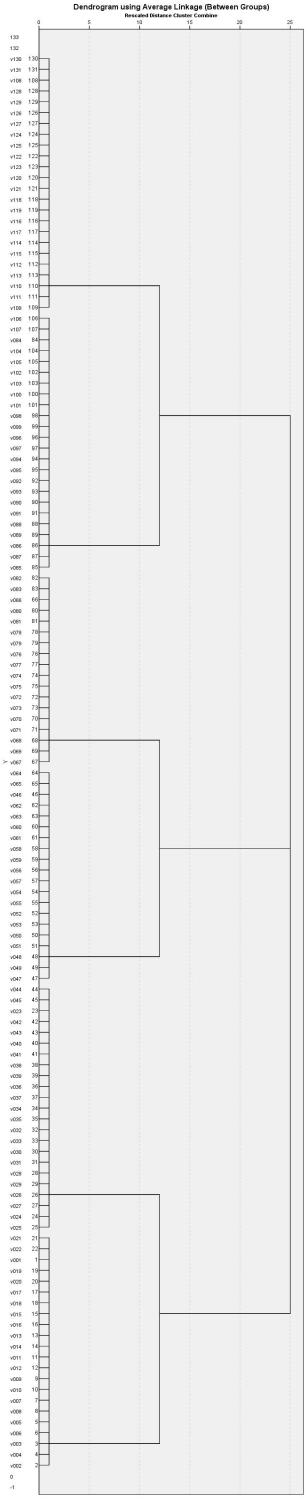
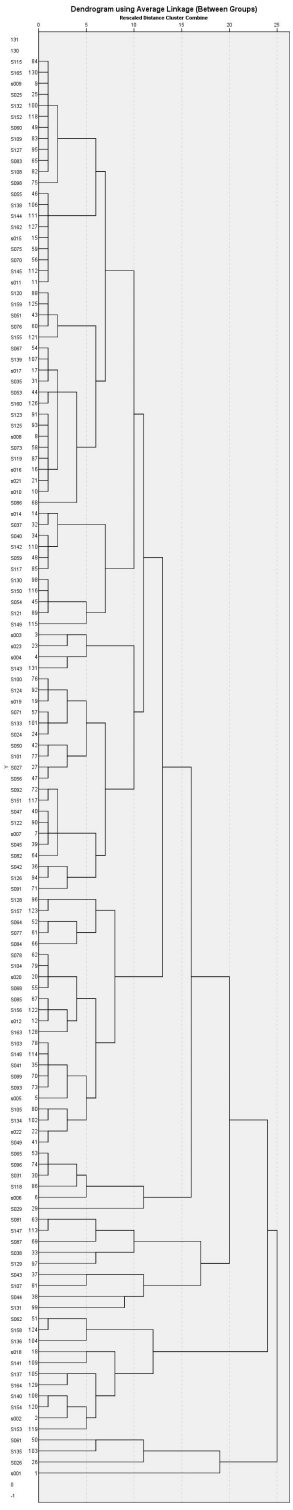


Figure 14

Dendrogram plotting relationships between responses on items V14 (When I am struggling with a passage it helps when I sit away from my instrument and study the passage carefully), A16 (When I am struggling with a passage it helps when I listen through the passage in my mind by imagining the sounds) and K1 (When I am struggling with a passage it helps when I make the movements of playing the passage without making a sound). Several respondents answered similarly, and can be seen near the top of the dendrogram, but the groupings get smaller and more dissimilar from each other further down the plot. There is no suggestion of a three-part structure to the dendrogram tree.



In the third dendrogram (Figure 14) the situation is clearly very much more complex. This dendrogram was drawn using the following three items from the questionnaire that shared the same stem, and were assumed to clearly represent basic divisions in the perceptual usage of the respondents.

> V14 When I am struggling with a passage it helps when I sit away from my instrument and study the passage carefully.
>
> A16 When I am struggling with a passage it helps when I listen through the passage in my mind by imagining the sounds.
>
> K1 When I am struggling with a passage it helps when I make the movements of playing the passage without making a sound.

Notice that there is a series of nested branches, where each cluster is contrasted with the ones that came before, unlike in the other two dendrograms where a clear macro-structure emerged. The data are "chained" rather than "clumped" together. This indicates large variability between individuals, and that clear groupings do not exist. Although some of the relationships between the individuals are close (as in the ideal dendrograms) these occur more at the top of the dendrogram than at the bottom, suggesting that there is a core of respondents who answered similarly, and that they are contrasted with the rest of the respondents who did not answer similarly. Individuals cannot be clearly divided into categories, based on similarity, but are rather grouped apart from each other based on dissimilarity. The large number of clusters that were formed also points to greater dissimilarities than similarities.

The same analysis was repeated with each set of conceptually related variables (V1,V11, A2, K3, K4; V3, A1, K2; V2, A12, K12) and none of these analyses returned a cluster structure that is clearer than the one presented, and that could be predicted by perceptual learning style. (See Appendix G for the dendrograms derived from these other groups of variables.) The possible causes for this lack of structure where the theory predicts a structure are the same as discussed in the factor analysis above. They are worth reviewing: (1) the questionnaire lacks face validity; (2) the questionnaire lacks construct validity; or (3) there are other variables involved that are not addressed by the questionnaire, and that in fact have a larger influence than perceptual learning style on the variation between individuals. I will return to this issue in the conclusion of this chapter.

4.2.2.2 Cluster membership compared

For the next phase of the analysis, I was interested whether the (admittedly weak) cluster groupings stayed similar across different combinations of variables. Perceptual learning style predicts that those people who answer, for example, more visually on one group of items should do the same in others, and the cluster analysis data provided a way of investigating this. Three individuals were selected completely at random (S012, S068 and S081), and the clusters they occurred in in four dendrograms (A=V1, V11, A2, K3, K4; B=V2, A12, K12; C=V3, A1, K2; and D=V14, A16, K1) were analysed. The idea was to see if members of, say, S012's clusters stayed the same in dendrograms A, B, C and D. Within each dendrogram the clusters that contained the three individuals were identified. Deciding where a cluster starts and ends is an entirely subjective matter. For this analysis cluster size was determined through membership of a common clade, or failing this possibility, of a similar level of division from the main tree

structure. This selection, however, resulted in clusters with widely varying membership sizes, since all of the dendrograms contained nested structures. If a cluster lower down on the dendrogram contained one of the individuals selected, and another one was nearer the top, then the lower one generally had a very few individuals in their cluster, while the one at the top had very many (sometimes more than half the sample) in their cluster. Nevertheless, this procedure was deemed important, since choosing branches from different clades may mean comparing groupings of different importance.

The results of this analysis are tabulated below (Table 17). For each individual, the total number of other respondents in their clusters is noted, and then divided by whether those individuals occur once, twice, thrice or four times. These are also expressed as percentages (in brackets), and a total percentage of individuals who share multiple clusters is given. What this tabulation reveals is that the number of individuals who occur together in more than one cluster is very low. They are highest for S081, but even then they occur together only slightly more than a chance distribution would generate. The almost non-existent triple and quadruple repeaters are very telling for this analysis, indicating that very few people answered in ways that could be considered a perceptual pattern across the different items of the questionnaire. From this analysis it is concluded that the groupings formed through clustering similar responses on those items that are conceptually close do not move together as predicted by perceptual learning style theory. Once again, this poses the question why they do not move as predicted, and I turn to the possible reasons for this after a brief summary of the cluster analysis.

Table 17

Tabulation of the number of individuals that occur together across the four dendrograms

Respondent	Total respondents in shared clusters across the four dendrograms	Respondents who occur in one cluster across the four dendrograms	Respondents who occur in two clusters across the four dendrograms	Respondents who occur in three clusters across the four dendrograms	Respondents who occur in four clusters across the four dendrograms	**Percentage of respondents who occur together in more than one cluster across the four dendrograms**
S012	111	72 (65%)	31 (28%)	8 (7%)	0 (0%)	**35**
S068	59	47 (80%)	12 (20%)	0 (0%)	0 (0%)	**50**
S081	117	56 (48%)	59 (50%)	2 (2%)	0 (0%)	**52**

4.2.2.3 Summary of the cluster analysis

The cluster analysis has shown, firstly, that individuals do not neatly fall into groupings according to their perceptual preferences. This is a view that is shared by some learning style theorists: individuals can have one of a large number of gradations of modality mixtures (Fleming, 2006a). Secondly, however, it has also shown that individuals who answer one way in one set of questions are unlikely to answer similarly on another, preferring to choose different modality combinations for different described situations. This lack of consistency in choosing a specific modality combination means that it is not possible to make any perceptual learning style classification of individuals based on their choices on this questionnaire, and raises the

question whether it is at all possible to do so. Perceptual learning style theory predicts that visual learners will prefer visual strategies in most situations, and so on for the other modalities, but this analysis has not found such a pattern. Perhaps answering the question on classification of individuals should be delayed until larger samples and psychometrically valid instruments are available, but the lack of pattern formation along the lines predicted by perceptual learning style causes concern for the validity of the theory.

4.3 Discussion of questionnaire study

The aim of this part of the research was to statistically identify whether there are patterns in the ways that music instrument students in the Sibelius Academy describe their practising behaviours and strategies, and to relate these patterns to perceptual learning style theory. None of the analytical approaches used on this data show a relationship between the data gathered and perceptual learning style theory.

The factor analysis highlighted groups of variables that were not aligned with perceptual modalities, but rather with musical and strategic issues. The components were named, in order of greatest variation to least, 1) movement imagery, 2) research, 3) simplification, 4) reflection apart from playing, 5) scouting out, 6) musical shaping, 7) distraction, 8) metronome use, and 9) vocalisation. These concepts should be understood as interpretations, and not as hard and fast absolutes, but they do give a glimpse of the different ways in which individuals describe their practising. Together they account for just over half of the variation found in the responses to the questionnaire, which is too little to claim any kind of psychological or pedagogical importance, but large enough to indicate that perceptual modality preferences do not form an important factor in the way that music students describe their practising.

The higher-order components highlighted tensions inherent in the work of an instrumentalist, poles between which to navigate in the choices made in the practising room every day. These patterns show that in the everyday work of the instrumentalist is characterised, not by choices with regards to perceptual modality use, but rather by issues such as whether to work more technically or more expressively (if these things can be said to be distinct), or whether to analyse more or to play more. Or, perhaps these patterns reveal choices in approach already made, more fixed distinctions between different musicians. This second interpretation could show the influence of aspects of personality or of habitual approach to practising that have been shown to influence strategy selection (Hallam, 2001b; Kemp, 1997; Miksza, 2006). Whatever the case, there is very little correspondence between the analysis presented (and between other analyses run) and the assumptions of perceptual learning style.

There was some influence of instrument grouping on the total variation in the questionnaire, some of which was distinct from any physical properties inherent in the instruments, and the affordances or limitations that they present. These may point to differences in instructional culture in the different groupings, but such an assertion would need further investigation. Helena Gaunt and Hallam (2009) have suggested that interactions between personality, practising and performance may be affected by instrument type in professional musicians (see also Kemp, 1997) and this may be another factor in the variation observed in the questionnaire data with regards to instrument type.

The cluster analysis further confirmed the conclusion of the factor analysis by showing that individuals did not readily group into any kind of distinctive modality preference groups, and nor did those who group together for a specific set of variables do the same with other sets of variables that ostensibly measure the same modality differences. Individuals who chose visually (for example) in one group of questions did not do so for the others, and these variations were not stable across a number of individuals. The group of people who chose visually (for example) in one group of questions did not move together and select either visually or something else as a group in the other groups. Individuals did not consistently answer perceptual questions with the same modality choice, as is suggested by perceptual learning style. Thus, the predictions of perceptual learning style are not borne out by the data. In both the factor analysis and the cluster analysis, three possible causes for the discrepancy between theory and data was highlighted.

The first issue has to do with the face validity of the items. These items were translated into Finnish by professional translators. The majority of the items are taken from observational research with musicians, and therefore have validity in the sense that they represent behaviours and strategies that are used by musicians in their day to day practice. There were no complaints or queries that items were unfamiliar or unintelligible to respondents. In fact the opposite happened on several occasions, where respondents were interested in the issues raised by their thinking through the questionnaire. A teacher who teaches practising strategies in a professional development course at the institution also commented on the usefulness of thinking through these issues, and took a copy for her own use. Therefore I conclude that the face validity of these items is strong.

The second issue addresses the construct validity of the questionnaire. This is more difficult to prove beyond critique. Some of the items in the questionnaire are vague with regards to their principal perceptual modality. For instance: V12 I write out sections of the piece, either in full or in reduced notation. Does this represent a primarily visual or kinaesthetic experience? Others are vague in the sense that they might be about something other than gathering and processing information through a modality. For instance: A13 I use a metronome while I am playing. Is this about hearing the regular beat or about external regulation of behaviour? This touches on an issue raised in Chapter 2: whether pure modality experience exists, and whether it can be extracted from other experience and action? The answer given there is that this is not possible. Is it, furthermore, possible to write items that are perceptually specific? If the answer to the first question is no, then it must also be no to the second. These are questions not only for the questionnaire, but also for the theory. If the construct validity of the questionnaire is compromised, a compromised theory is implied, since the questionnaire attempts to follow the theory as closely as possible. It may be that the interpretation of the theory presented here is faulty, and that error slipped in through that route.

However, in the cluster analysis four groups of questions were used from the questionnaire that address the same issue, but with different perceptual emphases. These groups were intentionally designed to highlight any difference of perceptual preference in aims, concentration, imagery and help strategies. In the cluster analysis, these groups did not yield results that followed the predictions of perceptual learning style. Using these same groupings in a factor analysis also did not yield results that would be predicted by perceptual learning style. Thus, even when items that are perceptually vague or that might be addressing something other than modality preference are left out from the analysis, the results do not support the claims of perceptual learning style. The questionnaire is based on careful reading of perceptual learning

style theory, and most items were included because they operationalise the theoretical constructs as put forward by published theorists. If there is a construct validity issue of the nature spoken of above, it concerns both the questionnaire and the theory itself.

Which brings us to the third issue, which is that the questionnaire, and by extension the theory, does not seem to adequately address the situation that musicians find themselves in, and that there may be other, stronger variables that account for the variation between the strategy selection of individuals. What these variables might be cannot be answered from this questionnaire, but likely includes social and environmental factors, historical, motivational, cognitive and personality factors (see, for example, Gabrielsson, 1999, 2003; Gaunt & Hallam, 2009). Based on this analysis the claim that perceptual learning style theory plays a role in the strategy selection of students of the Sibelius Academy must be rejected. The principal differences between the ways that individuals describe their practising in this study are not modality specific, nor do they suggest any kind of pattern that can be understood to be modality specific.

Although the previous paragraph forcibly states the conclusions of this part of the study, there are some weaknesses in the study that should be taken into account. These are related to the nature of the questionnaire and the nature of the analysis.

There are several weaknesses inherent in questionnaire design in general which are also reflected in the design of the current questionnaire. Questionnaires are dependent on accurate respondent reflection and memory. Although the majority of respondents answer in good will and with the best of intentions, asking questions that are responded to with a rating scale leads to a generalisation on the part of the respondent, and does not readily allow for dissent or divergent views. Where questions are difficult to answer, there will also be the tendency to give a general answer. The responses should thus be treated more as descriptions of ideal practice and not necessarily of actual practice. Questionnaires of this kind function more like an opinion poll than a practice poll. In the light of the situation-specific uses of certain strategies seen in the observation study, it might be beneficial for another incarnation of this questionnaire to ask the respondents about a specific piece that they recently learned rather than to give an indication of what they would do if they were to learn an (imaginary) piece, as was done in the current study. This might give a sturdier ground to see which strategies and behaviours were used in an actual learning process. Of course, then, a second issue arises regarding how much can be accurately remembered about the process of learning. These are issues that are inherent in any type of interview or questionnaire study, and while researchers do their best to minimise the effect of these issues, it is unlikely that they are ever completely absent from any research of this kind.

Another objection that may be raised is that the analytical methods chosen were weak and researcher influenced, leading to a result that is less than trustworthy. Both factor analysis and cluster analysis have an important dimension of researcher choice and influence. They were chosen because the questionnaire was designed to identify patterns in the ways that groups of individuals answer the questionnaire, and both these methods are ideal for identifying patterns. The questionnaire did not posit dependent and independent variables, and thus analytical tools such as regression were of little help. Regressions without clear dependent and independent variables show relationships that are mathematically sound, but may be theoretically dangerous. Furthermore, the non-normal distribution of the data precludes the use of most such analytic tools. Another possible avenue of analysis was to calculate cross-tabulations and correlations

between the items of the questionnaire. This shows the nature and strength of the relationship between two items. These *were* calculated and investigated using visual data analysis (drawing on Keim, Mansmann, Schneidewind, & Ziegler, 2006), but the factor analysis is also drawn from a correlation matrix, and incorporates these relationships into a larger picture of variation in the total dataset and this was concluded to be a more robust and inclusive interpretation of these relationships.

While there are some difficulties with the results of the questionnaire study, discussed above, I conclude that the results presented here bear scrutiny, and are generally sound. This study offers no support for the claims of perceptual learning style in the self-descriptions of the practising of music students taken from the Sibelius Academy, even when the questionnaire was explicitly constructed to elicit information on perceptual learning style. Extrapolating this finding to the broader population of music students in Finland cannot, unfortunately, be advocated strongly.

The questionnaire as it stands is not useful as a tool for perceptual modality preference identification. It is furthermore not complete enough to be a practising aid as it stands. Inclusion of other items drawn from the practising literature that do not specifically address only perceptual issues but also time management, motivation, organisation, and other aspects need to be included for this questionnaire to be useful in future research projects.

5 Results II – Observation study

The previous chapter showed that the questionnaire data did not support perceptual learning style theory, and painted a more complex picture of the practising of a sample of students from the Sibelius Academy, with a possibility of other influences being more prominent than perceptual learning style. Three reasons were posited to account for this discrepancy, either that the 1) face or 2) construct validity of the questionnaire is compromised, or that 3) the theory is inadequate. This observational study offers another way to investigate the adequacy of the theory. The aim of this part of the study is to investigate which differences can be identified in observations of the practising of six pianists and in their descriptions of this practising, and how these differences relate to perceptual learning style. The data gathering and approach to analysis for this section were discussed in the methodology chapter.

An important concept in this chapter is that of *information processing,* which is used to describe the definition of learning that perceptual learning style uses. In this view learning is the process of gathering information through the senses, and processing it in the related sensory cortex prior to memorising. I have assumed that information processing should be distinguished from other aspects of the learning process (such as motivation or self-regulation), and other conceptions of learning (such as the situated or constructivist views). These processes and conceptions are not discussed in the literature on perceptual learning style that I have accessed.

As a result of the analysis of both the interview and observation data, thirteen categories of behaviours were identified that differentiate the participants in the study. They have been grouped here into auditory (5.1), visual (5.2) and movement-related (5.3) areas for ease of discussion. For each behaviour a brief description of the range of uses to which it is put by the participants is given. Some comments on the influence of teachers on the data discussed is offered (5.4) prior to a discussion of the results (5.5).

5.1 Auditory aspects

According to perceptual learning style theory, people who best retain information through hearing can be considered auditory learners. In the practising situation, while playing, there is almost always sound (unless a silent keyboard is used). This sound is, however, inextricably linked to the kinaesthetic aspects of producing the sound and usually also to the visual aspects of either looking at a score or at the keyboard and hands. Therefore this *principal* source of auditory learning is not considered in the discussion below. This is done because it is not possible in observational data to distinguish which modality a person is primarily drawing on *while playing*. In the interview data participants were loath to specify only one modality for those sections where they were playing. Even if they specified, there was some possibility that they were mistaken, either because they did not take account of all the sensory information they

were processing (Massaro, 2004), or because they might have forgotten aspects of what they were doing (Schacter, 2001). Therefore, the discussion below draws on behaviours involving hearing that do not include physical playing (and likewise for the visual aspects discussed later). Four such behaviours were identified from the research data: listening to recordings, both of others and of one self, speaking and singing. A fifth behaviour, using a metronome, is also discussed with reference to perceptual learning theory, although it is a less clear case of specific modality use.

In the observation sessions there was very little time devoted to using aural imagery, or imagery of any kind, for that matter. This is partly a result of the study design, with participants perhaps assuming that it would be uninteresting to observe this and that they should be playing as much as possible. Two of the participants (Carlos and Martha) spent some time in of one of their sessions studying the score without playing. Because they can be seen conducting (see section 5.3.1 below), one can conclude that there was some mental aural representation taking place. They were, however, loath to identify a specific modality in those moments. Their discussion of this showed that the mental representation involved each of their senses, not only the auditory modality. A lack of convincing data therefore excludes this aspect of their learning from this discussion. This issue will be addressed again in the discussion of this study.

5.1.1 Listening to recordings

5.1.1.1 Listening to recordings of other performers

Listening to recordings of the music one is learning is perhaps the only behaviour that could be understood in purely auditory terms, although listening sometimes takes place while following a score, which adds a visual dimension. Rolf Godøy (2003) has, furthermore, argued that our perception and cognition of music may have images of movement deeply embedded. However, since these motor-mimetic images are not observable, listening to recordings is here considered a primarily auditory behaviour. Perceptual learning style predicts that auditory learners will use listening more often to aid their learning than other types of learners, and that they would tend to learn easily by ear.

In this analysis I distinguish between intentional, focussed listening to recordings as a means of learning, and listening in a more general sense. Intentional listening is assumed to give a clearer indication of the kind of behaviours auditory learners are supposed to engage in to aid their learning. The participants in the observation study did not often *intentionally* listen to recordings of the pieces they were learning to aid their learning either before or during the learning process. Every piece studied in this project, however, *was* known to the participants, either through repeated hearing in concerts and recordings, or through participants' colleagues studying the works, thus though the second, more general, kind of listening. Martha tellingly asked in this regard, “why [would] I start a piece that I don't know?” Two exceptions to knowing the work well prior to starting practising were Carlos, whose O'Byrne work was unrecorded and unperformed at the time he started learning it, and Khatia, whose Franck was unknown to her, and which she had only listened to once.

Maurizio had the most intentional use of recordings of the participants. He claimed to almost always listen to the work prior to starting to learn it. He had listened to the Beethoven

when he needed to select a sonata to prepare, but had not listened to the Bach because it was a prelude and fugue “that I know, like, I have listened to it a lot.” He also listened to several recordings close to the first performance date, to compare and take note of interpretative details that he wanted to experiment with. These listening sessions usually occurred with the score at hand. Vladimir, on the other hand, had not developed such an intentional approach, largely because a previous teacher forbade him to listen to the works that he was studying. His teacher at the Academy did not have a similar prohibition and he used the opportunity to listen to the Beethoven many times. “I think it helps a lot, a lot” was his assessment of this (for him) novel strategy. He did not listen to the Ravel as much as the Beethoven, although he was familiar with the work from previous hearings.

None of the other participants intentionally listened to the works they were studying in order to help them learn or remember the music, but all were familiar with the works from repeated hearings. Khatia's reasoning behind not listening to the Franck she was learning (except for one hearing before she started) was that she wanted to avoid being influenced by another's interpretation. This is a matter that several participants remarked on. In this view, freshness of interpretation and close attention to the score are both endangered by too close a knowledge of a specific recording. The fear of imitating another performer and thereby playing in a derivative way was something that outweighed any benefit that the formation of a strong aural image of the work prior to learning it might have had. Also, having a strong aural image is understood to inhibit a close reading of the score because the interpretative decisions of the previous performer are so deeply ingrained that their interpretation is chosen over any clues the learner might pick up from the score. Carlos had, for example, recently learned a very popular Beethoven sonata, and by his reckoning it took him some months “to get the feeling that it's your piece, it's my piece,” and not a copy of some other interpretation.

Despite the general position against knowing another interpretation too well prior to practising, and while intentional listening to a recording in order to help the learning process was not prominent in the six participants of this study, in almost every case there was an aural image of the work prior to the first practising session. In most cases the aural image of the work is formed over a long period of repeated hearings, which is not necessarily directly connected to the intentional learning process, and may in some cases happen years before the works are taken up. The importance that knowing the work aurally has for some of the participants shows, however, that this long assimilation through repeated hearing is a contributing factor to their understanding and learning of the work. There is for each individual a large background of enculturation into the norms and standards of musical practice as a whole, and very often into the norms and standards of the specific piece they are learning. None of the participants actively listened to the works they were studying either during the time that they were studying them or just prior, with the intention of aiding their learning. It is, thus, difficult to conclude from this analysis that one person may be more auditory than another, even if some were slightly more intentional in their use of recordings immediately prior to learning. In several cases, getting to know the work aurally happened over many months or years of listening prior to starting to learn a specific piece. Weighing the relative importance of intentional listening against longer-term general listening should not be undertaken lightly.

5.1.1.2 Listening to recordings of own practising and performances

Making recordings of one's own practising and listening to that recording is considered to be a primarily auditory behaviour (like listening to recordings of others), although there are also self-regulatory and evaluative aspects to doing this, meaning that information processing may not be the primary objective of this behaviour. Participants reported often listening to themselves with a score at hand, adding another modality to be considered. Perceptual learning style predicts that auditory learners will use listening more often to aid their learning than other types of learners, and that they would tend to learn easily by ear.

The participants revealed a range of practices with regards to recording themselves. None of them were observed recording themselves (20 minutes was perhaps too short to allow for this approach), although the whole research situation revolved around recording and viewing that recording. For Khatia this offered a novel learning strategy. She had, until participating in the research, recorded herself at performances but remarked that she planned to start recording her practising sessions also. Joining in this research project opened a new strategy which she will "have to do" because "it is very useful". She, together with all of the other participants, used the research recordings not only as a way of answering the researcher's questions, but also as a means of evaluating their own playing in the practising sessions. There were regular comments about musical ideas that worked or didn't work, about technical aspects which had escaped notice, and a kind of meta-cognitive commentary on their organisation of practising. This points to a general use of self-recordings in an evaluative mindset.

Both Carlos and Martha occasionally recorded their own practising, although Carlos had started this practice only the week prior to the first interview, and was experimenting with the idea of recording himself as a learning tool. There were several comments from the participants that it is not possible to concentrate on every aspect of playing while playing – some aspects always had to stay hidden from attention. Listening to or viewing recordings of oneself brought these aspects to the fore.

It was unusual for the participants to record very early work with pieces, as was the case in some of the research situations they encountered. More common was for participants to record themselves later in the process, when greater fluency had been achieved. The purpose of this later recording is to evaluate musical ideas rather than to investigate practising or to help with learning the notes or rhythms. For example, Maurizio tended to record himself when approaching a concert date. He then compared this recording to the commercial recordings that he listens to at around the same time to evaluate musical ideas and to identify areas to pay attention to. Comparing two recordings is a simpler task than listening to a recording and then trying to compare it to your own playing while playing. The emotional and cognitive distance involved in listening to recordings makes the comparison much easier and more fruitful.

It is not possible to conclude that those who record themselves more often would be more auditory in their learning style due to the primarily evaluative way that these recordings are used. Perceptual learning style would claim that Carlos' use of recordings, in order to learn faster, would be more predictive of an auditory learning style, but he had only used this approach experimentally and for a brief time. This does not give enough indication that he would be an auditory learner.

5.1.1.3 Auditory learning style and use of recordings

It is not possible to argue that an auditory learning style would be identifiable by looking at the use of recordings as a whole, since recording of self and listening to recordings of others seem to be motivated by different needs and desires. It is therefore important to consider the aim that individuals have in listening to the recording prior to classifying them into some perceptual learning style category based on a propensity to listen. Furthermore, it is important to note that much of the auditory learning of works happens long before they are actively studied, through a thorough aural acquaintance with the music of the style period, the composer's ouvre, and the specific work. Martha explained as follows,

> Me: How much are you sight reading, I mean, this is the first time, well not the first time, but the first time in a long time that you have read this?
>
> Martha: Yeah quite, quite much, yeah but this is so familiar...
>
> Me: You know it very well, the sound?
>
> Martha: So I think I also play with my ear so much, so it is much easier.
>
> Me: So I mean you can sing this in your head, you can hear it in your head?
>
> Martha: Yeah.
>
> Me: From several recordings or from...
>
> Martha: Yeah, yeah, of course, and I mean people...
>
> Me: performances
>
> Martha: people have played it, my friends have played it, so I have heard this many times and I have heard many, so it ma.. that is why it is really easy.

Simply observing what happens immediately before or during an individual's learning of a specific work is to overlook a large amount of work that has been done in preparation of this learning. If an auditory learning style were to be identified in someone based on their listening behaviour, it would need to be based on a long-term observation, and not just isolated events.

5.1.2 Vocalisation

Vocalisation can either be understood as, firstly, an auditory behaviour, in which the learner needs to hear his own voice (or that of someone else) explaining or describing, or, in the case of music, enacting or giving expression to melodic or rhythmic material that needs to be remembered, or, secondly, as a kinaesthetic behaviour in which the speaking is more important than hearing what is said. Most likely, both these aspects play a role in the vocalisation situation. In their original theory, the Dunns (R. Dunn & Dunn, 1978) placed speaking in the auditory category, but in their revised BE questionnaire (Rundle & Dunn, 2007) speaking can be found in its own category: verbal kinaesthetic, probably because of the difficulty in classifying this behaviour. None of the other theorists (Fleming & Mills, 1992, for example) make this distinction, and so for the purpose of analysis it is treated here as an auditory behaviour. Perceptual learning style predicts that auditory learners need to hear information, and may vocalise it themselves in order to hear it.

The most intentional use of vocalisation came in Vladimir's first session with the Beethoven *32 Variations.* He did not use this approach in any of the other sessions observed. In the fourth variation of the Beethoven (see Illustration 1) he can be heard singing with the alto line, which moves in an arpeggiated triplet pattern.

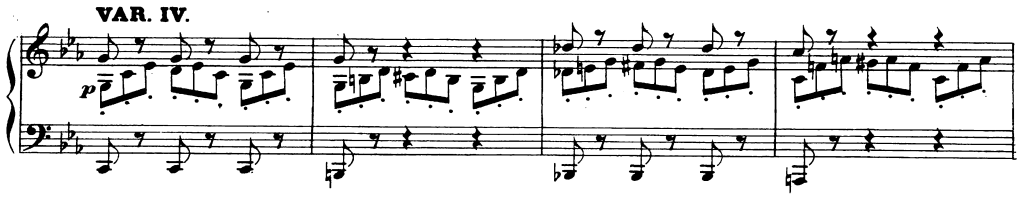


Illustration 1
The first four bars of the fourth variation of Beethoven's 32 Variations in c minor, WoO 80. Vladimir was singing the alto part, moving in triplets, using solfege names.

He is singing using the French solfege syllables, something he was trained from a young age to do when sight reading. “When I am sight reading I am saying the names of the notes all the time.” At other times during this session he can often be seen mouthing, and, although not as audible as in variation four, it seems to be the same practice. This naming of the notes as he reads them is doubly helpful to him, firstly, because he is forced to recognise each note, and cannot just gloss or play something that is almost right, and, secondly, because he has perfect pitch, meaning the note name and the sound of the note are inseparably linked in his thinking. So saying the note is very closely linked to playing or hearing it. The note names also form a central part of his memory for music. He relies on this name and sound combination as his primary memory, this together with the names of the harmonies and the movements involved.

The other participants did not use speaking or singing as obviously as Vladimir. Khatia could be heard and seen singing with her own playing at different points in her learning of both works, but this was not as conscious a behaviour as Vladimir's was, and something that she would rather avoid but was not sure how; “sometimes it is not useful” was her assessment. She felt that it helped her to phrase the music better, and was thus more a tool to aid expression than one to help her process information. Maurizio spoke about an inner verbal narrative that takes place both with regards to selecting which fingers to use and with regards to harmonic progressions. For him, naming does not happen out loud, but internally there is, at least occasionally, such a narrative stemming from his harmonic analysis and from his careful work in finding the right fingers to use.

> So I'll even when I'm playing through I'll think, for example if I'm in this bar, and so this bar kind of stays the same harmonically and then I'll say to myself halfway through this bar, ok, Bflat7 is the next bar, you know, and then I get there and I go yes it is, there it is. Next bar, ok, E flat.

Both Khatia and Maurizio, however, seem to use these behaviours more in the later stages of learning, and thus more as an aid to expression or recall than as an aid to initial learning or understanding.

Both Carlos and Martha can be seen mouthing something when they are first learning the modern works. This mouthing happens in the context of sorting out rhythmical difficulties, and

they can be seen tapping a pulse or conducting at the same time. At the time of mouthing they are focussing just on one aspect of the music, the rhythm, and are thus simplifying. When playing the full texture, they have to deal with the complexity of rhythm AND coordination AND remembering the notes, by isolating only the rhythm and speaking it or tapping it, they aim to attain a level of automation for that aspect, allowing them to focus on the others when playing again. Only Rosalyn was not observed using speech or singing in her sessions.

In the sessions observed, vocalisation were seen to be used mostly in situations where there is a perceived difficulty and where the speaking or singing fulfils a reduction of complexity role. The same person was not observed both speaking and singing. Only Khatia seemed to have an involuntary singing response which seemed more related to expression than to learning or complexity reduction. In the majority of situations, vocalisation was thus used as an information processing strategy, but this was not observed in every situation. It would be important to distinguish between these uses of vocalisation before it is used as a tool to classify individuals into one or another perceptual learning style category. Although I have here treated vocalisation as an auditory behaviour based on publications dealing with perceptual learning style, doubt remains whether this is this an auditory or kinaesthetic response, and how one would tell the difference. This doubt alone should caution any classification into either category, and should, together with the conclusion that not all vocalisation is a part of information processing, dissuade use of this behaviour as a classification tool.

5.1.3 Metronome use

Using a metronome is not discussed by the perceptual learning style theorists, and is problematic to place in the theory. It has been argued that auditory learners will be distracted from their task by sounds that are intrusive. On this argument, then, a ticking metronome should be problematic to auditory learners since it will distract them from their task. On the other hand, however, the metronome sound forms part of the practised piece for the duration of its use and may therefore be considered unobtrusive in that situation. Furthermore, metronome use is not directly involved in information processing, but rather in the regulation of playing, and therefore should probably be considered as a tool that falls outside the perceptual learning style discussion.

Khatia was the only participant to use a metronome in the research sessions, and she used it extensively in the early sessions. She admitted to feeling scared when playing without it, as she felt that she struggled to keep a steady pulse when playing. When the metronome is playing, “I don't have to remember the tempo or something and it helps me, because I know how much time I have in one bar.” In addition to the metronome she could also be seen simultaneously tapping her feet, or rhythmically moving her head and upper body in an effort to control the aberrant pulse. She was ambivalent about the effectiveness of this strategy, but unable to find another way of addressing the problem she experienced. However, apart from controlling the pulse, her use of the metronome also functioned to keep her on track. “It also helps if I don't know how it goes or I don't remember, that I have to continue.” Small mistakes and other distractions have to be ignored to keep with the metronome's steady pulse, and this technique therefore develops her ability to keep going under adverse circumstances.

Vladimir did not use a metronome in the research sessions, because he felt that it would be inappropriate for the research setting because of the amount of time that his work with a

metronome usually occupied. He thought it would be boring for me to observe this work. However, he said that he used the metronome "all the time." He used the metronome to develop manual dexterity and as a way to enforce a systematic approach. He decried his lack of patience when it came to working on difficulties, and the metronome gave him an external stimulus to help him overcome this perceived lack. He claimed to regularly decide upon a problematic passage, start the metronome very slow, and for 20 or so minutes gradually increase the speed. This kind of work allowed him time to "think about everything" related to the passage, and developed his finger dexterity and strength.

There is a striking difference between the uses of Khatia and Vladimir. Khatia used the metronome for longer passages in order to get a sense of the pulse and flow of the music, while Vladimir used it for shorter passages that get repeated over and over in order to develop finger dexterity and strength. For both, the external stimulus is important as a regulatory tool, but used in very different situations and for different purposes. Martha and Maurizio both said that they occasionally used metronomes, but only in passages where rhythmical difficulties occurred, or where they wanted to check the tempo they were playing in. They seem to have less dependency on the metronome as a regulatory tool. Rosalyn preferred not to use a metronome at all because she did not like the way it felt. Carlos did not say whether or not he ever used a metronome.

Although a wide rage of habits and attitudes with regards to using a metronome can be observed, it is not possible to ascribe this variation to differences in perceptual strengths between the participants. From the observations in this study, the range of uses of and attitudes to using metronomes is influenced by skill levels in managing rhythmical difficulty, and by the level of need for external regulation and by habit. Only the second of these could be considered to be influenced by perceptual learning style, and even then it is difficult to say whether metronome use would be beneficial to an auditory learner or not.

5.1.4 Summary of auditory aspects

None of the three areas where variety was observed offered distinctions that can be considered to stem *only* from perceptual learning style. Listening to recordings of others came closest, but each person had a long background of listening prior to the start of the work, and it is difficult to say when the learning process began, which makes it difficult to compare individuals because you have to take their whole listening history into account in such a comparison. Listening to recordings of their own practising and using a metronome were both seen to be influenced by factors other than perceptual learning style. Using speaking and singing is unclear in its modality classification.

Even if these objections were ignored, and only the frequency with which individuals engaged in these behaviours were considered, a mixed picture emerges. Table 18 classifies the participants with regard to the frequency of their use of these strategies in the observed sessions and from the interview discussions. The distribution of frequencies given in this table (and in Tables 19 and 20) is somewhat subjective, being based on both observation and interview data. Sometimes these data sources are difficult to compare, for example Vladimir and Khatia's use of metronome, Khatia's use can be observed and counted, while the other is based on Vladimir's statement that he uses a metronome "a lot". While every effort has been made to use accurate measures, researcher judgement is involved. There is also no standard measure for what

'frequent' means, and for each behaviour this is judged relative to the occurrence of the behaviour in the observed sessions.

Using a metronome and using speaking and singing give a similar pattern, but this differs markedly from the two uses of recording. The similarity here might be equally related to the regulatory aspects in both metronome use and self-talk, as to any aural component that they share. Across the two uses of recording, Khatia and Maurizio seem to have a similar level of engagement, but Carlos and Martha differ drastically from one to the other. Rosalyn uses each of the behaviours only infrequently.

One would be hard-pressed to identify one or the other of the participants as an auditory learner based on these behaviours. There is very little pattern in the ways that the behaviours are observed in individuals, and each of the behaviours carry several meanings for the participants that are separate from their perceptual modality preference. On the basis of this analysis there is minimal support for the identification of an auditory learning style.

Table 18

Classification of frequency with which participants engaged in auditory behaviours

Behaviour	**Frequent**	**Intermittent**	**Infrequent**	**No Data**
Listening to recordings of other performers	Maurizio, Vladimir	Khatia	Carlos, Rosalyn, Martha	
Listening to recordings of own practising and performances	Carlos, Martha, Maurizio	Khatia		Vladimir, Rosalyn
Use of speaking and singing	Vladimir, Khatia	Maurizio, Carlos, Martha	Rosalyn	
Use of metronome	Khatia, Vladimir	Martha, Maurizio	Rosalyn	Carlos

5.2 Visual aspects

A visual learner is defined by perceptual learning style theorists as someone who remembers information best when seeing it. It is impossible to separate the visual aspect of reading the score or looking at the hands and keyboard from the auditory and kinaesthetic aspects of playing, as is the case for auditory (see 5.1). The three modalities seamlessly join together when making music. The discussion below thus draws on two more overt behaviours, writing on the score and relating to it as a physical object. Whether participants claim to form a visual memory of the score as part of their memorisation is also discussed.

5.2.1 Writing

In the terms of perceptual learning style theory, writing in the score can be understood either as a visual reinforcement – the learner has to see a written mark in order to make sense of information – or as a kinaesthetic/tactile reinforcement – the physicality of writing something helps to make sense of the information. Fleming (2006a), for example, creates a separate category for this action, and his four categories are visual, aural, kinaesthetic and read/write. This points to the difficulty in categorising this behaviour, much like the difficulty of categorising vocalisation. In this analysis it is treated as a primarily visual behaviour, although there is some data to suggest that the kinaesthetic aspect is also present in some cases. Perceptual learning style theory predicts that (if it is a visual behaviour) visual learners will more often and consistently write on their scores in order to process the information contained there than other types of learners.

Maurizio made the most constant and consistent use of writing of all the participants. This writing was concentrated in the early phases of the learning process, and mostly took the form of fingerings, harmonic labels, brackets and asterisks. In the Bach fugue he marked out the entries of the theme in each of the five voices with a different colour (An example of each of these types of markings can be seen in Illustration 2). He wrote markings even in places where the fingerings would be "obvious" to him and where he has "never played anything else." These are put there so that he can be certain about which fingers to use. Marking the score ensures that he is conscious and attentive to the details of (in this case) the movements and finger placement that is needed to play the work. The importance of writing in the early stages of work seems to be because he is using the markings as a way of building larger memory groupings. He notes that when he is looking at the sheetmusic, after a certain point he is no longer looking only at the notes themselves, but is also reading the markings he has made.

> I can see that bigger picture like 2.. 4.. 3.. [sings] 4.. 3.. like it gives you a bigger kind of framework and its its not, you don't have to look at every note, ok 423424, you know, it just gives you reference points and that's, and when you are playing fast, that's a whole lot easier. So, and also I think if I write it in, then um, especially if it's something like this, that's kind of messy and awkward, then that actually serves as a memory tool.

In this way the marking becomes an intermediate performance cue, standing for a larger grouping, but eventually to be superseded by another type of performance cue as he memorises the work, and moves away from looking at the score. In the Bach, for instance, the coloured entries were useful as long as he was using the music to play from, but by the time he had memorised the work, he could no longer remember which voice had which colour. He remarked in the final stages of working that his frame of reference became more the "keyboard and how it sounds than the page and what it looks like," and that any changes would be made with regard to this new frame of reference, rather than by going back to the score to note something there.

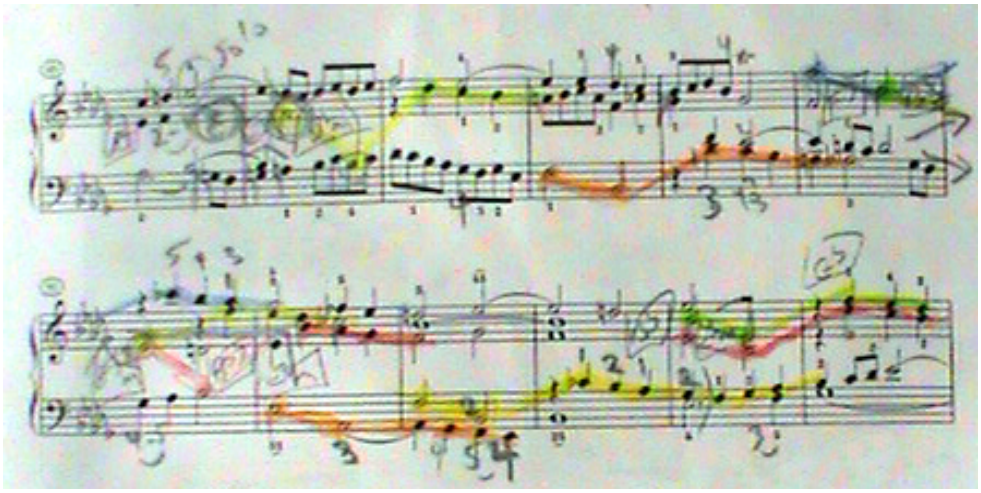


Illustration 2
A photograph of some bars from Maurizio's Bach score showing his use of colour, writing of fingerings and performance indicators, and harmonic analysis.

For Maurizio, the physicality of writing was in some ways more important than having something written. He argued that having the fingering already placed in the score might help in the initial readings, to know what to do, but would be of little help for the formation of his memory in the same way that the act of writing does. The "messiness" of his markings become a personalised layer that is placed over the score and that is used as a stepping stone to develop a firm memory of the work.

The other participants used writing only in situations where it was deemed necessary, and not as a means of building memory in the same way as Maurizio did. Martha wrote in the Dutilleux score but not in the Beethoven. This distinction came as a result of the rhythmic and melodic complexity of the first, and the simple texture of the second. In the Dutilleux the markings worked in a very similar way to what Maurizio described, adding a layer of personalised information that clarifies and eases reading. She marked in fingerings because some of the figurations were counter-intuitive, whereas in the Beethoven this was unnecessary since the figurations rely heavily on the patterns that she has studied numerous times in scales, arpeggios and technical exercises, and so she does not need the reminders of which finger to place where as urgently as in the modern work. Similarly, the Dutilleux's rhythms are much more complex than that of the Beethoven, and so she marked in beats and subdivisions in several places in the score (see Illustration 3). Another factor influencing these decisions was that she was unsure about the research situation in the first Beethoven session, which was also our first session together,

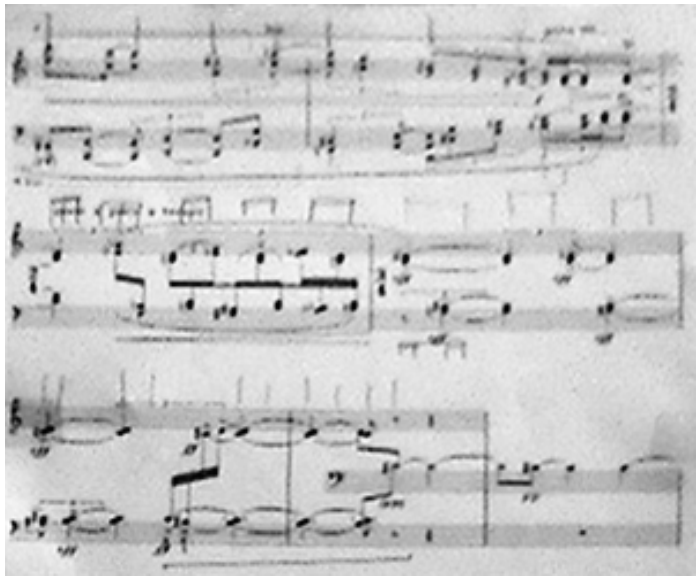


Illustration 3
A poor quality photograph of some bars from Martha's Dutilleux score, indicating her markings to clarify the beat and groupings within each beat.

> Ah yeah, sometimes I write, I think this is just so special occasion, I didn't have pencil or anything. Yeah, but I sometimes write some fingerings. But perhaps, perhaps in the first practice I don't write so much. Perhaps later I write much more, because then I know many things that my teacher has said to me and I have own ideas and perhaps now I was just concentrating on the text so I did not so much need to write

In familiar music it seems that she wrote more in the later stages of learning, and that these markings were more of an expressive nature, rather than the kind of learning or sense-making markings that she used in the Dutilleux, or that was described with regards to Maurizio.

Khatia did not write much. One of her previous teachers wrote copiously on her scores, and it helped her at the time, but since then she has not felt that she needed to write. The exception was the harmonic markers she wrote in her Franck. She was unfamiliar with the harmonic language of the composer, and did not know the work aurally, and so her analysis was both a way of making sense, and one of her memorisation strategies. In the Bach there were some markings from a masterclass she had attended, some fingerings and very small harmonic analysis markings (see Illustration 3). Khatia's markings do not form a layer above the sheetmusic, as in Maurizio's case, but rather seems to blend in, or even hide behind the notes of the score.

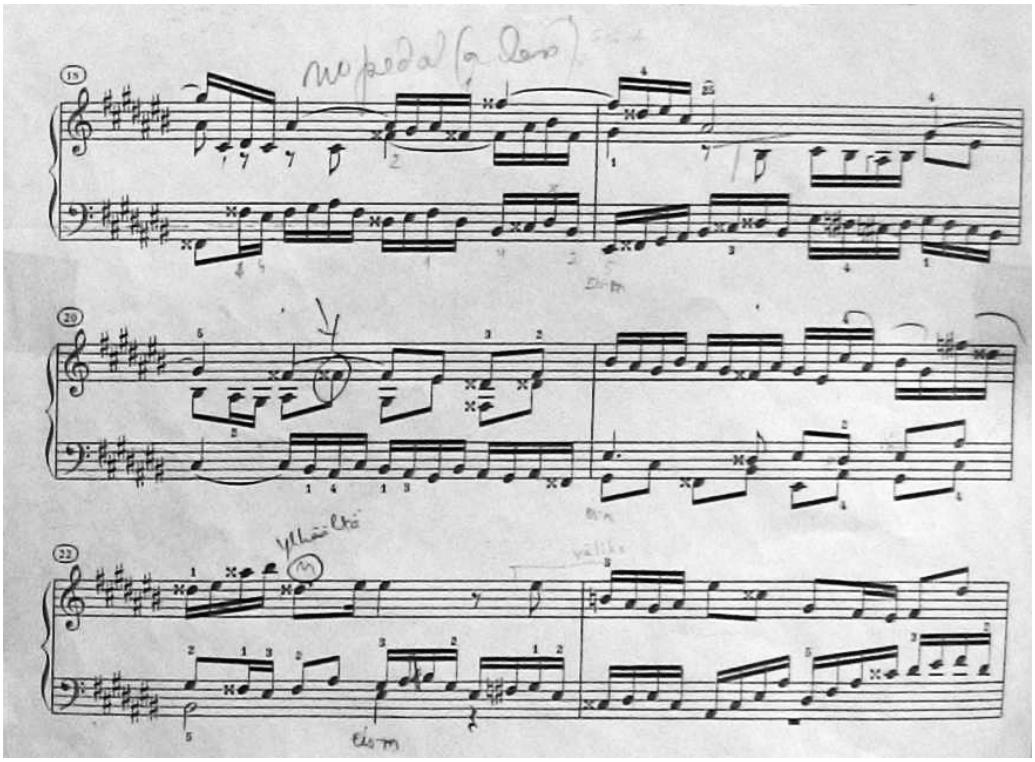


Illustration 4
A photograph of some bars from Khatia's Bach. The large writing at the top the centre is by the teacher of a masterclass, and the dark markings from her teacher. Her own writing is the small harmonic markers that can be seen below bars 19, 21 and 22, the fingerings that can be seen most clearly in bar 18, and the marking of an answer entry in the top voice in the upbeat to bar 23.

Rosalyn did not write much during the observation sessions, only some fingerings in the Beethoven. She had written in fingerings for some of the Brahms variations prior to our observation sessions. Her philosophy was to only write in places where the fingering is for some reason unclear, for instance in modern music that does not follow the patterns that she has rehearsed and learned in her years of study in the mainstream tonal repertoire. In music like the Brahms or Beethoven, many of the fingering decisions are similar to ones she has made countless times before, and therefore no big reminders are needed.

Both Vladimir and Carlos claimed to never write in their scores, however, Vladimir did circle a chord in the second observation, as he discovered that he had been playing it wrong until then. Prior to the same session his teacher had also made many changes to his established fingerings, and he was comparing the notes she had made in a photocopy of the score to the score he usually played from, and copied some detail from one score to the other.

While several of the participants used writing in their score, there seems to be a marked difference between the writing of these participants and the way that Maurizio used markings in his score. In Maurizio's case the act of writing is as important as what is contained in the writing, while the other participants seem more interested in the information contained in the writing than in writing as an aid to their learning process. Both the difference in the way that writing is used and the intentionality and amount of writing points to a more fundamental difference in the way that musical information is processed and remembered between Maurizio and the rest of the participants. For the first time in this study, a clear distinction that is in line with perceptual learning style theory can be observed. However, the question arises whether it is the visuality or the tactility of the writing that is important for Maurizio. There is a blurring of categories here which casts a shadow over the clear distinction. Should Maurizio be considered a visual or kinaesthetic learner as a result of this behaviour?

5.2.2 Reliance on the score

There was variation in the way that the score is used as an artefact, where it was placed and how often it was consulted. Reading from a score is viewed as a visual strategy, although there is of course also a visual aspect to playing by memory or by ear, when the hands and the keyboard can become visual reference points. But in reading from the score the information is presented visually, whereas in playing from memory or by ear it is not really a case of learning new information visually but rather of recall or reconfiguration of existing information, or of information gathered through other modalities. Perceptual learning style theory predicts that the visual learner will be more reliant on the score than other kinds of learners.

Carlos looked at the score the least of all the participants. This was in large because he had previously memorised the Clementi, and could still remember large parts of it when we met the first time. This first session with the Clementi was the only time I observed him with a score on the piano's music stand, he had, however, placed the music and stand flat rather than the more customary angled position. This made reading difficult for him, and he could from time to time be seen straining to see the score properly, and indicates a different relationship to the score than someone who has it propped open in front of them all the time. In all three the other sessions, the score was placed in another part of the room, either accessible or still packed away. He started learning the O'Byrne piece by using mental practice and placed the score on the windowsill behind the piano. He thus moved to and fro between the score and playing. At the other extreme, Khatia always had the score on the music stand of the piano, even when she played entirely by memory one week prior to her examination.

Placed between these extremes were the other participants. Vladimir also had the score present at all times, but had not yet memorised the works entirely, and so cannot be compared so easily to the other participants. Rosalyn also had the score present the whole time, but had gone through a phase of playing without it for the Brahms. In the second observation she had it open because she had not played the piece for a couple of weeks, and used it to refresh her memory. Both Martha and Maurizio were generally free from the scores in the later sessions. Maurizio did not use the score at all in the two later sessions, while Martha played for a while without the score in the Beethoven and then took it up to look at some fine details that her teacher had been suggesting in their previous lesson on this piece. She was not planning to play the Dutilleux from memory and thus would keep the music on the stand even to the final preparations for performance.

In relating to the score as an object, as in writing in the score, there seems to be a clear distinction between the participants. However, this variety is a product of the varied situations in which the participants were observed. A number of factors impact the situations in which the score is used, such as: a) whether or not the work is going to be performed without music; b) how thoroughly the piece has been memorised; and c) the kind of work that is planned for a specific session - for example mock performances and detail work each require a different kind of relationship to the printed score. So, while there is a range of relationships to the score, this is not understood to point primarily to any difference in perceptual learning style, but rather to differences in situation. Much longer observations of individuals may reveal some commonalities across the different situations, but in the limited observations of this study, none such commonalities were found, once again giving no support to the perceptual learning style theory.

5.2.3 Visual memory

Whether or not an accurate version of the score is remembered as part of the memorisation process would be a good indication that the information presented visually is also remembered and recalled in the same format. Reliance on visual memory could thus be a good indication of whether someone could be considered a visual learner. However, musical memory is almost always built of several layers, which include technical, structural, interpretive, expressive and perceptual cues (Chaffin, et al., 2007), and many of the processes of memory are hidden to those who use them. So this is not as clear-cut as it may seem. Perceptual learning style theory predicts that a visual learner will remember visual details with greater accuracy than other types of learners, and will rely on visual images as the most important part of their memory.

In the course of the interviews I asked each of the participants to try and explain the nature of their memory. The answer of each was generally the same: memory is layered and built of many facets. Each remembered aspects of harmonic movement, also aspects of the various arm, finger, head and other movements that are required to perform the music, together with the melodic structure of the pieces. Reading the literature on memorisation suggests other areas they did not speak of, including the emotional peaks and troughs of the music and expressive details (Chaffin, 2007). One aspect where there was some variance was whether they aimed to remember the score and to have a visual picture of the score while performing. So while all relied on auditory, motor and analytic memory to some extent, trying to remember the score showed greater differentiation than these other aspects.

Khatia was the only participant who claimed to actively pursue remembering the score in detail. This coincides well with what was mentioned under the previous heading of her reliance on the score in practising. To the last week before performance, the score was present on the music stand, and her aim seemed to be to take as much visual detail of the score to the performance as possible.

Rosalyn, Vladimir and Martha could all remember parts of the score as they performed from memory, but were not able to read from the score in their mind's eye. The knowledge was rather of where they were on the page. This kind of knowledge proved fleeting for Rosalyn, who after having played the Brahms from memory, and then not practising it for some weeks, returned to practise it for our final observation session. Her memory of where things were on the page had deteriorated. She occasionally found herself lost, after playing some section from memory and

needing to look at the score to remind herself of some detail, and then had to hunt a little for her place on the score. In memorising the music she had also carefully learned head movements in some of the more complex variations, and these movements were disrupted by having to look up and find her place on the sheet music.

Maurizio and Carlos said that they did not try to remember the sheet music at all, and relied more on keyboard positions, movement and sound. In Maurizio's case this is a little surprising given his extensive use of writing in the early stages of memorisation, but the writing could be understood as already moving away from the score to a secondary layer of cues, which are then replaced again by other cues as the sheet music is put aside.

Many participants remember the score, at least in broad details, and it seems that this kind of visual memory of the score is related to its familiarity. It is looked at and studied for a considerable portion of the time spent learning a work, and most of the participants can remember roughly where they are on the page when attempting to play from memory. This is probably not an indication of a strong visual memory. Actively pursuing, and succeeding, to remember the score in enough detail in order to read from it may be a better indication of this. In this case Khatia is the only one who pursued this goal. This study has no measure for the success or failure of this aim, but assumes that since it is a conscious goal it must reap at least some reward to justify its repeated use, and Khatia fulfils at least one criteria for being a visual learner according to perceptual learning style theory.

5.2.4 Summary of visual aspects

The variety between participants in the three behaviours that have here been grouped as visual is more obvious and clear-cut than between the behaviours grouped as auditory. There were clear differences in the ways that writing is used and in the ways that visual memory is used that were in line with the predictions of perceptual learning style. The ways that individuals used the score also differed, but this difference was strongly influenced by the situation in which the score was used. However, the clear differences in the ways that writing was used and in the ways that visual memory was used did not occur in the same person, as would be further predicted by perceptual learning style. Table 19 classifies each individual based on the frequency of their use of specific behaviours. Here it can be seen that Maurizio clearly used writing more than the others, but claimed not to use visual memory intentionally, and Khatia used visual memory consistently, but only very rarely wrote on her score. Perceptual learning style theory would have predicted that these two participants consistently use both, if they were to be identified as visual learners. What was observed could just be a difference in strategy selection rather than a deep-seated difference in information processing. Though there were glimmers of hope for the theory, once again it must be concluded that the data do not support the hypothesis.

Table 19

Classification of frequency with which participants engaged in visual behaviours

Behaviour	Frequently	Intermittently	Infrequently
Use of writing	Maurizio	Martha, Khatia, Rosalyn	Vladimir, Carlos
Reliance on score	Khatia	Vladimir, Rosalyn, Martha, Maurizio	Carlos
Visual memory	Khatia	Rosalyn, Vladimir, Martha	Maurizio, Carlos

5.3 Movement related aspects

Kinaesthetic learners are described by perceptual learning style theorists as people who retain information when they have moved or touched in the learning process, they are hands-on learners who learn by doing. This eminently describes the pianist, and most other musicians, who almost always learn by doing, or at least learn in order to do. Of the three modalities the kinaesthetic is possibly the most visible, since it can involve movements, and should thus be the easiest to observe. It is however, also the hardest to classify, since humans are almost constantly moving, even more so when playing the piano. Which of the movements made are part of the learning process, and which are extraneous to it, is difficult to decide. Just to focus on these movements, however, is to ignore the aural and visual monitoring that happens continually, even in the most drearily repetitious technical work. So, while it is possible to describe the movements that can be observed, this is not an indication that movement is primarily in the attention of the pianist. There may be something entirely else that occupies their attention, while the movement takes place. The following interaction between Maurizio and myself elucidates the difficulty in these distinctions,

> Maurizio: Like here I think it was really like I... my fourth finger wasn't working and, that, that was definitely like a touch kind of th...
>
> Me: Yeah so you were working trying to get it...
>
> Maurizio: Yeah yeah. Like I don't think it was really an aural thing, kind of here it was definitely a touch thing.
>
> Me: Ok. So were you concentrating at all on what it sounded like or were you just trying to...
>
> Maurizio: I guess a little bit, because, there's this, there's this crescendo so, so I'm even though I'm still, trying... Its really the flip to here [demonstrates fourth finger over] that I was trying to get, it was still with a crescendo. So I guess..., but I think that was more subconscious, like Ok, there is a crescendo here.

Much of the variation observed between the participants was in relation to movements that are strictly speaking extraneous to playing the piano, such as tapping feet, swaying bodies, conducting arms and other similar movements. This variation is divided into regular movements

and expressive or other non-regular movements for the purpose of discussion below. There was also variation in the way that participants played during the practising session, and here I specifically focus on the use of hands-separate practice and on using simplifications and variations of the music.

5.3.1 Regular movements

Excessive regular movement (such as head-banging, for example) is generally frowned upon in classical music performances. In this study, the tapping of feet while playing was the most observed of these kinds of regular behaviours, and seems to fulfil an important role for some of the participants. The importance of these kinds of movements is understood to lie in the regularity of the movement, rather than the occasional sound that may result. The regular movement is an externalisation of what is generally an internally felt and regulated pulse. This behaviour seems to depend upon reflex, rather than being consciously controlled, since the regular movement of muscles in this behaviour is often habituated (as in the case of walking or brushing teeth) meaning it passes from conscious awareness, although it is still subconsciously regulated (see Snyder, 2000, pp. 23-25, on habituation generally). The difficulty with relying on such movement is that in classical music the more overt parts of such movement need to be retrained prior to performance, in order to conform to performance practice. Like metronome usage, tapping feet seem to have a more regulatory function than an information processing function, which may mean that it is not an expression of a perceptual learning style, but on the other hand it may indicate a strong bodily involvement in the learning process, giving support to a kinaesthetic learning style.

When the playing stops, there are still regular movements being made. Tapping, conducting, and other rhythmic movements continue while the participants figure out some troubling rhythm or phrase. In these cases, it can be argued that the movement can be more conscious, as it is used as part of problem solving. It is not possible to separate these movements from aural and visual imagery that are employed simultaneously, but perceptual learning style theory argues that such movements aid kinaesthetic learners in processing information.

5.3.1.1 Regular movement while playing

Khatia was observed tapping her foot or making some other rhythmic movements, especially making small nodding movements with her head, in each session observed. This usually coincided with her use of a metronome. She did not feel that she was able to always control the tempo of the pieces she was working on, and both her use of a metronome and her bodily movements were attempts to gain control over the tempo, making it steady, not rushing or dragging. However, she did not think tapping her feet or moving her body to be necessarily good strategies to employ, saying, for example, “it does not fit here, in Bach.” She needed to get rid of the movements and internalise the steady beat prior to the performance date. But she did not have recourse to other strategies that would work as effectively for her as using a metronome and bodily movements, and so persisted with these.

Unlike Khatia, the other participants only moved their body parts rhythmically (apart from playing of course) in some sessions. For Vladimir, the tapping of feet only occurred at times where the general character of the music was lively, so this behaviour occurred less than in

Khatia's case, and seemed less consciously regulatory and more like a spontaneous overflow of excitement. Martha could be observed tapping her foot and nodding her head to the beat, and occasionally mouthing words, presumably counting, but only in the first Dutilleux session where she spent a lot of time figuring out the complex rhythmical interactions between her hands. In the same session she twice spent more than a minute contemplating some aspect of the piece. During this time she can be seen tapping the pulse while following the notation with her finger, and occasionally writing on the score. In her case the tapping was part of embodying the pulse in order to figure out a conceptually and physically challenging rhythm. Maurizio's leg could sometimes be seen bouncing in a way that seemed unrelated to the pulse of the music that he was playing. Since this was not tapping his foot in time to the music, and since the movement increased as the practice session progressed, this seemed to be related to his concentration and energy levels rather than self-regulation or problem solving as for the other participants mentioned above.

The participants seem to each have, when observed superficially, similar bodily reactions but these stem, in this analysis, from different physical and emotional states and seem to have different purposes. Regulation is the aim for Khatia, while for Vladimir and Maurizio movement of this kind seem to rather be reactions to either excitement or concentration. For Martha the tapping was a tool used to help her clarify the rhythm of the passage, and could thus be considered as an information processing tool. She was, however, very selective in her use of this strategy, and did not use it constantly as perceptual learning style theory would predict, but only to solve a specific problem. On this analysis, foot tapping or other bodily movements in time with rhythm does not automatically allow classification into the kinaesthetic learner category.

5.3.1.2 Regular movement when not playing

All of the participants spent most of their time in the observation sessions physically playing, the exceptions are Carlos, in his first learning of the O'Byrne, and Martha in her first session with the Dutilleux. Both these pianists took longer times to think about, analyse or mentally rehearse aspects of the work they were learning. These works were also the most rhythmically complex of all the works studied in this study, with irregular rhythms and time signatures, and harmonies not derived from traditional tonality, and there is probably a relationship between the time taken to think about the piece and its complexity. The movements they used during this time of not playing seem more consciously chosen to aid their learning than the kinds of movements described under the previous heading, which had a number of apparent uses and in several cases seemed to be unconscious reactions.

Carlos spent about half the time of his first observed session with the O'Byrne in studying and memorising the score which was placed about 2-3 metres away from the piano, on a windowsill. He moved from the score to the piano several times, in order to attempt to play what he had memorised. During the time he was studying the score he can occasionally be seen moving his arms as if conducting. The first page of the music he was working on changes time signature constantly, and also includes some irregular rhythmical patterns, and so the conducting movements are most likely related to figuring out the pulse and rhythm. Martha similarly focussed on figuring out the rhythmical interactions between the two hands in the Dutilleux, and took some time away from playing to mentally analyse and rehearse these passages. She can be seen tapping the score with her pencil before making some notes. This

silent learning was not only kinaesthetic, though, and clearly involved mental imagery of an aural, visual and kinaesthetic nature. These modalities cannot be separated easily in mental imagery, even as they cannot be separated easily in performance.

Perceptual learning style predicts that kinaesthetic learners will use bodily movements in order to aid their learning. Both Carlos and Martha seem to do this in the situations observed, although it should be noted that these were situation-specific uses, and were not constantly employed. Like foot tapping, the situationality of the use of this behaviour points away from perceptual learning style theory, and rather to strategy selection for resolving specific issues.

5.3.2 Expressive or non-regular movements

Movements such as expressive swaying are more readily welcomed on the concert stage than foot tapping. Participants showed a range of such movements, ranging from moving or crossing their feet, moving their upper bodies, to moving their heads in various ways. These movements seemed to be less about information processing, and were often related to emotional expression, meaning that they are often only tangentially related to perceptual learning style theory. However, as with rhythmical movements above, such movements often indicate a strong bodily expression of emotional involvement, which is one of the claims made for a kinaesthetic learner. Needing to move while engaged in learning is a hallmark of the kinaesthetic learner according to perceptual learning style theory.

5.3.2.1 Expressive or non-regular movement while playing piano

Playing the piano involves continuous movement. However, generally speaking, pianists sit with their backs fairly upright and head fairly still, feet close to the pedals. Famous exceptions (such as Glenn Gould) are still, generally speaking, exceptions. Between the participants variation occurred in the amount and amplitude of movements that departed from this idealised norm.

Carlos moved his upper body and legs a lot, especially in the Clementi sessions. He explained that the movement was related to intense experiences of the music and emotions related to the music, but was also of the opinion that he should find ways to incorporate those felt experiences into the sound and phrasing rather than into his body. He felt that the movements were “maybe too much, I need to get all this movement into the music.” He could often be observed with his head bent down to level with the top of the fallboard, and directly above the keyboard. This position was taken very often when he was repeating a chord or playing exceptionally slowly. He seemed to be putting his head nearer to the sound source in order to hear better, which was also one of his aims in these sessions, “to concentrate and listen to the sound, [...] you know, instead of kind of listening or just being aware, 'Ok, the attack is there,' but then not listening to what comes after: the actual sound.” In the first O'Byrne session, where he was not so much searching for sound or expression, but rather trying to recall the notes he had memorised, this bent-over position was taken noticeably fewer times. He also showed intense emotional involvement while playing the Clementi, especially in the early session, and made passionate movements with his head and torso in time with the musical climaxes.

Maurizio can also be seen moving his upper body a fair amount, these movements are almost always related to marked changes in dynamics. His upper body would for instance move gradually down as an arpeggio gains in volume and then back up as it reaches the apex of the run and climax of the crescendo. This embodiment of the direction of the phrase and the dynamics of the phrase are similar to Carlos' embodiment of the emotion behind the music.

Vladimir commented that he sometimes had “bad posture” when practising, after seeing himself in the second Beethoven session crossing his legs under the piano. On closer inspection, in this session his “bad posture” was very closely related to his levels of frustration. He was unable to achieve the level of playing he wanted to, and became increasingly agitated and frustrated with himself, slapping the keyboard and exclaiming in anger several times. As the session progresses his posture changes from his usual upright posture to a slumped back, crossed feet, drooping shoulders and bent neck. In the other sessions this kind of posture was not observed nearly as much, and he is usually sitting upright and still.

Khatia's posture changed very little, generally she sat still and upright, except that she tended to move her torso and head in time with the beat, as discussed under a previous heading. Rosalyn and Martha did not move very much in this way at all. Very gentle swaying with the music was as dramatic as their movements got.

These movements, when they occur, seem to be mostly expressions of the emotional state of the pianist, whether that state be frustration or exaltation. Emotion is, of course, a strong aid to learning, and in this way the movements may be involved in the learning process. There was consensus among the participants who commented on these movements that they were ultimately distracting from the playing, and that the energy that went into moving should rather be spent in generating the desired sounds. Although perceptual learning style theory advocates for kinaesthetic learners to move while learning, in music these movements may be distracting to the final aim. This puts a question mark over whether these expressive movements are aiding or distracting learning, and thus whether they should be considered as part of the perceptual learning style theory.

5.3.2.2 Expressive or non-regular movement while not playing piano

Only one example of this occurred, since the majority of practising in the observed sessions happened while seated at the piano. Carlos, after he had spent some minutes reading the score and memorising it, walked slowly back to the piano. He explained that this was not only locomotion, but gave him time to think about how to approach the piano and what sound he wanted to produce. Movement facilitated this reflection, in every case he started playing as soon as he sat down, meaning he had achieved some clarity on these two issues prior to getting to the piano.

> When I am looking at the score, it's of course easy to remember what is in there but then I need to kind of, it needs to be in my head, that's why I like to walk around a bit and think, [...] what are the chords, how to approach the piano and what is the sound.

This movement was also not related to emotional expression as was described for him above, but rather to reflection and to internalising the information he had just memorised. This is the clearest example of what perceptual learning style would consider kinaesthetic learning –

moving in the learning situation – although this movement was generally linked with recall and reflection rather than information processing.

5.3.3 Varied movement while playing

Separating the hands and playing only one at a time results in a qualitatively different experience from normal playing for the pianist, and poses certain advantages, such as the freedom to concentrate on exactly what the hand is doing without having to consider the other hand. It is strongly related to reduction of complexity in the information processing stage, but is also used as a tool to test recall in later stages of work. Using simplifications of texture by leaving out voices, changing accompaniments, playing without accurate rhythm or actively changing the rhythm could be considered a movement-related learning behaviour. This behaviour is strongly related to reduction of the complexity, and to development of tactile or "finger" memory and facility. There is again the difficulty that these movements cannot be separated from the auditory and visual monitoring that takes place while they are being used, and it is never clear whether the attention of the pianist is on the movements or the sound or the score or their hands on the keyboard (or some other thought process). Perceptual learning style predicts that kinaesthetic learners will enjoy technical work for its own sake, and both hands-separate work and simplifications and variations such as described below would fall into that category.

5.3.3.1 Hands-separate practice

Maurizio made the most systematic use of playing hands-separately, and in a count of hands-separate playing events also used the behaviour the most of all the participants. For him playing hands-separately is part of a conscious process to build a strong understanding of what each hand is doing. In the first Bach session, he played through the first couple of bars several times with each hand, and kept on alternating hands to refresh his memory of what each hand is doing. His aim was to "get it kind of smooth and kind of problem free" prior to attempting to play with his hands together. His plan was to do this for the whole piece, in sections, prior to attempting it hands together. He explained that, once he was able play through the piece hands together while reading the score, he would return to memorise each hand on its own in shorter sections. When the whole piece is memorised in this way, he then puts it back together again, memorising with hands together, "and that is like memorising again." For him, hands separate work was both a way of simplifying the complexity in the initial phases of learning, and of memorisation in the later phases. Being able to play the whole work by memory hands-separately was one of his aims, and ensured that he knew the details of each hand.

The other pianists did not use the strategy with such determinate focus in the observed sessions, although Vladimir had almost as many instances of hands separate work as Maurizio. For him, however, the work was more centred around technical facility than memory reinforcement. The other pianists worked on one hand when a problem arose, and then moved on to playing together once the problem was resolved to some degree. In Martha's case it is possible to see that hands separate practice is related to the kind of music and the problems that it poses. In the first Beethoven session she made use of hands separate practice, favouring the right hand to a large extent in this work. The left hand plays mostly arpeggiated patterns which she did not find technically challenging, and so she focussed a lot on the phrasing of right hand,

which carries the bulk of the melodic material. In the first Dutilleux session, however, she used relatively little hands separate work because at this early stage of work the difficulty lay in the rhythmic coordination of the hands rather than in technical problems in one or the other of the hands.

Every pianist that aspires to playing the standard repertoire arguably has to engage in some form of technical work. The nature of this work depends on the nature of the difficulty. Working hands separately is one aspect of this technical work, and in the cases observed was used in different ways depending on the nature of the problem to be addressed, and so working hands separately to develop phrasing is different from working hands separate to develop facility or memory. The situationality of this work shows little in the way of a pattern that would suggest anything like perceptual learning style influencing the decision to use this technique or not.

5.3.3.2 Simplifying or varying aspects of the music

When faced with a musical work of great complexity it is sometimes necessary to simplify the music in order to focus on specific issues which can then be automated so that attention can be given to others. This occurs in a number of ways, by leaving out notes, simplifying textures or changing rhythms, either haphazardly or systematically. In a count of separate simplifications, Martha made the most extensive use of this strategy. This was strongly related to the complexity of the rhythmical interactions between the hands in the first Dutilleux session. In this session she simplified the rhythms of the work in order to learn the right notes first, and played with an approximation of rhythmic duration. This strategy was not nearly as extensively used in the second Dutilleux session, nor in the Beethoven sessions.

The other participants occasionally used rhythmic variations in order to work on some technical aspect. Commonly they would impose a different repetitive rhythm on the notes of the passage they are working on, often a long note followed by a number of fast, short notes. Working with rhythms was usually used to develop evenness in the fingers, Khatia used it this way for a short passage in the Bach prelude. Vladimir used this technique in three of the Beethoven variations to develop technical facility. He also made a technical exercise out of a repeated note pattern in the Ravel that he struggled to get even, and worked on this exercise in both of the Ravel sessions, remarking “I just have to do that and then it works way better.” Rosalyn occasionally held some notes for longer than they are supposed to be held, in order to prepare for the next note, or to have time to think or listen to something specific. Vladimir also used this approach a few times. Carlos made the least use of simplification or variation, but he was relearning an old work and was not working on finger facility, memory, nor was he in need of reducing the complexity, but rather working on his listening and the sound he is making. In the O'Byrne he did not encounter significant technical or rhythmical issues, and so had not need to work in this way.

Simplification of the texture or rhythm or variation of the rhythm takes up a very small proportion of the total practising time in the observed sessions, and is usually focussed on a very specific problem over the span of a bar, or sometimes a phrase. There seems to be very little pattern behind these behaviours, other than specific needs at specific times. They therefore do not give us any indication of a kinaesthetic learning style.

5.3.4 Summary of movement related aspects

The behaviours where variation could be identified were not used consistently across different works and across different types of practising, but were rather used in specific situations where their application could solve specific issues. Much of the extraneous movement while playing, including foot tapping and swaying, were behaviours that were for the most part subconscious, and that needed to be unlearned prior to the performance situation. Movements made while not playing gave a clearer idea of possible kinaesthetic learning, although they were again limited to the situations in which they were used, and did not occur across different pieces or stages of work.

Even if one were to ignore these objections and classify the participants based on the frequency of their use of specific behaviours (Table 20), the pattern is hard to interpret. Carlos moves the most, but also uses simplification and variation least of the participants. Martha ranges from not using certain behaviours to frequently using others (but only in specific situations). Khatia uses some behaviours frequently, but others not at all. And the same can be said for each of the remaining three participants.

Considering the lack of pattern in classifying individuals discussed above, together with the objections raised against almost all of the behaviours in terms of their ability to predict kinaesthetic learning, I conclude that there is minimal support for any of the participants being classified as kinaesthetic learners.

Table 20

Classification of frequency with which participants engaged in visual behaviours

Behaviour	Frequently	Intermittently	Infrequently	No data
Regular movements				
Regular movement while playing	Khatia	Vladimir, Maurizio	Martha	Carlos, Rosalyn
Regular movement when not playing	Carlos	Martha		Maurizio, Rosalyn, Vladimir, Khatia
Expressive or non-regular movement				
Expressive or non-regular movement while playing piano	Carlos, Maurizio	Vladimir, Khatia	Martha, Rosalyn	
Expressive or non-regular movement while not playing piano	Carlos			Maurizio, Rosalyn, Vladimir, Khatia, Martha
Varied movement while playing				
Hands separate practice	Maurizio, Vladimir, Khatia	Martha, Rosalyn	Carlos	
Simplifying or varying aspects of the music	Martha	Vladimir, Rosalyn, Maurizio, Khatia	Carlos	

5.4 Teacher influences on participants

So, is there something else going on here? There are several hints of teacher influence on the practising behaviour of the participants in the interview data. Throughout the previous narrative there have been frequent references to teachers, and suggestions that they have made. The influence of teachers can be seen both in the short term, with a recent lesson influencing the practising in the sessions immediately after, and in the long term, with teachers from many years ago still influencing general approaches to practising and learning.

Martha made several references to the influence of a recent lesson with her teacher in the second session with the Beethoven. The lesson took place about half a week previous to our meeting, and influenced technical decisions, strategy decisions and expressive decisions. This can be seen in a number of comments that she made throughout the interview.

> Martha: Now I am quite much thinking what my teacher told me to practice this time, because we did quite many things only with right hand or with left hand last lesson, so I tried those things she asked me to...
>
> Me Articulation things?
>
> Martha: Yes, and phrasing and listening the phrases and listening some very tiny details,
>
> [...]
>
> Martha: This was also my teacher's advice to a little bit play with the left hand alone
>
> [...]
>
> Me: What are you using the score for, you can play this from memory already?
>
> Martha: I think I wrote some advices from my teacher so I am using the score to remember those.
>
> [...]
>
> Martha: In my lesson we talked about not playing like this [demonstrates curved fingers], but more like this kind [demonstrates flatter fingers] of fingers

The session was very clearly shaped by her previous interaction with her teacher, and although Martha pointed out that she was under no compulsion to do everything her teacher suggested, she wanted to think through and try every suggestion before they were forgotten.

Teachers also influenced practising over a longer time, and Maurizio spoke of a teacher he had when he was young, and the approaches she took to helping him practise and learn.

> When I was young, my teacher would have colours, and so if I was playing a fugue then the different voices would be kinda you know highlighted in different colours, or, there was something that I played that was, it was like a rondo or something, and you know when it came back that was a certain colour and all the different ones were different colours, and even to scales, like the scales were divided into colours, so when, cause you know for each [examination] you had to learn a certain set of scales and you had to know which fingering, like is it a 231 fingering or is it a 1231 or a 12341 fingering, like which and so that would be in groups of like colours, like this is this set of fingering and this is this set of fingering.

This teacher clearly still has an influence, evidenced in Maurizio's continued decisions to mark the voices of his fugue in different colours. She introduced him to a strategy that still bears fruit for him, and which he regularly applies. Possibly his use of writing of fingerings and other details on his score was also influenced by this teacher, if not directly, at least by suggestion of her insistence on using colours to mark the score. And so what could be marked out as a perceptual learning style influence in Maurizio's practising is clearly influenced by this teacher's approach.

Teacher influence is not, however, mechanically causal. Khatia had a teacher that wrote a lot on her scores, but this did not inspire her to write on hers in the same way.

> Khatia: No my [current] teacher doesn't

Me: Doesn't like it [when you write]? Oh, your teacher does not write?

Khatia: No doesn't write.

Me: And you don't write either?

Khatia: Yes.

Me: And has it always been like that, I mean when you were studying in school, did you write in your score?

Khatia: Not so much

Me: Not so much, you never really liked to write?

Khatia: I don't know, sometimes when I have some fingering what are difficult or if I analyse something then I do that.

Me: And your previous teachers, did they write in your score?

Khatia: Yes

Me: They wrote, lots?

Khatia: Yes (laughs)

Me: And does that help you, or?

Khatia: Yes of course, in Bach my last teacher, he wrote everything, how it says, the staccato marks and the legato.

Even though her previous teacher wrote articulation marks, and probably other kinds of markings judging by her assent to my suggestion of “lots”, this has not become a habit for her, unlike for Maurizio.

It is possible to change the tables that were used to describe the frequency of behaviour uses (Tables 18, 19, and 20) to reflect the teachers who teach each participant rather than the participants (Table 21). But this reveals very little in the way of pattern. Teacher Y's three students appear together in one cell 7 out of 13 possible times, and teacher X's two students appear together in one cell 4 out of 13 possible times. This cannot be said to form a pattern, and even if it did one would be hard pressed to draw any conclusion from it, due to the poor distribution of students per teacher, the low number of participants and the host of possible other influences, including previous teachers. And so this is not a fruitful approach.

Table 21

Classification of frequency with participants engaged in practising behaviours, with teachers replacing participants

Behaviour	Frequently	Intermittently	Infrequently	No Data
Listening to recordings of other performers	X, Y	Z	X, Y, Y	
Listening to recordings of own practising and performances	X, X, Y	Z		Y, Y
Use of speaking and singing	Y, Z	X, X, Y	Y	
Use of metronome	Y, Z	X, Y	Y	X
Use of writing	X	Y, Y, Z,	Y, X	
Reliance on score	Z	Y, Y, Y, X	X	
Visual memory	Z	Y, Y, Y	X, X	
Regular movement while playing	Z	X, Y	Y	X, Y
Regular movement when not playing	X	Y		X, Y, Y, Z
Expressive or non-regular movement while playing piano	X, X	Y, Z	Y, Y	
Expressive or non-regular movement while not playing piano	X			X, Y, Y, Y, Z,
Hands separate practice	X, Y, Z	Y, Y	X	
Simplifying or varying aspects of the music	Y	Y, Y, X, Z	X	

While there is thus a marked influence of teachers on the strategy selection of participants in the study, both in the short term and in the long term, this influence is also masked by other possible influences. Both Maurizio and Khatia were identified as using visual strategies more than the other participants. But they did not adapt the visual strategy of writing on the score in the same way, although given the opportunity through teachers who used these strategies. Perhaps there were qualitative differences in the ways that the teachers presented this approach. The selection of strategies seem to be based on other factors than perceptual learning style, and if such style differences could be said to exist, they have a minimal impact on the differences observed in this study.

5.5 Discussion of the observation study

In this chapter I have attempted to identify the observable differences between six pianists, based both on what they do when they are practising and on how they explain what they do. Thirteen categories of behaviours were identified that differentiate the six individuals, which

were grouped into auditory, visual and movement-related areas, depending on the apparently dominant modality. These behaviours probably do not constitute all of the variation that exists, either between these individuals, or between all pianists, but represent the observable differences found within the confines of this study. From this it was hoped that a pattern would arise in perceptual use that is aligned with perceptual learning style theory's claims, which is that individuals will exhibit a preference for behaviours that focus on a specific modality or modalities. This has not happened.

A number of issues arose as each area of difference was investigated. The most salient were: 1) What appeared to be dominant modalities in a behaviour were difficult to separate from the other modalities. This is in line with arguments presented earlier (Bertelson & De Gelder, 2004; Massaro, 2004), and poses a significant challenge to anyone attempting to classify individuals into learning style categories based on their practising behaviours. It seems from this analysis that if someone were to try and classify pianists into perceptual learning style categories, the judgement will inevitably be based on incomplete data. 2) Behaviours were not consistently applied, but rather used in specific situations and for specific problems, which has been noted in previous research (eg. Hallam, 2001a; Nielsen, 2001). This challenges the conception of stable and preferred modes of interaction with study material, which perceptual learning style theory assumes. The complexity of the task of learning to play a large-scale work, and the vast differences between the learning requirements of different styles of music precludes prescription of a set of strategies that would fit all of these. 3) If one of the participants clearly used one behaviour more than the other participants this person did not also use other behaviours in the same modality to the same extent, thus undermining the claim of a larger collection of strategies that would contribute to a modality-specific strength.

These problems have led me in each modality area to conclude that perceptual learning style theory is minimally supported by the data. In writing in the score, listening to recordings and moving apart from playing as an aid to learning there was some support for the perceptual learning style theory, with isolated individuals using these behaviours in highly specific and intentional ways. The analysis concluded, however, that since these behaviours each had other factors impacting them, and, that since there was minimal support from other behaviours to create a complex of modality specific behaviours, it cannot be claimed with any certainty that the differences observed in these three behaviours are indeed stemming from a deep-seated difference in perceptual preference such as suggested by perceptual learning style. The clear influence of an early teacher in the adoption of writing on the score for Maurizio further complicates the notion of inherent preference, and shows the importance of socialisation in the adoption of specific strategies, although it is also clear that this is not the only influence.

A possible objection that may be raised against the non-support of the perceptual learning style theory is whether eighty minutes of observation and eighty minutes of interview are enough to identify someone's learning style. When the almost three hours of engagement with each pianist is compared to how long learning style instruments usually take (in the range of 10-40 minutes), then the answer must be yes. However, learning style instruments clearly state their purpose and thus force the respondent into choosing a specific category over others, while the observation and interview situations of this study were intentionally unstructured and the participants were not explicitly informed of the theory under investigation. This was done to prevent the participants from giving the answers that they think the researcher wants, and to try and ensure as natural an observation as possible. Were the participants to be directly asked to identify their learning style, they might very well have classified themselves into one of the

groupings. It is questionable whether this classification would have taken into account the diversity of ways that strategies and behaviours function in the studio, both in terms of the situationality of strategy use and in terms of the variability of strategy use, nor the ways that teachers (and probably other significant persons) influence strategy selection.

The observations were not intended to describe the practising *in toto* of one or all of the participants, and important areas of their work fell outside of the observed sessions. Thus, there was very little mental practice or use of mental imagery, which has a strong research base (eg. Bernardi, Schories, Jabusch, Colombo, & Altenmüller, 2009; Cahn, 2008; Lim & Lippman, 1991) and practical application (Conolly & Williamon, 2004; McKinney, 2008; Sisterhen, 2004). Any strategy that involved lengthy reflection or periods of not playing was not seen, except in two sessions. This is probably the result of the research situation only lasting 20 minutes, with practising as a focus. That practising was interpreted as physically practising in most cases points to an assumption that practising is what happens when you sit in front of the piano and play, rather than including reflection, listening, imagery and other such non-playing strategies. It is not possible to say how widespread this notion is, and perhaps the participants would not ascribe to such a view, but in practice (no pun intended) this is what was observed. The strangeness of the situation largely dictated the response, and longer observation may have made other strategies visible. This does not mean, however, that what was observed was not standard or central activities for the participants. Their willingness to be frustrated and elated in front of the camera points to the 'naturalness' of the observation, despite the somewhat contrived situation.

6 Discussion and conclusion

This research project started with the explicit aim to explore a research question, through investigating two points of view on the same issue, each defined by its own sub-question. The research question was formulated as follows:

> *Which aspects of perceptual learning style theory are in evidence in the learning behaviours and strategies of music instrument students in higher music education when they learn notated musical material?*

The sub-questions were formulated as follows:

> *1) Are there patterns in the ways that music instrument students in higher education describe their practising behaviours and strategies, and how do these patterns relate to perceptual learning style theory?*
>
> *2) What differences can be observed in the practising of individuals and in their descriptions of this practising, and how do these differences relate to perceptual learning style theory?*

Based on the analysis presented in this thesis, I have responded to sub-question 1 by asserting that there are indeed patterns in the ways that music instrument students describe their practising behaviours and strategies, but that these patterns have little or no relationship with the assumptions of perceptual learning style theory, as defined in this thesis. Similarly, my response to sub-question 2 includes that there are indeed differences that can be observed in the practising of individuals, but that these differences have little or no relationship to perceptual learning style theory, as defined in this thesis.

With regards to the main research question, given that the responses to both the sub-questions were to point out little or no relationship between the data and perceptual learning style theory, I can only conclude that almost no aspect of perceptual learning style theory is evidenced in the learning behaviours and strategies of the students investigated in this study. Where differences exist that could conceivably be classed under perceptual learning style influence, inevitably, other explanations are as salient, if not more salient, than that offered by perceptual learning style theory.

In the rest of this chapter, results from the two studies are compared (6.1), followed by discussions on the relationship between the results of this study and research on perceptual learning style in music (6.2), and other research in practising and learning of music (6.3). The generalisability of the results are discussed (6.4), as are the implications for education (6.5) and further research (6.6). In conclusion the study as a whole is evaluated (6.7).

6.1 Relationship between results of two studies

There are some correspondences between the findings of the two studies that go beyond their ultimate rejection of perceptual learning style theory, which will be discussed under this heading. Correspondences should be expected when the same phenomenon is studied from different angles, and adds to the credibility of both studies. The studies describe some of the variation between the practising of different individuals along similar lines, although these do not always correspond exactly.

In the analysis of the questionnaire, visual memory was associated with movement and imagery of the hands and instrument rather than with explicit memory of the score (Component 1). Although Khatia did claim to remember the score visually (Imreh & Crawford, 2002), the rest of the participants described their memory as being related to the keyboard and their hands on the keyboard, corresponding to this component in the questionnaire. Although mental imagery studies sometimes distinguish between different kinds of mental imagery, this has proved elusive to study, partly because mental imagery seems to be a trained response, much like physical practice is (Cahn, 2008, p. 189). Studies that explore this terrain need to take into account the developed skills of the participants in using mental imagery of a certain kind, and find reliable ways of distinguishing between different kinds of mental imagery (Moran, 1993). In the higher-order component analysis, movement-related imagery was linked with other kinds of reflection apart from playing (Component 4), which include visual examination of the score, and auditory imagery. This suggests that part of the difficulty in studying mental imagery is that the differences are not very clear-cut. Movement, score and sound are probably blended in the same mental image, much as they blend in physical playing.

Writing on the score does not feature prominently in the questionnaire analysis, but other forms of writing do. In the questionnaire analysis drawing graphs are associated with research, or a more academic approach to learning (Component 2), and using colours is associated with simplification (Component 3). Perhaps Maurizio's methodical approach to writing is exceptional, and most people follow the ways of the other participants, writing only when necessary. In some way, Maurizio's writing can be seen as a simplification exercise as the questionnaire suggests, allowing him to chunk groups of notes according to their fingering patterns. Speaking out rhythms and counting out loud (the other items in Component 3) were not, however, linked with Maurizio, much as writing was not linked with those participants that did speak in this way. The distinction made by the higher-level components between speaking rhythms (Component 3) and singing melodies (Component 9) was marginally observed, with participants who vocalise generally doing one or the other rather than both. Not enough data on this matter was observed, however, to make a confident statement.

The factor analysis linked listening to recordings and watching videos (Component 5), and is probably reflective of the ease with which music can be accessed through video sharing sites such as YouTube. In this regard, the distinction between the mediums is probably blurring to some extent due to accessibility of both media. The link between these behaviours and finding technically difficult parts is interesting, since those participants in the observation that listened to recordings used them in order to see where the difficulties are, and to get oriented in the piece. Although they did not do this a lot, and especially not while in the process of practising, there is a correspondence between the data sources. The higher-order components contrasted this process of scouting out with that in Component 6, musical shaping in the early learning

phases. While the respondents certainly aimed to play with phrasing and dynamics early on, there was often a compromise, due to a lack of attentional capacity. It is impossible in a work of complexity to pay attention to all the aspects of playing in the first sitting, and compromises need to be made. The observation and questionnaire data suggests that the compromise is to a middle ground where some musicality and some technicality is addressed, rather than focussing on only one or the other. The observations did not, however, suggest any link or contrast between the two components.

In the observations a variety of ways of using the metronome was highlighted. The questionnaire analysis suggests that one is prominent, and that is to use the metronome for shorter, more technical work, much like Vladimir did. The higher-order components contrasted this use of metronomes with that of a more research oriented approach. There were hints of this in the observation data, where those who used metronomes most frequently also seemed to be more physical in their playing while those who didn't seemed to be more intellectual, at least in their explanations of their practising during the interviews. This is a tenuous statement, and would need further exploration before being confidently asserted. But the distinction might correspond with John Biggs and colleagues' concept of surface and depth learning (Biggs, Kember, & Leung, 2001; Biggs & Moore, 1993). This has been explored with relation to score reading by Sullivan and Cantwell (1999), who classified practising behaviours into lower-, mid- and higher-level strategies (see Table 2, p. 7) and found that music students in higher education who self-identified as deep learners through an altered and shortened form of the Biggs' Study Process Questionnaire were more likely to engage in mid and high level strategies when describing their approach to learning an unfamiliar score. The converse was true of those who self-identify as surface learners. Although this angle of investigation was not followed in the present study, it could describe some of the variation observed between individuals, but which will need to be explored further. A further qualifier is that deep and surface learning are not necessarily attributes of the learner, but may also be situationally varying (Biggs, 2001, 2002).

The questionnaire did not highlight any of the variations in movement that the observation sessions picked up, and the observation sessions did not show any distractions (Component 7), probably because the sessions were too short. Many participants expressed surprise at how quickly 20 minutes passed, and felt that they had only started working. Perhaps much longer observation sessions would allow for the investigation of distraction as fatigue sets in.

In conclusion, there are some correspondences between the two analyses presented here, but certainly not a perfect match. The questionnaire data are of course limited by the kinds of questions asked, and thus differs slightly form the observations and interviews which were open-ended and unstructured. A further difference between the studies is in the nature and stage of work done in the observations, and assumed by the questionnaire. The questionnaire assumes an overview of the entire process of learning a work, whereas the observations looked at specific moments in that process. These two perspectives may not be entirely compatible, given the range of strategies and behaviours that individuals engaged in in different situations, depending on the aims of the particular session, the stage of work and characteristics of the music to be learned. The full range of approaches that an individual has to different issues they face in learning different types of music is something that was not adequately addressed, either in the questionnaire or in the observation studies.

Other issues that were highlighted in the results presented in this thesis, is 1) the possible influence of the instrument on strategy selection (in the questionnaire study) and 2) the

influence of the teacher on strategy selection (in the observation study). These two issues are most likely related, with instruments having pedagogical traditions which are passed from teacher to student, forming cultures of instruction, interpretation and technique. Each of these issues was highlighted as an important influence on the variety of strategy selection. In the introduction I used Salomon and Perkins' (1998) review to justify the selection of an individual focus on learning. Despite this focus, social influences were apparent, perhaps even more so than the theory under investigation. Researching the approaches of students should probably not discount the strong influence that teachers and peers have on the learning behaviours of this cohort, and individual differences cannot easily be separated from such significant relationships.

Despite the differences between the methods and results of the two studies, there is enough correspondence to give credence to the claims made throughout the analysis and discussion, which is that this study provides very little support for the claims of perceptual learning style. This finding is in contradiction with other studies that have found support for the perceptual learning style theory. The next section turns to the question why.

6.2 Relating results to other studies investigating perceptual learning style in music

There are several experimental or observational studies that have confirmed the existence of perceptual learning style in a range of musical learning situations. These have been discussed already and will not be reviewed in depth here. The most convincing study, both in design and results (R. E. Dunn, 2008) found a crossover effect, where reinforcement of the perceptual strength aided the musical listening of individuals, and reinforcement in other modalities distracted them. Other studies support this finding in other populations or with other musical aspects (Calissendorff, 2006; Korenman & Peynircioglu, 2007; Persellin, 1992, 1993; Persellin & Pierce, 1988). Given a fair number of studies that show support for the concept, why do the results of this study not do so?

Firstly, the age of participants in the studies that support perceptual learning style are almost all young children, with the exception of the young adults studied by Korenman and Peynircioglu. It may be that as specialisation in music is pursued over a longer period of time, and skills are developed in each of the modalities, that the differences between modality strengths are lessened. It has been suggested that neuronal plasticity and flexibility should be an important consideration in learning style theory in general, although perceptual learning style theorists claim their concept is stable over time (Coffield, et al., 2004b) (see Table 3, p. 13). If it is assumed that perceptual learning style plays a role in younger music students, as the literature suggests, then the results of this study further suggest that the modality preferences and skills of advanced music students have changed over time through intensive training. This therefore challenges the notion of stable modality preferences, and thus also the usefulness of the concept. If perceptual learning style is not stable, but changes with training, why should someone expend energy in using strategies that match their preference? They may as well expend the same energy in developing other preferences or skills. There may be routes that are easy, matched to preferences, but that do not allow for development in the full range of skills necessary. Coming back to Table 3, it should probably be assumed that individual differences

between musicians are more to the right of the table, defined as flexibly stable learning preferences, rather than constitutionally based and largely unalterable.

Secondly, the experimental studies that found support for the concept all focussed on a single aspect such as listening (R. E. Dunn, 2008), learning a rhythm (Persellin & Pierce, 1988), pitch matching (Persellin, 1993), or memory for short melodies (Korenman & Peynircioglu, 2007). In each case the contact period was relatively short, and the tasks focussed. Possibly this allowed for information processing through a single modality. Certainly this also allowed for short-term memory to play a larger role than long-term memory. Learning to perform a complex work requires much more than just such information processing from the musician. Emotional regulation, motivational regulation, meaning making, coordination, long-term memory encoding, and managing stress and energy levels are only some of the things that musicians deal with as they are learning to play a new work (see, for example, Gabrielsson, 1999; 2003, for further insight into the complexities). Arguably, few of these impact on a short experimental setting. These added layers to the learning process mask any effects that perceptual learning style might have had, had it survived the years of training to develop each of the modalities that musicians typically engage in.

Thirdly, some of these studies that support perceptual learning style made use of existing perceptual learning style identification instruments. However, R. E. Dunn's (2008) study showed large discrepancies between existing instruments and close observation. This is in line with other studies outside music that have similarly found a discrepancy between learning style identification instruments and close observation (Krätzig & Arbuthnott, 2006). The psychometric validity and reliability of some of the tests are questionable. VARK has not been statistically verified despite a sympathetic assessment (Leite, et al., 2010). The BE has not met standards for internal consistency, test-retest reliability nor construct validity (Coffield, et al., 2004b). Validity and reliability measures for ELSIE was not included in the description of the method (Reinert, 1976). Barbe and Swassing (1979) report adequate validity and reliability for the SBMI, but this was the instrument that R. E. Dunn (2008) showed to be largely mis-identifying the perceptual preferences of young children in a listening task. Although each of these instruments claim to measure the same thing, they do not necessarily do so, and thus do they neither necessarily measure perceptual learning style preference. The question of why supportive results are obtained with instruments that may be mis-identifying the construct under investigation is puzzling. It may be that when the research is introduced, and the participants complete the instrument, they are pre-conditioned to think of themselves in the terms of the theory and therefore perform according to this conditioning. This was one of the reasons for not introducing the theory to the participants of this study, and investigating such an influence would be a fascinating avenue of study.

If, as R. E. Dunn (2008) suggests, the best way of identifying perceptual learning style is through close observation in the learning situation, it must be concluded, based on the analysis presented in this thesis, that this would not be possible in the practising of the instrumentalists investigated in this study (although, see the issue of generalisability, below). The relationship between learning strategy or behaviour and learning style in students of the Sibelius Academy has been shown, in this study, to be very tenuous, in fact, almost non-existent. And if learning style cannot be identified through learning strategy and behaviour, the only other way to identify learning style is through the instruments such as the SBMI or VARK. These do not inspire a lot of confidence in their validity and reliability. It is my conviction at the close of this

study that perceptual learning style and the learning of musical works through practising should not be coupled.

6.3 Relating results to studies on musical learning, strategy use and variation

Although the study has focussed on the applicability of perceptual learning style theory, some other implications for existing research have emerged through the analyses. In describing the theoretical context of the study, central issues were the definition of musical learning (describing the *what* of learning) offered by Chaffin, Imreh and colleagues, and strategy use (describing the *how* of learning) as defined and described by Nielsen and Miksza, among others. While assuming these studies as the theoretical context within which the study took place, the results of the current study also probe and possibly extend understandings given through the research of these scholars.

The central argument of Chaffin, Imreh and colleagues about *what* is learned is that performance cues (made up of basic, interpretative and expressive elements of the music) are the basis on which performers build the conceptual frameworks of the works they learn. These conceptual frameworks allow for the execution of expressive performances, but are complemented by procedural memory. Procedural memory accounts for all the parts of performances that are automated, and not in active conscious thought while performing. Practising can be said to be about the formation of a reliable procedural memory stock and a conceptual framework that allows access to this procedural memory stock. This model is largely based on the work of one pianist learning one work, although it has correspondence in many other studies of expert memory, and is being extended through various studies with other instruments, genres and works (Ginsborg, Chaffin, & Nicholson, 2006; Lisboa, et al., 2011; Noice, Jeffrey, Noice, & Chaffin, 2008).

The results of the current research suggests some of the differences in the details that pianists use to form performance cues, although it was not explicitly framed as an investigation into the formation of these cues. Maurizio described how he uses writing as a first layer of memorisation, so that early on in his learning of a piece he looks at his written fingering marks rather than the notes, and later in the process then these written marks become less important and his memory is rather linked to harmonic progression and hand position. Both of these aspects seem to be linked to the performance cue concept. He uses writing of fingerings to establish a first layer of performance cues, which are later superseded by performance cues linked to harmonic structures and hand position. Although some of the other pianists used writing, none of them showed a similar reliance on writing as a means of forming performance cues. Vladimir relied much more on naming, and using French solfege names combined with perfect pitch provided him with the basis of his memory formation. Khatia used analysis and playing as two ways of forming performance cues, together with attempting to remember the visual details from the score. Carlos used movements after visualising and analysing the score to cement understandings of the modern work he was learning. Thus, although the research was not specifically formulated towards identifying different ways of forming performance cues, it is evident from the ways of working, and the differences between individuals, that each approaches the task of forming conceptual and procedural memory in distinct ways. These

differences are differences in memory formation as much as they are differences in strategy selection.

Nielsen (1999a) has given a classification of different kinds of strategies, and distinguishes between primary cognitive processing and secondary regulative strategies in her study comparing 2 organ students. Primary strategies involve selection (eg. visual examination, sight reading), organisation (eg. repeating sections, hands separate work, metronome, markings) and integration (eg. mental rehearsal, singing along, listening to recordings) strategies. Secondary strategies involve directing attention (eg. pausing, self talk), mastering anxiety (eg. mental and relaxation exercises) and efficient use of time (eg. formulating goals and objectives). She found differences in how strategies were employed between different stages of work, and between the two individuals. The results of the observation study, however, point to a further area of variety, which is that each behaviour/strategy may be used for various end-goals, so, using a metronome may be organisational, but it may also be used to master anxiety, or to help with efficient use of time. Similarly, writing in the score may be organisational, but it may also help to direct attention. Thus, a firm classification of each strategy into a definite goal may not be helpful, but perhaps strategies should be understood as contributing to a range of goals, such as those she has defined: selection, organisation, integration etc.

The results of this study do not cast further light on findings of other studies that have classified musicians as deep or surface, holist or serialist, high-impulsive of low-impulsive. There were similarities, however, between the results of the current study and the findings of Miksza's (2006) study of 40 college level brass players. Miksza described the variation between his participants in terms of percentages. Of interest for the current study, he described the variation in non-playing strategies as: 70% engaged in singing or whistling, the same ratio in blowing air through their instruments; 77.5% in buzzing on their mouthpieces; 65% gave signs of frustration; 85% spoke to themselves; 42.5% used some form of silent practice; 67.5% used a metronome; all used an electronic tuner; and 15% wrote on their part. The observational study adds to these findings by describing a different population, which might suggest slightly different percentages although this study is too small to confirm this claim. The current study extends Miksza's findings by giving more depth to these percentages, showing that a while, for example, few write in their scores, there are also qualitative differences in the writing. Or, while much less singing and no whistling occurred in the data presented here, there were qualitative differences in the singing. Simply counting the number of occurrences is not sufficient to account for the differences between individuals.

A contribution of this thesis, apart from non-support of perceptual learning style theory, is thus to point to the variety of uses to which a “single” strategy can be put, and to argue for careful consideration of this variety in the classification of musical learning strategies, and to point to the variety of ways in which musical material is encoded to form both the conceptual and procedural memory stores that musicians use to perform learned works.

6.4 Generalisability of results

The issue of generalisability should be considered separately for the two studies, as they draw on divergent traditions. The sample size and distribution in the questionnaire study resulted in a confidence interval of 7.9 at 95%, which is acceptable. Although a concern was raised regarding the size of the sample in relation to the number of variables for the purpose of

performing a factor analysis, this issue was deemed not to affect the conclusion of the study negatively after two analyses with subsets of the data did not yield widely divergent results. The non-normality of the data, and the use of this data in a Pearson's correlation matrix as part of a principal components analysis, does affect generalisability negatively. The principal components analysis accurately describes the variation in the dataset used in this study, but may not allow for generalisation of these patterns to a broader population. The results of the questionnaire study, therefore, should only be generalised to the target population of music instrument students in higher education in Finland with some reservation.

It is not common, in studies such as the observation study, to speak of generalising to a population, but rather to a theory (Miles & Huberman, 1994, p. 27). The findings of the observation study has challenged the assumptions of perceptual learning style theory through describing in detail the variation that occurs between six pianists. It has also offered suggestions to other current research for areas for further investigation. It would not be possible, on the basis of this study to conclude that the differences identified here apply to all pianists, nor even that they apply to the participants of the study apart from the situations in which they were observed. But the findings do challenge the conceptions of perceptual learning style theory, and suggests either a significant reformulation or rejection of the theory.

There was a fair correspondence between details of the questionnaire data and the observation data, giving confidence to both sets of results. The final conclusions of both studies were broadly similar, suggesting that while particular details might differ in different populations, the "answer" to the research question is fairly reliable, and can be cautiously asserted of music students in higher education in Finland. Similarity between this population and other populations of music students in higher education may allow for these results to be applied to such populations, but extreme caution should be exercised, and differences in society at large and education in specific taken into account prior to such extrapolation.

6.5 Implications for education

The primary application of the results presented in this thesis is to dissuade teachers from using perceptual learning style theory as an organising factor in their thinking about their students in higher music education. I have argued that perceptual learning style does not adequately explain the variation between the individuals studied, and that it is not possible to use it as a vehicle for such explanation without discounting a host of evidence. The variation that occurs between the ways that musicians approach the task of learning is much more complex than what the theory allows. However, these results should not be taken to mean that variation between individuals is not important. On the contrary, the results of the studies point to wide-ranging differences in the learning strategy selection of individuals in different situations, and also in the purposes for which individuals use different strategies. Sensitive teachers will take account of individual differences in approaches to learning without attempting to rigidly classify students.

Being aware of differences also precludes a one-size-fits-all approach to practising and the teaching of practising. The differences highlighted in this study may stem from a number of possible causes, including the teachers themselves, and addressing both the use of strategy and the decisions that lead to strategy use will be a fruitful discussion between student and teacher, enhancing the type and quality of feedback in the teaching situation. This discussion can be

further enhanced by using video recording, as was done in this study. The participants of the observation study mostly found viewing and commenting on their own approaches to work a fruitful exercise. The positive benefits of this might be much greater within the confines of a trusted and established teacher-student relationship. It has been typical to record performances in order to evaluate musicality (Schlosser, 2011) but arguably less common to record early stages of practising as a means of developing meta-cognition about approaches to learning. In this regard the approach of Yves Clot (2009) to reveal tacit understandings in the workplace using video-stimulated discussions may prove applicable.

6.6 Implications for future research

In the light of findings that perceptual learning style plays a role in the learning processes of young children (Calissendorff, 2006; R. E. Dunn, 2008), and the findings of this study, that perceptual learning style plays no role in the learning processes of the students of the Sibelius Academy, there is an unresolved issue of the developmental aspect of perceptual use in musical learning that can be addressed through longitudinal observational research, such as that conducted by Gary McPherson and colleagues (McCormick & McPherson, 2003; McPherson, 2005; Renwick & McPherson, 2002). Such research might cast light on the development of perceptual skill and its relationship to perceptual learning style theory. It would need to consider the differences between learning to play a musical work, learning to play an instrument, learning to perform, learning to practise, and learning musicianship, each of which have different foci and processes involved.

Allied to the change in perceptual use over time is the influence of teachers and teacher modelling on the adaptation of strategies, which has not been intensively studied (although, see Heikinheimo, 2009; Rostvall & West, 2003; Siebenaler, 1997). Studies that investigate long term student-teacher relationships should take into account the process of enculturation of the student into the attitudes and practices of the world of professional musicians, and engage with the complexities of this process.

A big question in the field of musical learning concerns the effectiveness of practising strategies (eg. Hallam, 2001a; Miksza, 2007). The finding that strategies may be used in various ways and for various aims and purposes complicates this agenda by questioning whether a straight line exists between strategy selection, use and outcome. If a strategy were to be effective in and of itself, this would suppose that it usually works in the same way. The variability with which strategies are used, however, opens a new area of research where the researcher needs to consider not only the strategy used, but also the purpose for which it is used, and the context in which it is used.

The variation observed in this study suggests further research of the scope and intensity of Chaffin, Imreh and Crawford's (2002) study of one pianist. Investigating the work of other performers, who are learning other works, who play other instruments, and who have different expertise levels is necessary to refine the model proposed by these authors. This work is already being pursued by a number of researchers (Ginsborg, et al., 2006; Lisboa, et al., 2011), and further research on these topics should be encouraged. A benefit to such studies would be to consider work done prior to starting physical practice, and also work done away from the instrument.

6.7 Evaluation of the study

In this section I will argue for the quality of the conclusions made in this study based on suggestions for such a task made by Miles and Huberman (1994, pp. 277-280).

This study has used well-established research methods, questionnaire, observation and stimulated-recall interviews, and has attempted to critically engage with inherent flaws in each research method. The study has offered detailed descriptions of data gathering and analysis for each data source. It has attempted to show that the conclusions reached are supported by the various data sources used in the study. The combination of methods has allowed the study show different perspectives on the same phenomenon, and still reach broadly similar conclusions. Although the study started with the aim of identifying perceptual learning style in the study population, this has not happened, and the rival conclusion was argued for on the basis of better data fit. As far as possible the influence of theoretical starting points on the respondents and participants of the study has been minimised.

The question of validity has been a central concern in the preceding pages, where it was argued that while the construct validity of the questionnaire is deemed sufficient, the construct itself is not. The failure of the questionnaire to find results that match the theory are because the theory is deficient in scope and definition. The similarity in the results between the two studies has been an important indicator of validity in this case. The validity of the observation and interview study is more difficult to argue, as is the case with any qualitative research project, because findings depend to a large extent on researcher judgement and choices. The project has been repeatedly discussed at various stages in the doctoral seminar of the Music Education Department (now the Faculty of Music Education, Jazz and Folk Music). The analytical methods have been clearly described, and conform to accepted norms. The descriptions offered relate well to other studies on similar populations. A perceived weakness in this study is the lack of intensive peer review of the actual analysis. Random coding checks were conducted by an independent coder, but a more thorough interaction around the coding and analysis of the qualitative data could have benefited the study. The vignettes drawn from this coding process were also presented to the pianists for comment, but only one responded. She felt the vignette was an accurate description of her approach to practising. Deeper engagement with the participants around the validity of my interpretations would have given more confidence to the analysis presented here.

As a pianist studying pianists, it is easy to glide over the taken-for-granted aspects of our common practice. There is a certain amount of blindness to the tacit aspects of playing the piano, which is hard to overcome. Occasionally, being aware of this danger, it was obvious to me that I was hearing more than was being said. This especially happened in the earlier interviews. As my interviewing skill developed, these problems became less glaring, which does not mean that I did not still have blind spots, but that the obvious ones had been highlighted. Perhaps a non-pianist or non-musician reading this thesis will still see the less obvious (to me) blindnesses. I can only ask for indulgence and the gentle pointing out of such things. As far as possible I have sought to understand these moments of tacitness, and to explicate them. Having a common bond with the participants also meant, however, that it was easier to progress in our conversations, and easier to identify with the work that the pianists were doing in the observation sessions. I did not advertise my background in piano, although it came up in some conversations, and must have been evident in the kinds of comments I gave.

And so, while taken-for-granted tacit meanings were present in our interactions, these also aided our communication, and formed a means with which to build a common understanding.

As a foreigner studying locals (or vice versa, depending on your perspective) there is an obvious issue in cultural and language differences. Language differences were easier to notice, although for almost all of the participants English was a comfortable communication medium. Khatia was communicating in her third language, and sometimes found it hard to express her exact meanings. This meant that we were often prodding for the right word or nuance. This occasionally happened with the other participants as well. This prodding to find a shared understanding is, however, part of the communication process, and in some ways brings clarity to what is being said and what is being heard. There is of course also an issue of power here. As the researcher I dictate the language, setting and purpose of the meetings. The pianists did not object to this, being used to attending lessons and classes where some degree of submission is required. The research design was, however, crafted to allow the pianists to speak as much or little as they wanted, on their terms. The observations took place in rooms where the participants regularly played or practised, and were intended to be as natural as can be. The unstructured nature of the interview gave the participants space to highlight aspects of their practice that they found worth commenting on, and I attempted to preserve this balance as much as possible. In all research involving interview and other forms of personal contact, the researcher brings their own assumptions and perspectives to bear on the situation. It is no different in this case. The only remedy for this is awareness, but even keen awareness cannot be aware of every tacit assumption because they are by definition outside of the cognition of their holder.

It is my opinion, argued for in this discussion, that the methods used, results found and conclusions reached are appropriate for the intentions of this research project.

7 References

Ahveninen, J., Jääskeläinen, I. P., Raij, T., Bonmassar, G., Devore, S., Hämäläinen, M., et al. (2006). Task-modulated ‘‘what’’ and ‘‘where’’ pathways in human auditory cortex. *Proceedings of the National Academy of Sciences, 103*(39), 14608–14613.

Alain, C., Arnott, S. R., Hevenor, S., Graham, S., & Grady, C. L. (2001). ‘‘What’’ and ‘‘where’’ in the human auditory system. *Proceedings of the National Academy of Sciences, 98*(21), 12301–12306.

Baddeley, A. D., & Hitch, G. J. (1974). Working memory. In G. A. Bower (Ed.), *Recent Advances in Learning and Motivation* (Vol. 8, pp. 47-89). New York: Academic Press.

Barbe, W. B., & Swassing, R. H. (1979). *Teaching Through Modality Strengths: Concepts and practices*. Columbus, Ohio: Zaner-Bloser.

Beheshti, S. (2009). Improving studio music teaching through understanding learning styles. *International Journal of Music Education, 27*(2), 107-115.

Bergman, M. M. (2008). The straw men of the Qualitative-Quantitative divide and their influence on mixed methods research. In M. M. Bergman (Ed.), *Advances in Mixed Methods Research: Theories and applications* (pp. 11-22). Thousand Oaks: Sage.

Bernardi, N. F., Schories, A., Jabusch, H.-C., Colombo, B., & Altenmüller, E. (2009). *Mental practice in music memorization: An ecological-empirical study.* Paper presented at the 7th Triennial Conference of European Society for the Cognitive Sciences of Music, Jyväskylä, Finland.

Bertelson, P., & De Gelder, B. (2004). The psychology of multimodal perception. In C. Spence & J. Driver (Eds.), *Crossmodal Space and Crossmodal Attention* (pp. 141-177). Oxford: Oxford University Press.

Biggs, J. (2001). Assessment of student learning: Where did we go wrong? *Assessment Update, 13*(6), 6-9.

Biggs, J. (2002). Assessment: Where did we go wrong? A reply. *Assessment Update, 14*(4), 6-9.

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ- 2F. *British Journal of Educational Psychology, 71*(1), 133-149.

Biggs, J., & Moore, P. J. (1993). *The Process of Learning*. New York: Prentice Hall.

Bong, S. A. (2002). Debunking myths in qualitative data analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 3(2). Retrieved from http://www.qualitative-research.net/index.php/fqs/article/view/849/1845

Bruner, J. S. (1964). The course of cognitive growth. *American Psychologist, 19*, 1-15.

Bruner, J. S. (1966). *Toward a Theory of Instruction*. New York: W.W. Norton.

Bruner, J. S. (1996). *The Culture of Education*. Cambridge: Harvard University Press.

Buckingham, A., & Saunders, P. (2004). *The Survey Methods Workbook: From design to analysis*. Cambridge: Polity.

Butler, K. A. (1987). *Learning and Teaching Style: In theory and practice* (2nd revised ed.). Columbia: The Learner's Dimension.

Cahn, D. (2008). The effects of varying ratios of physical and mental practice, and task difficulty on performance of a tonal pattern. *Psychology of Music, 36*(2), 179-191.

Calissendorff, M. (2006). Understanding the learning style of pre-school children learning the violin. *Music Education Research, 8*(1), 83-96.

Campbell, P. S., Scott-Kassner, C., & Kassner, K. (2006). *Music in Childhood: From preschool through the elementary grades*. Belmont, CA Thomson Schirmer.

Chaffin, R. (2002). Expert memory. In R. Chaffin, G. Imreh & M. Crawford (Eds.), *Practicing Perfection: Memory and piano performance* (pp. 66-92). New York: Psychology Press.

Chaffin, R. (2007). Learning *Clair de Lune*: Retrieval practice and expert memorization. *Music Perception, 24*(4), 377-393.

Chaffin, R., & Imreh, G. (1997). Pulling teeth and torture: Musical memory problem solving. *Thinking and Reasoning, 3*(4), 315-336.

Chaffin, R., & Imreh, G. (2001). A comparison of practice and self-report as sources of information about the goals of expert practice. *Psychology of Music, 29*(1), 39-69.

Chaffin, R., & Imreh, G. (2002a). Effects of musical complexity on practice. In R. Chaffin, G. Imreh & M. Crawford (Eds.), *Practicing Perfection: Memory and piano performance* (pp. 165-196). New York: Psychology Press.

Chaffin, R., & Imreh, G. (2002b). Lessons from J.S. Bach: Stages of practise. In R. Chaffin, G. Imreh & M. Crawford (Eds.), *Practicing Perfection: Memory and piano performance* (pp. 93-138). New York: Psychology Press.

Chaffin, R., & Imreh, G. (2002c). Practicing perfection: Piano performance as expert memory. *Psychological Science, 13*, 342-349.

Chaffin, R., Imreh, G., & Crawford, M. (2002). *Practicing Perfection: Memory and piano performance*. New York: Psychology Press.

Chaffin, R., Imreh, G., Lemieux, A. F., & Chen, C. (2003). "Seeing the big picture": Piano practice as expert problem solving. *Music Perception, 20*, 461-485.

Chaffin, R., Lemieux, A. F., & Chen, C. (2007). "It is different each time I play": Variability in highly prepared musical performance. *Music Perception, 24*(5), 455-472.

Clot, Y. (2009). Clinic of activity: The dialogue as instrument. In A. Sannino, H. Daniels & K. D. Gutierrez (Eds.), *Learning and Expanding with Activity Theory* (pp. 286- 302). Cambridge: Cambridge University Press.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004a). Learning Styles and Pedagogy in Post-16 Learning: A systematic and critical review. London: Learning and Skills Research Centre.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004b). Should We Be Using Learning Styles? What research has to say to practice. London: Learning and Skills Research Centre.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education* (6th ed.). Abingdon: Routledge.

Conolly, C., & Williamon, A. (2004). Mental skills training. In A. Williamon (Ed.), *Musical Excellence: Strategies and techniques to enhance performance* (pp. 221-245). Oxford: Oxford University Press.

Corbin, J., & Strauss, A. (1990). Grounded Theory research: Procedures, canons and evaluative criteria. *Zeitschrift für Soziologie, 19*(6), 418-427.

Creswell, J. W. (2002). *Research Design: Qualitative, quantitative and mixed methods approaches* (2nd ed.). Thousand Oaks: Sage.

Curry, L. (1983). An organisation of learning styles theory and constructs. Paper presented at the 67th Annual Meeting of the American Educational Research Association, Montreal, Quebec. www.eric.ed.gov

De Grave, W. S., Boshuizen, H. P. A., & Schmidt, H. G. (1996). Problem based learning: Cognitive and metacognitive processes during problem analysis. *Instructional Science, 24*(5), 321-341.

Desmedt, E., & Valke, M. (2004). Mapping the learning styles "jungle": An overview of the literature based on citation analysis. *Educational Psychology, 24*(4), 445-464.

Devilly, G. J. (2005). Power Therapies and possible threats to the science of psychology and psychiatry. *The Australian and New Zealand Journal of Psychiatry, 39*(6), 437-445.

Diener, C. I., & Dweck, C. S. (1978). An analysis of learned helplessness: Continuous changes in performance, strategy, and achievement cognitions following failure. *Journal of Personality and Social Psychology, 36*(5), 451-462.

Dougherty, P. (1997). Somatosensory systems. In J. H. Byrne (Ed.), *Neuroscience Online: An electronic textbook for the neurosciences*. Houston: Department of Neurobiology and Anatomy, University of Texas Medical School at Houston. Retrieved from neuroscience.uth.tmc.edu.

Dragoi, V. (1997). Visual processing: Cortical pathways. In J. H. Byrne (Ed.), *Neuroscience Online: An electronic textbook for the neurosciences*. Houston: Department of Neurobiology and Anatomy, The University of Texas Medical School at Houston. Retrieved from neuroscience.uth.tmc.edu.

Dunn, R., & Dunn, K. (1978). *Teaching Students Through Their Individual Learning Styles: A practical approach*. Reston: Reston.

Dunn, R., & Griggs, S. A. (2003). *Synthesis of the Dunn and Dunn Learning-Styles Model Research: Who, what, where, when, why and so what?* Jamaica, NY: St. John's University.

Dunn, R., Honigsfeld, A., Doolan, L. S., Bostrom, L., Russo, K., Schiering, M. S., et al. (2009). Impact of learning-style instructional strategies on students' achievement and attitudes: Perceptions of educators in diverse institutions. *The Clearing House, 82*(3), 135-140.

Dunn, R. E. (2008). The effect of auditory, visual or kinesthetic perceptual strengths on music listening. *Contributions to Music Education, 35*, 47-78.

Elliott, C. A. (1982). The relationships among instrumental sight-reading ability and seven selected predictor variables. *Journal of Research in Music Education, 30*(1), 5-14.

Ericsson, K. A. (1997). Deliberate practice and the acquisition of expert performance: An overview. In H. Jørgensen & A. C. Lehmann (Eds.), *Does Practice Make Perfect? Current theory and research on instrumental music practice* (pp. 9-52). Oslo: Norges Musikkhøgskole.

Ericsson, K. A., & Kintsch, W. (1995). Long term working memory. *Psychological Review, 102*(2), 211-245.

Everett, Y. U. (1997). Modality-based aural skills pedagogy: Ear-training strategies for post-tonal and non-western musics. *Journal of Music Theory Pedagogy, 11*, 27-58.

Eysenck, S. B. G., Pearson, P. R., Easting, G., & Allsop, J. F. (1985). Age norms for impulsiveness, venturesomeness, and empathy in adults. *Personality and Individual Differences, 6*(5), 613-619.

Falkner, D. L. (1994). *An investigation of modality preferences, musical aptitude, and attitude toward music at the third-grade level.* (Ph.D. dissertation). University of Mississippi, Mississippi. Retrieved from ProQuest Dissertations and Theses. (Accession order no. AAT 9509516).

Fernald, G. M. (1943). *Remedial Techniques in Basic School Subjects*. New York: McGraw-Hill.

Fleming, N. D. (1995). *I'm different, not dumb: Modes of presentation (V.A.R.K.) in the tertiary classroom.* Paper presented at the Annual Conference of the Higher Education and Research Development Society of Australasia.

Fleming, N. D. (2006a). *Teaching and Learning Styles: VARK strategies* (2nd ed.). Christchurch: Neil D. Fleming.

Fleming, N. D. (2006b). VARK Questionnaire. Retrieved 6 February, 2009, from www.vark-learn.com

Fleming, N. D., & Baume, D. (2006). Learning styles again: VARKing up the right tree! *Educational Developments, 7,* 4-7.

Fleming, N. D., & Mills, C. (1992). Not another inventory, rather a catalyst for reflection. *To Improve the Academy, 11*, 137.

Gabrielsson, A. (1999). The performance of music. In D. Deutsch (Ed.), *The Psychology of Music* (2nd ed., pp. 501-602). San Diego: Academic Press.

Gabrielsson, A. (2003). Music Performance Research at the Millennium. *Psychology of Music, 31*(3), 221-272.

Gadermann, A. M., Guhn, M., & Zumbo, B. D. (2012). Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. *Practical Assessment, Research & Evaluation, 17*(3).

Garcia, S. (2002). Learning styles and piano teaching. Piano Pedagogy Forum, 5(1). Retrieved from http://www.music.sc.edu/ea/keyboard/PPF/5.1/5.1.PPFpp.html

Gardner, H. (1985). *Frames of Mind: The theory of multiple intelligences*. London: Paladin.

Gault, B. (2005). Music learning through all the channels: Combining aural, visual, and kinesthetic strategies to develop musical understanding. *General Music Today, 19*(1), 7-9.

Gaunt, H., & Hallam, S. (2009). Individuality in the learning of musical skills. In S. Hallam, I. Cross & M. H. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 274-284). Oxford: Oxford University Press.

Ginsborg, J. (2002). Classical singers learning and memorising a new song: An observational study. *Psychology of Music, 30*(1), 58-101.

Ginsborg, J. (2004). Strategies for memorizing music. In A. Williamon (Ed.), *Musical Excellence: Strategies and techniques to enhance performance* (pp. 121-141). Oxford: Oxford University Press.

Ginsborg, J., Chaffin, R., & Nicholson, G. (2006). Shared performance cues in singing and conducting: A content analysis of talk during practice. *Psychology of Music, 34*(2), 167-194.

Ginsborg, J., Williamon, A., & Kreutz, G. (2009). Health-promoting behaviours in conservatoire students. *Psychology of Music, 37*(1), 47-60.

Godøy, R. I. (2003). Motor-mimetic music cognition. *Leonardo, 36*(4), 317-319.

Gorsuch, R. L. (1983). *Factor Analysis* (2nd ed.). Hillsdale: Lawrence Erlbaum.

Grasha, A. F. (1990). The naturalistic approach to learning styles. *College Teaching, 38*(3), 106-114.

Green, P. E., Carmone, F. J., & Smith, S. M. (2011). Cluster analysis (Revision of Section 5 of Green, Carmone & Smith (1989) Multidimensional Scaling. Addison Wesley.). Retrieved from www.qualtrics.com/university/researchsuite/docs/ClusterAnalysis.pdf

Gregorc, A. F. (1982). *An Adult's Guide to Style*. Columbia: Gregorc Associates.

Grigorenko, E. L., & Sternberg, R. J. (1995). Thinking styles. In D. H. Saklofske & M. Zeidner (Eds.), *International Handbook of Personality and Intelligence* (pp. 205-230). New York: Plenum Press.

Grinder, J., & Bandler, R. (1976). *The Structure of Magic II*. Palo Alto: Science and Behaviour Books.

Gromko, J. E. (2004). Predictors of music sight-reading ability in high school wind players. *Journal of Research in Music Education, 52*(1), 6-15.

Gruson, L. M. (1988). Rehearsal skill and musical competence: Does practice make perfect? In J. A. Sloboda (Ed.), *Generative Processes in Music: The psychology of performance, improvisation, and composition* (pp. 91-112). Oxford: Oxford University Press.

Hakkarainen, K. (2012). Mapping the research ground: Expertise, collective creativity and shared knowledge practices. In H. Gaunt & H. Westerlund (Eds.), *Collaborative Learning in Higher Music Education: Why, what and how* (pp. 13-26). Aldershot: Ashgate.

Hallam, S. (1995). Professional musicians' orientations to practice: Implications for teaching. *British Journal of Music Education, 12*(1), 3-19.

Hallam, S. (1997). The development of memorisation strategies in musicians: Implications for education. *British Journal of Music Education, 14*(1), 87-97.

Hallam, S. (2001a). The development of expertise in young musicians: Strategy use, knowledge acquisitions and individual diversity. *Music Education Research, 3*(1), 7-23.

Hallam, S. (2001b). The development of metacognition in musicians: Implications for education. *British Journal of Music Education, 18*(1), 27-39.

Hannaford, C. (1995). *Smart Moves: Why learning is not all in your head*. Arlington: Great Ocean Publishers.

Hattie, J. (2009). *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement*. London: Routledge.

Hayward, C. M., & Gromko, J. E. (2009). Relationships among music sight-reading and technical proficiency, spatial visualization, and aural discrimination. *Journal of Research in Music Education, 57*(1), 26-36.

Heikinheimo, T. (2009). *Intensity of Interaction in Instrumental Music Lessons.* (DMus dissertation). Sibelius Academy, Helsinki. Retrieved from ethesis.siba.fi. (Accession order no. 9789525531718).

Hill, T., & Lewicki, P. (2007). *Statistics: Methods and applications*. Tulsa, OK: StatSoft.

Holmes, P. (2005). Imagination in practice: A study of the integrated roles of interpretation, imagery and technique in the learning and memorisation processes of two experienced solo performers. *British Journal of Music Education, 22*(3), 217-235.

Hultberg, C. (2008). Instrumental students' strategies for finding interpretations: complexity and individual variety. *Psychology of Music, 36*(1), 7-23.

Imreh, G., & Chaffin, R. (1996). Understanding and developing musical memory: The views of a concert pianist and a cognitive psychologist. *American Music Teacher, 46*(3), 20-24, 67.

Imreh, G., & Crawford, M. (2002). In the words of the masters: Artists' account of their expertise. In R. Chaffin, G. Imreh & M. Crawford (Eds.), *Practicing Perfection: Memory and piano performance* (pp. 26-65). New York: Psychology Press.

Jakobson, L. S., Lewycky, S. T., Kilgour, A. R., & Stoesz, B. M. (2008). Memory for verbal and visual material in highly trained musicians. *Music Perception, 26*(1), 41-55.

Jørgensen, H. (1997). Time for practising? Higher level music students' use of time for instrumental practising. In H. Jørgensen & A. C. Lehmann (Eds.), *Does Practice Make Perfect? Current theory and research on instrumental music practice* (pp. 123-140). Oslo: Norges Musikkhøgskole.

Jørgensen, H. (2009). *Research into Higher Music Education*. Oslo: Novus Press.

Jørgensen, H. (2010). Higher music education institutions: A neglected arena for research? *Bulletin of the Council for Research in Music Education, 186*, 67-80.

Keefe, J. W. (1985). Assessment of learning style variables: The NASSP Task Force model. *Theory Into Practice, 24*(2), 138-144.

Keim, D. A., Mansmann, F., Schneidewind, J., & Ziegler, H. (2006). *Challenges in visual data analysis.* Paper presented at the Tenth International Conference on Information Visualisation, London.

Kemp, A. E. (1997). Individual differences in musical behaviour. In D. J. Hargreaves & A. C. North (Eds.), *The Social Psychology of Music* (pp. 25-45). Oxford: Oxford University Press.

Knierim, J. (1997). Motor units and muscle receptors. In J. H. Byrne (Ed.), *Neuroscience Online: An electronic textbook for the neurosciences*. Houston: Department of Neurobiology and Anatomy, The University of Texas Medical School at Houston. Retrieved from neuroscience.uth.tmc.edu.

Knoblauch, H., Schnettler, B., & Raab, J. (2006). Introduction. In H. Knoblauch, B. Schnettler, J. Raab & H.-G. Soeffner (Eds.), *Video-Analysis Methodology and Methods: Qualitative audiovisual data analysis in Sociology* (pp. 9-28). Frankfurt-am-Main: Peter Lang.

Kopiez, R., & Lee, J. I. (2006). Towards a dynamic model of skills involved in sight reading music. *Music Education Research, 8*(1), 97-120.

Kopiez, R., & Lee, J. I. (2008). Towards a general model of skills involved in sight reading music. *Music Education Research, 10*(1), 41-62.

Korenman, L., & Peynircioglu, Z. (2007). Individual differences in learning and remembering music: Auditory versus visual presentation. *Journal of Research in Music Education, 55*(1), 48-64.

Korpela, P., Kuoppamäki, A., Laes, T., Miettinen, L., Muhonen, S., Muukkonen, M., et al. (2010). Music education in Finland. In I. Rikandi (Ed.), *Mapping the Common Ground: Philosophical perspectives on Finnish Music Education* (pp. 14-31). Helsinki: BTJ.

Krätzig, G. P., & Arbuthnott, K. D. (2006). Perceptual learning style and learning proficiency: A test of the hypothesis. *Journal of Educational Psychology, 98*(1), 238-246.

Lehmann, A. C., & Ericsson, K. A. (1996). Performance without preparation: Structure and acquisition of expert sight-reading and accompanying performance. *Psychomusicology - A Journal of Research in Music Cognition, 15*, 1-29.

Leite, W. L., Svinicki, M., & Shi, Y. (2010). Attempted validation of the scores of the VARK Learning Styles Inventory with multitrait–multimethod confirmatory factor analysis models. *Educational and Psychological Measurement, 70*(2), 323-339.

Lim, S., & Lippman, L. G. (1991). Mental practice and memorization of piano music. *The Journal of General Psychology, 118*(1), 21-31.

Lisboa, T., Chaffin, R., & Logan, T. (2011). *A self-study of practice: Words versus action in music problem solving.* Paper presented at the International Symposium on Performance Science, Toronto, Canada.

Lyle, J. (2003). Stimulated recall: A report on its use in naturalistic research. *British Educational Research Journal, 29*(6), 861-878.

MacCallum, R. C., Widaman, K. F., Preacher, K. J., & Hong, S. (2001). Sample size in factor analysis: The role of model error. *Multivariate Behavioural Research, 36*(4), 611-637.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Pscyhological Methods, 4*(1), 84-99.

Markle, D. T., West, R. E., & Rich, P. J. (2011). Beyond transcription: Technology, change and refinement of method. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research,* 12(3), Art. 21. Retrieved from http://nbn-resolving.de/urn:nbn:de:0114-fqs1103216.

Massaro, D. W. (2004). From multisensory integration to talking heads and language learning. In G. A. Calvert, C. Spence & B. E. Stein (Eds.), *The Handbook of Multisensory Processes* (pp. 153-176). Cambridge, Massachusetts: MIT Press.

Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge Handbook of Multimedia Learning* (pp. 31-48). Cambridge: Cambridge University Press.

McCormick, J., & McPherson, G. E. (2003). The role of self-efficacy in a musical performance examination: An exploratory structural equation analysis. *Psychology of Music, 31*(1), 37-51.

McKinney, D. L. (2008). Mental Strategies to Improve Playing. *American Music Teacher, 57*(6), 26-28.

McPherson, G. E. (2005). From child to musician: Skill development during the beginning stages of learning an instrument. *Psychology of Music, 33*(1), 5-35.

Miklaszewski, K. (1989). A case study of a pianist preparing a musical performance. *Psychology of Music, 17*, 95-109.

Miklaszewski, K. (1995). *Individual differences in preparing a musical composition for public performance.* Paper presented at the International Seminar of Researchers and Lecturers in the Psychology of Music, Radziejowice, Poland.

Miksza, P. (2006). Relationships among impulsiveness, locus of control, sex, and music practice. *Journal of Research in Music Education, 54*(4), 308-323.

Miksza, P. (2007). Effective practice: An investigation of observed practice behaviors, self-reported practice habits, and the performance achievement of High School wind players. *Journal of Research in Music Education, 55*(4), 359-375.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks: Sage.

Miller, B. A. (2002). Touch the music! Learning modalities in elementary music class. *General Music Today, 15*(2), 4-13.

Mills, J., & McPherson, G. E. (2006). Musical literacy. In G. E. McPherson (Ed.), *The Child as Musician: A handbook of musical development* (pp. 155-171). Oxford: Oxford University Press.

Mishra, J. (2005). A theoretical model of musical memory. *Psychomusicology, 19*(1), 75-89.

Mishra, J. (2007). Correlating musical memorization styles and perceptual learning modalities. Visions of Research in Music Education, 9/10, 1-19. Retrieved from http://www-usr.rider.edu/~vrme/v9n1/vision/Mishra%20Final.pdf

Mixon, K. (2004). Band: Three learning styles ... four steps to reach them. *Teaching Music, 11*(4), 48-51.

Molumby, N. L. (2004). *The Application of Different Teaching Strategies Reflective of Individual Students' Learning Modalities in the University Flute Studio Class.* (D.M.A. dissertation). Ohio State University, Columbus. Retrieved from ProQuest Dissertations and Theses. (Accession order no. AAT 3148196).

Moran, A. (1993). Conceptual and methodological issues in the measurement of mental imagery skills in athletes. *Journal of Sport Behavior, 16*(3), 156.

Myers, C. A. (1978). Reviewing the literature on Fernald's technique of remedial reading. *The Reading Teacher, 31*(6), 614-619.

Nielsen, S. G. (1999a). Learning strategies in instrumental music practice. *British Journal of Music Education, 16*(3), 275-291.

Nielsen, S. G. (1999b). Regulation of learning strategies during practice: A case study of a single church organ student preparing a particular work for a concert performance. *Psychology of Music, 27*(2), 218-229.

Nielsen, S. G. (2001). Self-regulating learning strategies in instrumental music practice. *Music Education Research, 3*(2), 155-167.

Nielsen, S. G. (2004). Strategies and self-efficacy beliefs in instrumental and vocal individual practice: A study of students in higher music education. *Psychology of Music, 32*(4), 418-431.

Nielsen, S. G. (2008). Instrumental practicing and self-regluation: A social cognitive perspective. *Finnish Journal of Music Education, 11*(1-2), 19-25.

Noice, H., Jeffrey, J., Noice, T., & Chaffin, R. (2008). Memorization by a jazz musician: A case study. *Psychology of Music, 36*(1), 63-79.

Norušis, M. J. (2011). *The IBM SPSS Statistics 19 Statistical Procedures Companion*. Upper Saddle River: Prentice Hall.

Odendaal, A. (2010). Teaching every learner: Variety in the light of multiculturality and difference. *Finnish Journal of Music Education, 13*(2), 23-29.

Odendaal, A. (2011). *Practicing habits shaped by perception: Results of two pilot studies.* Poster presented at the Performa'11 Conference for Performance Studies, Aviero, Portugal.

Paivio, A. (1971). *Imagery and Verbal Processes*. New York: Holt, Rinehart & Winston.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest, 9*(3), 105-119.

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology, 46*, 128-148.

Persellin, D. C. (1992). Responses to rhythm patterns when presented to children through auditory, visual, and kinesthetic modalities. *Journal of Research in Music Education, 40*(4), 306-315.

Persellin, D. C. (1993). Influence of young children's learning modalities on their pitch matching. *Perceptual & Motor Skills, 76*, 313-314.

Persellin, D. C., & Pierce, C. (1988). Association of preference for modality to learning of rhythm patterns in music. *Perceptual and Motor Skills, 67*, 825-826.

Pitts, S., Davidson, J. W., & McPherson, G. E. (2000). Developing effective practise strategies: Case studies of three young instrumentalists. *Music Education Research, 2*(1), 45-56.

Pohjannoro, U. (2013). *Sävellyksen synty: Tapaustutkimus säveltäjä ajattelusta.* (Dmus dissertation). Sibelius Academy, Helsinki. Retrieved from ethesis.siba.fi.

Rayner, S., & Riding, R. (1997). Towards a categorisation of cognitive styles and learning styles. *Educational Psychology, 17*(1-2), 5-28.

Reinert, H. (1976). One picture is worth a thousand words? Not necessarily! *Modern Language Journal, 60*(4), 160-169.

Renwick, J. M., & McPherson, G. E. (2002). Interest and choice: Student-selected repertoire and its effect on practising behavior. *British Journal of Music Education, 19*(2), 173-188.

Riding, R. (2002). *School Learning and Cognitive Style*. London: David Fulton.

Riding, R., & Cheema, I. (1991). Cognitive styles - an overview and integration. *Educational Psychology, 11*(3/4), 193.

Riener, C., & Willingham, D. (2010). The myth of learning styles. *Change, 42*(5), 32-35.

Rigdon, E. (1997). Not positive definite matrices — causes and cures. Retrieved from http://www2.gsu.edu/~mkteer/npdmatri.html

Roderique-Davies, G. (2009). Neuro-linguistic programming: Cargo cult psychology? *Journal of Applied Research in Higher Education, 1*(2), 58-63.

Rosnow, R. L., & Rosenthal, R. (2008). *Beginning Behavioural Research: A conceptual primer* (6th ed.). Upper Saddle River: Prentice Hall.

Rostvall, A.-L., & West, T. (2003). Analysis of interaction and learning in instrumental teaching. *Music Education Research, 5*(3), 213.

Rowe, V. C. (2009). Using video-stimulated recall as a basis for interviews: some experiences from the field. *Music Education Research, 11*(4), 425-437.

Rundle, S., & Dunn, R. (2007). Building Excellence Survey. Retrieved 5 February, 2009, from www.learningstyles.net

Rundle, S., & Dunn, R. (2008). BE 2000 Research Manual. Retrieved 5 February, 2009, from www.asb.dk

Salomon, G., & Perkins, D. N. (1998). Individual and social aspects of learning. *Review of Research in Education, 23*, 1-24.

Sapsford, R. (2007). *Survey Research* (2nd ed.). London: Sage.

Sax, L. J., Gilmartin, S. K., & Bryant, A. N. (2003). Assessing response rates and nonresponse bias in web and paper surveys. *Research in Higher Education, 44*(4), 409-432.

Schacter, D. L. (2001). *The Seven Sins of Memory: How the mind forgets and remembers*. Boston: Houghton Mifflin.

Schlosser, M. (2011). Minding the music: Neuroscience, video recording, and the pianist. *International Journal of Music Education, 29*(4), 347-358.

Schomburg, H., & Teichler, U. (2006). *Higher Education and Graduate Employment in Europe: Results from graduate surveys from 12 countries*. Dodrecht: Springer.

Schriesheim, C. A., & Denisi, A. S. (1980). Item presentation as an influence on questionnaire validity: A field experiment. *Educational and Psychological Measurement, 40*(1), 175-182.

Sharpley, C. F. (1984). Predicate matching in NLP: A review of research on the preferred representational system. *Journal of Counseling Psychology, 31*(2), 238-248.

Sharpley, C. F. (1987). Research findings on neurolinguistic programming: Nonsupportive data or an untestable theory? *Journal of Counseling Psychology, 34*(1), 103-107.

Siebenaler, D. J. (1997). Analysis of teacher-student interactions in the piano lessons of adults and children. *Journal of Research in Music Education, 45*(1), 6-20.

Silver, C., & Patashnick, J. (2011). Finding fidelity: Advancing audiovisual analysis using software. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 12(1), Art. 37. Retrieved from http://nbn-resolving.de/urn:nbn:de:0114-fqs1101372.

Sisterhen, L. (2004). Enhancing Your Musical Performance Abilities. *American Music Teacher, 54*(1), 32-109.

Skukauskaite, A. (2012). Transparancy in transcribing: Making visible theoretical bases impacting knowledge construction from open-ended interview records. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 13(1), Art. 14. Retrieved from http://nbn-resolving.de/urn:nbn:de:0114-fqs1201146.

Snyder, B. (2000). *Music and Memory: An introduction*. Cambridge, Massachusetts: MIT Press.

Söderman, J., & Folkestad, G. (2004). How hip-hop musicians learn: Strategies in informal creative music making. *Music Education Research, 6*(3), 313-326.

Sprenger, M. (2003). *Differentiation Through Learning Styles and Memory*. Thousand Oaks: Corwin Press.

Stein, B. E., & Meredith, M. A. (1994). *The Merging of the Senses*. Cambridge, Massachusetts: MIT Press.

Sullivan, Y., & Cantwell, R. H. (1999). The planning behaviors of musicians engaging traditional and non-traditional scores. *Psychology of Music, 27*(2), 245-266.

Sur, D. D. (2006). *Exploratory or confirmatory factor analysis?* Paper presented at the 31st Annual SAS® Users Group International Conference, Cary, NY.

Swanson, C. D. (2005). The private studio: Learning styles and the voice student. *Journal of Singing 62*(2), 203-208.

Swassing, R. H., Barbe, W. B., & Milone, M. N. (1979). *The Swassing-Barbe Modality Index: Zaner-Bloser modality kit*. Columbus: Zaner-Bloser.

Tallis, R. (2003). *The Hand: A philosophical inquiry into human being*. Edinburgh: Edinburgh University Press.

Vesterinen, O., Toom, A., & Patrikainen, S. (2010). The stimulated recall method and ICTs in research on the reasoning of teachers. *International Journal of Research & Method in Education, 33*(2), 183-197.

Williamon, A., & Egner, T. (2004). Memory structures for encoding and retrieving a piece of music: An ERP investigation. *Cognitive Brain Research, 22*(1), 36-44.

Williamon, A., & Valentine, E. (2002). The role of retrieval structures in memorizing music. *Cognitive Psychology, 44*(1), 1-32.

Williams, M. (2010). Situated objectivity. In W. Olsen (Ed.), *Realist Methodology* (Vol. I, pp. 267-288). Los Angeles: Sage.

Wood, B. (2007). The mild child & the wild child: A tale of two stringed instrument beginners. *American String Teacher, 57*(1), 32-37.

Zikmund, A. B., & Nierman, G. E. (1992). The effect of perceptual mode preferences and other selected variables on upper elementary school students' responses to conservation-type rhythmic and melodic tasks. *Psychology of Music, 20*(1), 57-69.

8 Appendices

A) Questionnaire in Finnish with randomised question order, as presented to respondents in the questionnaire study

Heti ensimmäiseksi kiitokset ajastasi, jonka panostat tähän kyselylomakkeeseen vastaamiseen. Olen jatko-opiskelijana Sibelius-Akatemian musiikkikasvatuksen osastolla ja tutkin strategioita, joita klassista ohjelmistoa soittavat instrumentalistit käyttävät opetellessaan uutta musiikkikappaletta.

Lomakkeen kysymykset koskevat musiikillista taustaasi ja strategioita, joita käytät uuden musiikkikappaleen opettelemiseen. Pyydän, että vastaat kysymyksiin huolellisesti, ja toivon, että opit niiden avulla jotain omista harjoitustottumuksistasi. Vastaamisen ei pitäisi viedä 10 minuuttia kauempaa.

Vastauksesi käsittelen luottamuksellisesti niin, että henkilöllisyytesi ei paljastu missään vaiheessa. Kukaan Sibelius-Akatemiassa ei pääse käsiksi tutkimustietoon eivätkä vastauksesi tähän kyselylomakkeeseen vaikuta mitenkään sinun ja Sibelius-Akatemian väliseen suhteeseen. Vastaukset tuhotaan tutkimuksen valmistuttua.

Jos sinulla on kysyttävää projektista, ota yhteyttä. Puhelinnumeroni on 040 710 4308 ja sähköpostiosoitteeni andries.odendaal@siba.fi.

Kiitokset vielä kerran osallistumisestasi.

Terveisin

Albi Odendaal
Sibelius Akatemian Musiikkikasvatuksen Osasto

Musiikillista taustaasi

Mikä on pääinstrumenttisi?

Mitä muita instrumentteja soitat?

Mihin musiikinlajiin olet erikoistunut pääsoittimellasi?

Mitä muita musiikinlajeja soitat?

Kuinka monta vuotta olet ottanut soittotunteja?

Kuinka monta soitonopettajaa sinulla on ollut, mukaan lukien nykyinen/nykyiset opettajasi?

Kuinka mones opiskeluvuosi sinulla on meneillään?

- ◯ 1. – 3. vuosi kandidaatintutkinnossa
- ◯ 1. – 2. vuosi maisterintutkinnossa
- ◯ Jatko-opiskelija

Missä koulutusohjelmassa olet kirjoilla?

Minkä ikäinen olet?

Strategioita

Kuvittele olevasi aloittamassa laajamittaisen teoksen (esim. klassismin tai romantiikan ajan sonaatin tai konserton) harjoittelua pääsoittimellasi ja vastaa seuraaviin kysymyksiin.

	Ei koskaan	Erittäin harvoin	Harvoin	Satunnaisesti	Usein	Aina
Selvitän kappaleen rakenteen käymällä nuotit tarkasti läpi ilman soitinta.	◯	◯	◯	◯	◯	◯
Soitan kappaleen läpi äänettömästi.	◯	◯	◯	◯	◯	◯
Laulan itselleni kappaleen melodioita, kun en soita.	◯	◯	◯	◯	◯	◯
Yksinkertaistan vaikeita kohtia jättämällä pois osan nuoteista.	◯	◯	◯	◯	◯	◯
Teen kappaleen osista teknisiä harjoituksia.	◯	◯	◯	◯	◯	◯
Yksi tavoitteistani on pystyä soittamaan automaattisesti, ajattelematta liikaa.	◯	◯	◯	◯	◯	◯
Luen koko kappaleen alusta loppuun monta kertaa enkä mielelläni työstä sitä pienissä osissa.	◯	◯	◯	◯	◯	◯
Äänitä omaa soittoani ja kuuntelen äänitteitäni.	◯	◯	◯	◯	◯	◯
Yksi tavoitteistani on pystyä näkemään nuotit mielessäni.	◯	◯	◯	◯	◯	◯
Jos minusta tuntuu, että en harjoitellessani muista, miten kappale menee, katson nuotteja.	◯	◯	◯	◯	◯	◯
Puhun itsekseni kappaleen yksityiskohdista, kun työskentelen sen parissa.	◯	◯	◯	◯	◯	◯
Tutkin useita nuottilaitoksia ja vertailen niiden yhteneväisyyksiä ja eroja.	◯	◯	◯	◯	◯	◯
Soitan osia kappaleesta ja kuuntelen niitä sitten mielessäni soittamatta.	◯	◯	◯	◯	◯	◯
Paneudun aluksi yksinomaan teknisiin haasteisiin ja työstän kappaleen musiikillista muotoa vasta myöhemmin.	◯	◯	◯	◯	◯	◯
Käytän uuden kappaleen nuotteja pohjana improvisaatiolle ennen kuin alan harjoitella kappaletta yksityiskohtaisesti.	◯	◯	◯	◯	◯	◯
Käytän metronomia soittaessani.	◯	◯	◯	◯	◯	◯
Yksi tavoitteistani on muistaa miltä sormeni/käteni näyttävät, kun soitan työn alla olevaa kappaletta.	◯	◯	◯	◯	◯	◯
Jos minusta tuntuu, että en harjoitellessani muista, miten kappale menee, laulan tai hyräilen (ääneen tai mielessäni), ja se auttaa minua keskittymään.	◯	◯	◯	◯	◯	◯
Vaikean kohdan selvittäminen sujuu paremmin, kun soitan (= toistan kohtaan liittyvät soittoliikkeet) sen äänettömästi.	◯	◯	◯	◯	◯	◯
Teen nuotteihin merkintöjä muistini tueksi.	◯	◯	◯	◯	◯	◯
Luen paljon kappaleesta, jota olen harjoittelemassa.	◯	◯	◯	◯	◯	◯
Puhun jonkun kanssa, joka on soittanut kappaletta aiemmin.	◯	◯	◯	◯	◯	◯
Lasken vaikeita rytmejä ääneen.	◯	◯	◯	◯	◯	◯
Piirrän kappaleesta graafisen esityksen, josta kappaleen rakenne käy selvemmin ilmi.	◯	◯	◯	◯	◯	◯
Teen harjoittelusuunnitelman.	◯	◯	◯	◯	◯	◯
Yritän soittaa hitaasti ensimmäisten harjoitustuokioiden aikana.	◯	◯	◯	◯	◯	◯
Soitan osia kappaleesta erilaisin rytmein saadakseni kappaleen sormiini.	◯	◯	◯	◯	◯	◯
Soitan kappaleen niin kuin se on kirjoitettu yrittämättä improvisoida sen pohjalta.	◯	◯	◯	◯	◯	◯

Strategioita

Kuvittele olevasi aloittamassa laajamittaisen teoksen (esim. klassismin tai romantiikan ajan sonaatin tai konserton) harjoittelua pääsoittimellasi ja vastaa seuraaviin kysymyksiin.

	Ei koskaan	Erittäin harvoin	Harvoin	Satunnaisesti	Usein	Aina
Jos minusta tuntuu, että en harjoitellessani muista, miten kappale menee, yritän antaa sormieni liikkua automaattisesti.	◯	◯	◯	◯	◯	◯
En lue kappaletta kokonaisuutena ensin, vaan alan työstää sitä osissa välittömästi.	◯	◯	◯	◯	◯	◯
Käytän merkinnöissäni värejä.	◯	◯	◯	◯	◯	◯
Kirjoitan itseäni varten uudelleen osia kappaleen nuotinnoksesta, joko täydellisinä tai pelkistettyinä versioina.	◯	◯	◯	◯	◯	◯
Luen kappaleen kokonaan läpi kerran tai kaksi ennen kuin alan työstää sitä osissa.	◯	◯	◯	◯	◯	◯
Kuuntelen muiden muusikoiden äänitteitä kappaleesta, jota olen opettelemassa.	◯	◯	◯	◯	◯	◯
Improvisoin kappaleen materiaalin pohjalta, kun olen oppinut sen.	◯	◯	◯	◯	◯	◯
Minun on vaikea keskittyä soittamiseen, jos kuulen muuta musiikkia.	◯	◯	◯	◯	◯	◯
Selvitän kappaleen rakenteen soittamalla, en analysoimalla.	◯	◯	◯	◯	◯	◯
Tititoin vaikeat kohdat.	◯	◯	◯	◯	◯	◯
Lyön soittaessani jalalla (tai muulla kehon osalla) tahtia selvitäkseni rytmisesti vaikeista kohdista.	◯	◯	◯	◯	◯	◯
Yksi tavoitteistani on käydä mielessäni läpi liikkeet, joita teen soittaessani.	◯	◯	◯	◯	◯	◯
Päätän ennen jokaista harjoitustuokiota, mitä haluan saavuttaa.	◯	◯	◯	◯	◯	◯
Katson muiden muusikoiden videoituja esityksiä kappaleesta, jota olen opettelemassa.	◯	◯	◯	◯	◯	◯
Suljen silmäni nähdäkseni soittimeni ja sormeni/käteni mielessäni.	◯	◯	◯	◯	◯	◯
Yritän etsiä teknisesti vaikeat kohdat pystyäkseni keskittymään niihin.	◯	◯	◯	◯	◯	◯
Yksi tavoitteistani on pystyä kuulemaan kappaleen jokainen nuotti mielessäni.	◯	◯	◯	◯	◯	◯
Minulle on tärkeää tunnistaa toistuvia rakenteita kappaleessa, jota olen opettelemassa.	◯	◯	◯	◯	◯	◯
Minun on vaikea keskittyä soittamiseen, jos fyysinen ympäristö (istuin, lämpötila, valaistus) on epämukava.	◯	◯	◯	◯	◯	◯
Lakkaan soittamasta ja käyn mielessäni läpi liikkeet, joita teen soittaessani.	◯	◯	◯	◯	◯	◯
Hyräilen melodioita ja/tai rytmejä itselleni, kun soitan.	◯	◯	◯	◯	◯	◯
Minun on vaikea keskittyä soittamiseen, jos näen huoneessa on liikettä.	◯	◯	◯	◯	◯	◯
Vaikean kohdan selvittäminen sujuu paremmin, kun kuuntelen sen mielessäni.	◯	◯	◯	◯	◯	◯
Pyrin kiinnittämään huomiota fraseeraukseen ja dynamiikkaan heti ensilukemalta.	◯	◯	◯	◯	◯	◯
Vaikean kohdan selvittäminen sujuu paremmin, kun tutkin sitä tarkasti ilman soitinta.	◯	◯	◯	◯	◯	◯
Pidän (päivä)kirjaa harjoituksistani.	◯	◯	◯	◯	◯	◯
Käytän metronomia tempojen hahmottamiseen mutta en soittaessani.	◯	◯	◯	◯	◯	◯
Käytän apuna johtamiseleitä tai muita kehon liikkeitä löytääkseni oikean fraseerauksen.	◯	◯	◯	◯	◯	◯

B) Questionnaire in English with questions grouped according to modality classification

Thank you for taking time to answer this questionnaire. I am a doctoral student at the Sibelius Academy Music Education Department. My research focusses on the strategies that classical instrumentalists use when they learn a piece that they have not played before.

In this survey there are questions about your musical history, and about strategies that you might use in learning a piece you have not played. I would appreciate if you answered the questions carefully, and I hope that answering them will also show you something about your own habits of learning. It should not take more than 10 minutes.

I respect your privacy, and will not use this data in any way that will identify you. No one at the Sibelius Academy will have access to the raw data in any form, and your responses on this questionnaire will not affect Sibelius Academy's relationship with you. The answers you provide will be destroyed at the conclusion of the research.

If you have any questions regarding this project, please feel free to contact me at my office in the Sibelius Academy, at 040 710 4308 or by email at andries.odendaal@siba.fi.

Thank you again for participating in this survey.

Yours,

Albi Odendaal

Sibelius Academy, Department of Music Education

What is your main music instrument?
Which other instruments do you play?
What genre of music do you specialise in with your main instrument?
What other genres do you study and play?
How many years have you been taking music lessons?
How many instrument teachers have you had, including your current teacher(s)?
Which year of study are you currently enrolled for? (1st – 3rd year Bachelor, 1-2 year Master, Post-Graduate)
Which degree program are you enrolled in?
What is your age?

Respond to the following statements by imagining that you are about to start learning to play a large scale work (like a sonata or a concerto) from the classical or romantic era on your primary instrument. (Never, very rarely, rarely, occasionally, frequently, always)

V1 One of my aims is to be able to visualise the score in my mind's eye.
V2 I find it hard to concentrate on my playing when I see movement in the room.
V3 If I feel that I will lose my place while I am practising, I look at the notation as a reminder.
V4 I close my eyes in order to see my instrument and fingers/hands in my mind's eye.
V5 I figure out how the piece is structured by looking carefully through the score away from my instrument.
V6 I figure out how the piece is structured by playing and not by analysis.
V7 I make notes to myself on the sheetmusic.
V8 I use colours to mark my sheetmusic.
V9 I consult several editions of the piece and compare similarities and differences.
V10 I look at video recordings of other performers playing the same piece I am learning.
V11 One of my aims is to remember what my fingers/hands look like when playing the piece.
V12 I write out sections of the piece, either in full or in reduced notation.
V13 I draw graphic representations of the piece to make the structure clear.
V14 When I am struggling with a passage it helps when I sit away from my instrument and study the passage carefully.
V15 I read a lot of information about the piece I am playing.
V16 It is important to me to recognise patterns in the music that I am learning.

A1 If I feel that I will lose my place while I am practising, I sing or hum. along (aloud or internally) to help me concentrate.
A2 One of my aims is to be able to hear every note of the piece in my mind's ear.
A3 I play sections of the piece and then listen to those passages in my head without playing.
A4 I listen to audio recordings of other performers playing the same piece I am learning.
A5 I record myself and listen to my playing.
A6 I speak the rhythms of sections that I find difficult.
A7 I sing melodic material from the piece to myself when I am not playing.
A8 I hum melodies and/or rhythms to myself while playing.
A9 I talk to myself about details while I am working.
A10 I try to pay attention to phrasing and dynamics from the first reading.
A11 I talk to someone who has played the piece before.
A12 I find it hard to concentrate on my playing when I can hear other music playing
A13 I use a metronome while I am playing.
A14 I use a metronome to find the tempos, but not while I play.
A15 I count out loud to help me figure out difficult rhythms.
A16 When I am struggling with a passage it helps when I listen through the passage in my mind by imagining the sounds.

K1	When I am struggling with a passage it helps when I make the movements of playing the passage without making a sound.
K2	If I feel that I will lose my place while I am practising, I try to let my fingers play automatically.
K3	One of my aims is to be able to play the music automatically, without too much thought.
K4	One of my aims is to be able to think through the movements I will make while playing.
K5	I go through the motions of playing sections of the piece without making a sound.
K6	I stop playing and think through the movements I will make while playing.
K7	I make technical exercises from sections of the piece.
K8	I use conducting gestures or other bodily movements to help me find the right phrasing.
K9	I focus on technical demands in the early stages of practising, and work on musical shaping at a later stage.
K10	I try to find the parts that are technically difficult in order to focus on them.
K11	I try to play slowly in the early practice sessions.
K12	I find it hard to concentrate on my playing when the physical environment (seating, temperature, lighting) is not comfortable.
K13	I simplify difficult passages by taking away some of the notes.
K14	I tap my feet (or other body parts) while I play to help with rhythmical difficulties.
K15	I play passages from the piece using different rhythms in order to “get it in my fingers.”

O1	I read all the way through the piece once or twice before starting to work on sections.
O2	I read all the way through the piece many times and prefer not to work on smaller sections.
O3	I don't read all the way through the piece, but start working on sections immediately.
O4	I make a plan of how to approach my practice of the piece.
O5	I decide before each practice session what I would like to achieve.
O6	I use the sheetmusic of a new piece as a basis for improvisation before trying to learn it carefully.
O7	I improvise on the musical material of the piece after learning it.
O8	I play the music as it is written, without attempting improvisation.
O9	I keep a written record of my practising work, like a diary.

C) Participant invitation letter

Dear XXXX

I got your contact details from your teacher, XXXX, who suggested that you might want to participate in this research project. The project investigates the ways that pianists practice and especially looks at how pianists differ from each other in their use of their senses.

To investigate this, I hope to video tape 20 minutes of you practising a piece you are already working on, and then view it together with you while discussing what is happening. In total, one observation will take less than an hour, but I would like to do 4 different observations of you, using different repertoire, at different times. Ideally, I would like to look at you beginning to learn a piece from the Classical and Modern eras, and then also see how you work on these or similar pieces after learning them well, but we can discuss this further, based on your current repertoire. After the observations are finished I would like to review my analysis of your practising with you, and discuss it with you in an interview. In total I expect your involvement to amount to about 5 hours, possibly spread over a number of weeks or months, depending on our schedules.

As a sign of gratitude for your involvement I would like to offer you 2 movie tickets or 1 symphony concert ticket. You are free to turn down my request, and even after you have agreed to participate, you may leave the research project at any time, on request. Other students who have been involved in similar studies have usually reported that participation in such a study was a great benefit to them, giving them fresh perspectives on their work. I hope that the same would be true for you, and that it will be a fruitful opportunity to reflect on how you work.

I am doing this study for my Doctoral degree here at the Sibelius Academy, and will be the only one doing the observing and interviewing. I will be using the data gathered in my doctoral dissertation, in conference presentations and in academic papers. I will *not* use video footage or stills of your practising in these publications without your explicit consent, but I *will* use descriptions of your practising and quotes from the interviews. I will make every effort to ensure your anonymity in these publications, through using a pseudonym and through not referring to obviously descriptive data about you.

I sincerely hope that you will consider my request and that you will agree to participate.

I look forward to hearing your reply,

Yours,

Albi Odendaal

anodenda@siba.fi
+358 40 710 4308

Doctoral School of Music Education, Jazz and Folk Music, Sibelius Academy
Finnish Doctoral Programme for Music Research

D) Descriptive statistics for each item in the questionnaire

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
V1	130	1	6	3.61	1.422
V2	131	1	6	3.47	1.303
V3	130	2	6	5.22	.707
V4	130	1	6	3.16	1.305
V5	131	1	6	3.68	1.326
V6	130	2	6	4.62	1.037
V7	131	1	6	4.97	1.116
V8	130	1	6	2.09	1.332
V9	131	1	6	2.93	1.248
V10	131	1	6	3.53	1.361
V11	130	1	6	2.73	1.603
V12	130	1	6	1.52	1.006
V13	131	1	5	1.63	.978
V14	131	1	6	4.33	1.243
V15	131	1	6	3.17	1.247
V16	131	1	6	4.69	1.081
A1	129	1	6	3.53	1.329
A2	130	1	6	4.39	1.321
A3	131	1	6	3.86	1.299
A4	131	1	6	5.01	.965
A5	131	1	6	3.79	1.228
A6	127	1	6	3.78	1.506
A7	130	1	6	4.20	1.320
A8	130	1	6	3.63	1.526
A9	130	1	6	3.03	1.565
A10	131	2	6	4.90	.876
A11	131	1	6	3.97	1.074
A12	131	1	6	4.04	1.230
A13	131	1	6	4.09	1.153
A14	130	1	6	3.39	1.242

A15	131	1	6	4.43	1.183
A16	129	1	6	4.41	1.129
K1	130	1	6	3.45	1.392
K2	130	1	6	3.87	1.157
K3	131	1	6	3.94	1.492
K4	131	1	6	3.54	1.464
K5	130	1	6	2.78	1.443
K6	131	1	6	3.15	1.218
K7	131	1	6	4.40	1.352
K8	131	1	6	3.52	1.416
K9	130	1	6	3.84	1.435
K10	131	1	6	4.79	1.008
K11	129	2	6	5.34	.723
K12	131	1	6	4.13	1.255
K13	131	1	6	3.43	1.622
K14	131	1	6	4.02	1.342
K15	131	1	6	4.42	1.436
Valid N (listwise)	115				

E) SPSS outputs of the Varimax and Promax rotations for the 9 component solution used in the main analysis

1 Varimax

Rotated Component Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
V1	.093	.094	.253	.148	.526	-.247	.028	-.089	.205
V2	.122	.047	-.071	.148	-.092	-.072	.700	.022	.085
V3	-.126	-.117	.084	-.059	.235	-.031	.409	.024	.031
V4	.581	.069	.026	-.085	.050	.289	.088	.005	.084
V5	.105	.096	-.115	.718	.072	.086	.033	.161	.054
V6	.132	-.089	.020	-.682	.271	-.015	-.044	.166	-.161
V7	-.124	.165	.318	-.108	-.041	.054	.442	.366	-.046
V8	.147	.219	.530	-.059	.083	-.125	-.031	-.032	-.136
V9	.055	.671	.016	.052	.109	-.060	-.054	-.144	-.078
V10	-.046	.391	.024	-.042	.626	.108	-.051	-.074	.024
V11	.533	.247	-.040	.139	.116	-.406	.175	-.157	.207
V12	.110	.242	.265	.334	-.157	-.253	-.120	-.127	.184
V13	.255	.560	-.025	-.234	-.082	.155	.030	-.078	.094
V14	.215	.112	.298	.538	.014	.348	.250	-.059	-.299
V15	-.084	.694	-.020	.278	.083	.110	.028	.216	.067
V16	-.005	.098	-.001	.239	.158	.235	.098	-.242	.392
A1	.497	-.115	.050	-.031	-.046	.263	-.047	-.022	.473
A2	.153	.315	.231	-.016	.281	.265	-.029	-.427	.149
A3	.412	-.110	.074	.542	.215	.146	-.095	-.028	.076
A4	.061	.109	-.130	-.025	.599	.230	.082	.231	-.172
A5	-.077	.447	.062	.139	.356	-.083	-.107	.157	.177
A6	-.048	-.060	.750	.008	.038	.132	.063	.045	.143
A7	.146	.069	.000	.178	.079	.279	.087	.192	.651
A8	.192	.227	.066	-.179	-.198	.130	.294	.102	.476
A9	-.016	.312	.275	.149	-.112	-.116	.008	-.166	.539
A10	.090	.122	-.004	.092	.133	.710	-.086	-.075	.101

A11	-.024	.293	.403	.152	.092	-.121	.274	.061	-.268
A12	.072	-.022	.081	.167	.227	-.032	.597	-.079	.059
A13	-.049	.128	.157	.025	.117	-.047	.036	.747	-.040
A14	.203	.157	.197	.088	.064	.208	-.070	.170	-.395
A15	.074	.060	.646	.046	.015	.138	.181	.089	.206
A16	.215	-.173	.228	.196	.055	.570	.161	-.081	.107
K1	.473	-.002	.539	.133	-.018	.024	-.111	.245	-.180
K2	.337	-.132	.068	-.112	.393	-.009	-.014	.086	-.039
K3	.311	-.162	.010	-.056	.301	-.244	-.195	.482	.091
K4	.550	.389	.012	.102	.107	-.180	.223	-.265	.040
K5	.388	.082	.127	.306	-.113	.301	-.162	.369	.136
K6	.726	.219	.009	.247	-.076	.137	.127	.049	-.033
K7	-.031	.181	.125	.024	.424	-.102	.112	.433	.127
K8	.155	.498	.154	.116	.060	.078	.148	.219	.077
K9	-.113	-.132	.113	-.046	.286	-.544	.325	.244	-.098
K10	-.036	-.006	.042	-.028	.574	.040	.217	.020	-.168
K11	.007	.108	.268	-.122	.098	.027	.269	-.080	-.190
K12	.321	.090	.155	-.248	-.078	.033	.573	.036	.083
K13	.219	-.110	.286	.178	-.061	-.063	-.093	.104	.327
K14	-.202	-.129	.446	-.184	.129	-.029	.179	.219	.057
K15	.180	.436	.127	-.246	.010	-.067	.102	.360	-.094

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 18 iterations.

Component Transformation Matrix

Component	1	2	3	4	5	6	7	8	9
1	.519	.474	.416	.307	.244	.206	.260	.126	.229
2	-.267	.093	.293	-.368	.431	-.379	.298	.425	-.316
3	.176	-.717	.461	-.060	-.248	.249	.141	.304	.043
4	.135	-.122	-.202	.162	.481	.368	-.538	.361	-.336
5	.591	-.050	-.345	-.690	.115	.074	.144	-.110	.026
6	-.316	-.159	.030	.011	.410	.522	.410	-.501	-.119
7	.163	-.440	-.298	.398	.413	-.473	.216	-.020	.301
8	-.333	.028	.032	-.295	.227	.178	-.233	.188	.792
9	.154	-.119	.527	-.133	.242	-.287	-.493	-.531	-.026

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

2 Promax

Pattern Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
V1	.040	.016	.232	.075	.490	-.203	.004	-.067	.165
V2	.167	-.042	-.175	.213	-.091	-.140	.759	.017	.119
V3	-.119	-.167	.068	-.033	.243	-.030	.424	.006	.063
V4	.601	.014	-.034	-.149	.060	.266	.080	-.041	.075
V5	.073	.067	-.226	.762	.051	.052	.085	.207	.050
V6	.179	-.053	.050	-.719	.290	.003	-.091	.119	-.146
V7	-.149	.141	.280	-.077	-.062	.003	.387	.358	.015
V8	.095	.167	.545	-.153	.036	-.119	-.134	-.046	-.176
V9	.043	.686	-.042	.001	.113	-.040	-.130	-.101	-.109
V10	-.076	.399	-.009	-.103	.653	.181	-.113	-.057	.017
V11	.561	.148	-.145	.087	.078	-.434	.199	-.127	.146
V12	.048	.190	.257	.279	-.216	-.262	-.149	-.082	.131
V13	.265	.572	-.068	-.293	-.061	.152	-.037	-.071	.091
V14	.182	.028	.222	.522	.008	.317	.227	-.094	-.311
V15	-.131	.730	-.119	.286	.080	.098	-.032	.287	.087
V16	-.049	.048	-.007	.207	.179	.274	.116	-.233	.394
A1	.477	-.177	.045	-.105	-.052	.255	-.027	-.050	.465
A2	.108	.260	.251	-.135	.306	.337	-.097	-.450	.113
A3	.377	-.189	.008	.499	.191	.140	-.060	-.034	.032
A4	.075	.128	-.209	-.018	.634	.253	.069	.221	-.144
A5	-.135	.464	.012	.108	.338	-.055	-.161	.220	.174
A6	-.160	-.139	.825	-.080	-.013	.146	-.031	.010	.144
A7	.084	.031	-.038	.161	.072	.272	.110	.217	.688
A8	.178	.188	.036	-.199	-.201	.094	.282	.106	.514
A9	-.099	.256	.296	.081	-.151	-.100	-.029	-.119	.519
A10	.053	.133	-.004	.049	.188	.749	-.114	-.112	.126
A11	-.057	.239	.356	.134	.057	-.144	.201	.063	-.276
A12	.087	-.128	.007	.188	.230	-.051	.632	-.096	.076

A13	-.088	.167	.087	.070	.069	-.107	-.006	.784	.014
A14	.194	.161	.153	.061	.056	.187	-.132	.144	-.404
A15	-.021	-.029	.673	-.031	-.032	.130	.101	.064	.213
A16	.175	-.247	.229	.155	.076	.574	.161	-.145	.124
K1	.422	-.070	.512	.049	-.088	-.022	-.184	.212	-.218
K2	.349	-.172	.037	-.161	.385	.000	-.018	.055	-.057
K3	.307	-.162	-.040	-.069	.249	-.271	-.185	.501	.083
K4	.583	.293	-.094	.032	.095	-.199	.214	-.260	-.019
K5	.338	.070	.062	.281	-.147	.250	-.177	.375	.141
K6	.751	.142	-.121	.202	-.094	.071	.132	.032	-.066
K7	-.071	.176	.058	.028	.394	-.110	.080	.469	.157
K8	.119	.481	.066	.092	.041	.048	.087	.249	.089
K9	-.096	-.175	.071	.000	.240	-.571	.342	.265	-.093
K10	-.028	-.036	.002	-.034	.595	.075	.206	-.001	-.158
K11	.006	.064	.264	-.149	.099	.028	.218	-.114	-.187
K12	.358	.002	.095	-.260	-.079	-.021	.564	-.007	.110
K13	.156	-.171	.296	.127	-.118	-.081	-.097	.112	.307
K14	-.257	-.160	.496	-.200	.097	-.027	.125	.198	.090
K15	.184	.456	.056	-.262	-.011	-.112	.024	.377	-.075

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 18 iterations.

Structure Matrix

	Component								
	1	2	3	4	5	6	7	8	9
V1	.159	.134	.334	.211	.574	-.311	-.002	-.099	.238
V2	.132	.128	.058	.119	-.064	-.051	.661	.002	.077
V3	-.121	-.070	.117	-.076	.236	-.039	.400	.054	.000
V4	.593	.094	.115	-.029	.042	.287	.084	.043	.113
V5	.189	.116	.021	.711	.105	.088	-.020	.098	.095
V6	.057	-.133	-.043	-.670	.229	-.006	.004	.248	-.191
V7	-.065	.209	.363	-.117	-.029	.085	.514	.395	-.097
V8	.207	.262	.546	.011	.124	-.136	.034	.005	-.121
V9	.122	.670	.107	.113	.144	-.098	.000	-.182	-.026
V10	.022	.383	.103	.021	.627	.034	-.018	-.061	.053
V11	.546	.292	.108	.196	.185	-.431	.106	-.217	.279
V12	.183	.278	.312	.385	-.089	-.274	-.131	-.190	.228
V13	.291	.555	.047	-.170	-.076	.133	.087	-.089	.124
V14	.311	.199	.419	.566	.037	.361	.274	-.018	-.270
V15	.037	.684	.110	.312	.114	.087	.084	.151	.095
V16	.065	.137	.070	.278	.166	.173	.063	-.266	.412
A1	.518	-.095	.097	.027	-.050	.242	-.091	-.017	.492
A2	.227	.359	.289	.083	.290	.186	.000	-.396	.191
A3	.474	-.072	.183	.583	.241	.128	-.159	-.035	.131
A4	.086	.089	-.045	-.016	.570	.211	.099	.275	-.168
A5	.017	.430	.148	.186	.388	-.132	-.084	.109	.203
A6	.052	.014	.727	.069	.063	.114	.125	.106	.111
A7	.233	.084	.092	.214	.085	.241	.049	.150	.649
A8	.235	.258	.133	-.145	-.186	.121	.303	.079	.463
A9	.080	.355	.322	.215	-.056	-.171	.003	-.233	.559
A10	.158	.124	.036	.136	.087	.675	-.053	-.030	.108
A11	.052	.356	.478	.179	.139	-.114	.334	.081	-.263
A12	.105	.067	.201	.165	.253	-.044	.561	-.066	.057
A13	.011	.097	.201	.007	.127	-.005	.087	.741	-.076
A14	.242	.161	.237	.113	.061	.236	-.006	.222	-.380
A15	.181	.138	.679	.109	.048	.123	.233	.130	.185
A16	.276	-.110	.277	.231	.033	.557	.161	-.015	.103

K1	.535	.038	.581	.195	.017	.055	-.069	.294	-.159
K2	.326	-.128	.109	-.079	.389	-.020	-.032	.132	-.023
K3	.301	-.204	.038	-.047	.312	-.228	-.228	.475	.097
K4	.579	.446	.172	.175	.163	-.208	.196	-.291	.115
K5	.467	.080	.205	.341	-.103	.324	-.155	.359	.156
K6	.764	.261	.169	.302	-.045	.156	.107	.044	.030
K7	.039	.176	.208	.040	.444	-.117	.130	.422	.116
K8	.252	.519	.278	.163	.094	.069	.197	.196	.096
K9	-.133	-.106	.142	-.081	.325	-.527	.300	.238	-.121
K10	-.019	.015	.102	-.019	.566	.013	.222	.071	-.169
K11	.028	.158	.293	-.101	.106	.026	.317	-.028	-.199
K12	.323	.163	.242	-.228	-.065	.051	.587	.072	.068
K13	.270	-.081	.307	.217	-.027	-.071	-.122	.085	.336
K14	-.164	-.095	.408	-.179	.133	-.027	.227	.269	.002
K15	.215	.423	.191	-.216	.028	-.045	.178	.363	-.095

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

Component Correlation Matrix

Component	1	2	3	4	5	6	7	8	9
1	1.000	.146	.264	.190	.072	.065	-.032	.049	.136
2	.146	1.000	.232	.125	.049	-.038	.203	-.118	.058
3	.264	.232	1.000	.219	.143	-.015	.210	.093	.023
4	.190	.125	.219	1.000	.105	.003	-.108	-.123	.104
5	.072	.049	.143	.105	1.000	-.162	-.012	.024	.049
6	.065	-.038	-.015	.003	-.162	1.000	.090	.164	-.102
7	-.032	.203	.210	-.108	-.012	.090	1.000	.075	-.115
8	.049	-.118	.093	-.123	.024	.164	.075	1.000	-.143
9	.136	.058	.023	.104	.049	-.102	-.115	-.143	1.000

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

F) Results of two alternative principal components analyses, one using only variables with communalities above .5, and the other using only variables that share common wordings.

A principal components extraction using the same 14 items that were used in the cluster analysis (V1, V2, V3, V11, V14, A1, A2, A12, A16, K1, K2, K3, K4, K12). These variables can be grouped into four groups, each group having very similar wordings with only a change in modality focus between them. Perceptual learning style predicts that the modalities will group together. However, in this analysis, the grouping mostly happened according to the similarity of the wording groups rather than to similarity of the modalities. Five components were extracted.

Component 1 describes aims, including remembering the score, hands, movements and sound of the piece.

Component 2 describes strategies for overcoming difficulty together with aiming to hear every note of the piece.

Component 3 describes distractions from concentration.

Component 4 describes a movement focus, incorporating playing automatically with soundless playing.

Component 5 describes a focus on notation together with vocalisation as a strategy for aiding concentration.

5			V3	0.709		V1	0.481		A1	-0.608				
4			K3	0.849		K2	0.535		K1	0.384				
3			A12	0.727		K12	0.685		V2	0.676				
2			A16	0.781		V14	0.747		K1	0.62		A2	0.402	
1			V11	0.849		K4	0.73		V1	0.569		A2	0.433	

1		2		3		4		5		6		7		8		9	
K4	0.8	A10	0.725	V5	0.746	A6	0.803	A13	0.65	A7	0.632	V15	0.685	A4	0.86	V2	0.694
K6	0.754	A16	0.614	V14	0.627	A15	0.79	K1	0.628	A1	0.62	V9	0.663	V10	0.724	K12	0.637
V11	0.65	V14	0.519	A3	0.589			K3	0.582	A9	0.546						
		K9	-0.627	V6	-0.67			K5	0.568								

Principal components analysis conducted with variables with communalities >.5. Nine components were extracted, showing some difference in the order of extraction from the principal components extraction discussed in the body of the thesis, which used all the variables. The component loadings also vary, and therefore some variables are dropped and others added, but the extraction still offers no support for the perceptual learning style theory.

Component 1 corresponds to movement imagery (Comp1), but without V4.

Component 2 corresponds to musical shaping (Comp6) but without K9.

Component 3 corresponds to reflection apart from playing (Comp4).

Component 4 corresponds to simplification (Comp3) but without K1 and V8.

Component 5 corresponds to metronome use (Comp8) but with K1 and K5 added.

Component 6 corresponds to vocalisation (Comp9) but without A8 and with A1 added.

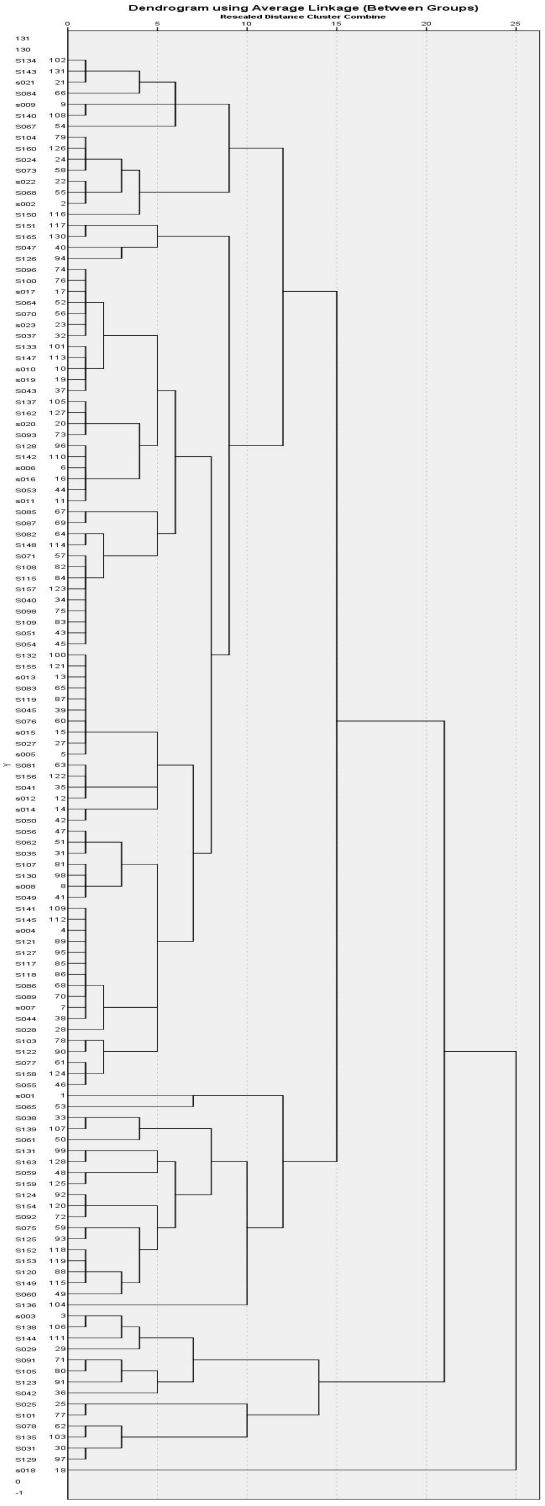
Component 7 corresponds to research (Comp2) but without V13.

Component 8 corresponds to scouting out (Comp5) but without K10.

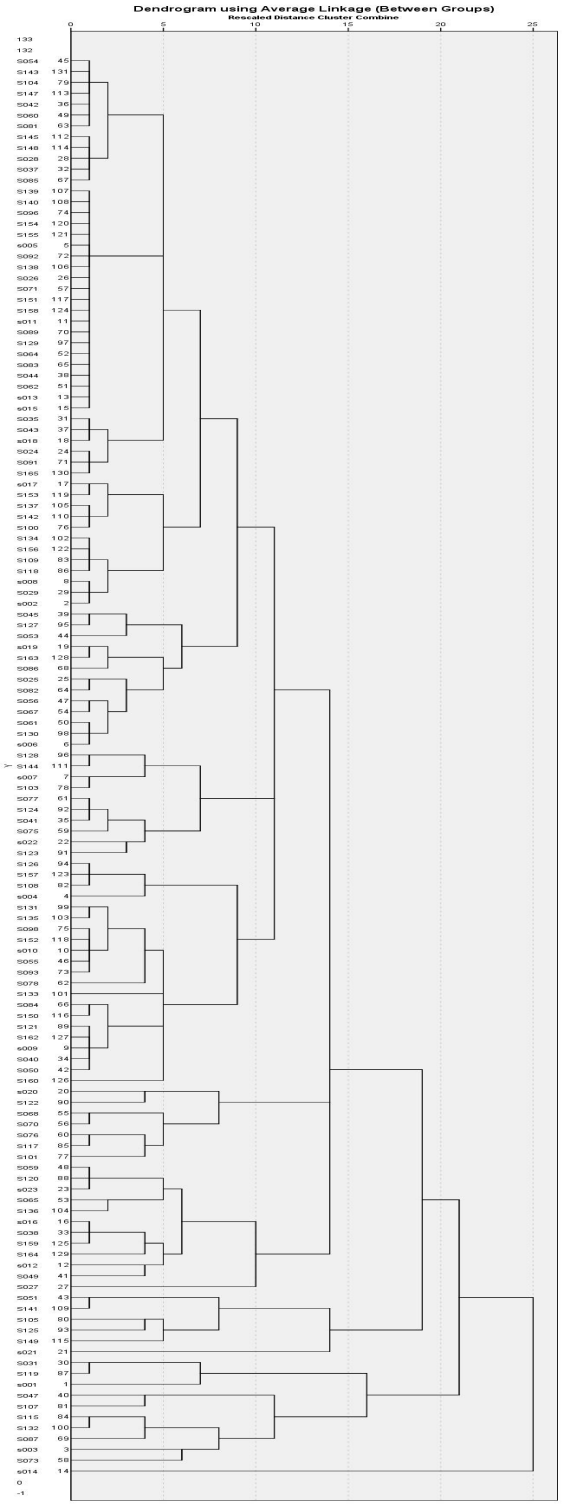
Component 9 corresponds to distraction (Comp7) but without A12.

G) Three other dendrograms calculated and analysed in cluster analysis

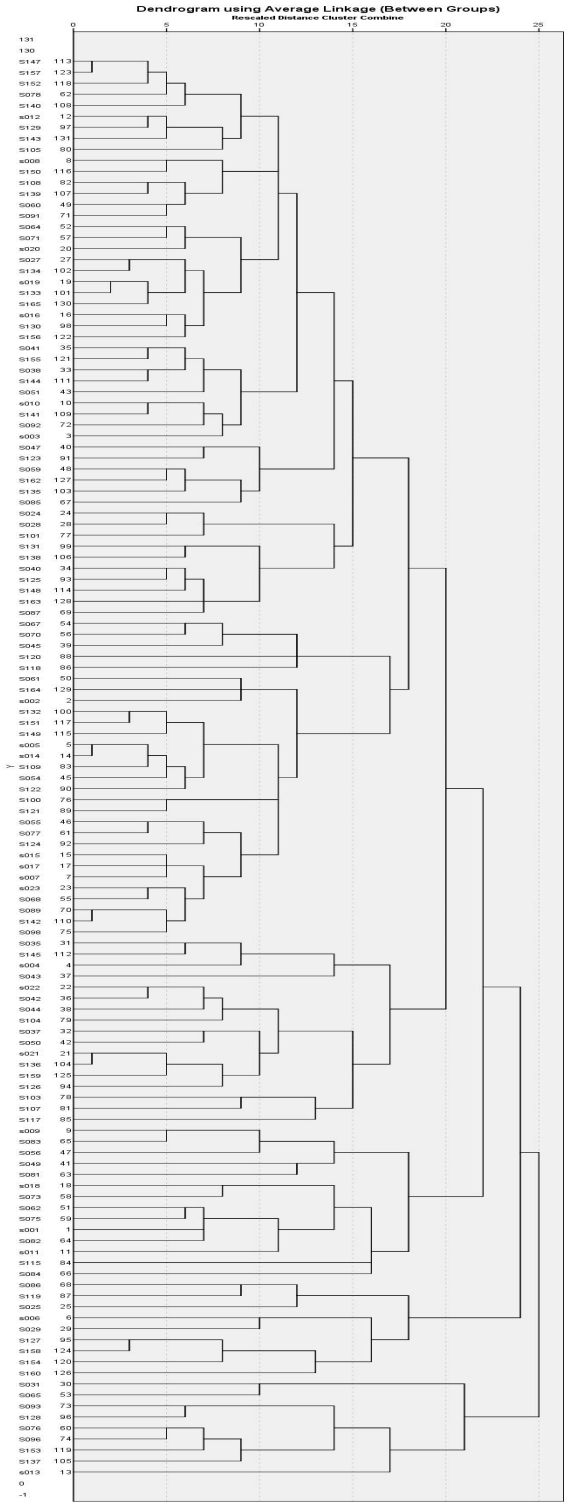
Dendrogram plotting the relationships between responses on items V3 (If I feel that I will lose my place while I am practising, I look at the notation as a reminder), A1 (If I feel that I will lose my place while I am practising, I sing or hum. along (aloud or internally) to help me concentrate) and K2 (If I feel that I will lose my place while I am practising, I try to let my fingers play automatically). This dendrogram comes closest to plotting something akin to the three categories of perceptual learning style theory of all the dendrograms plotted. The structure is more clumped than chained, and could be interpreted to form 3 categories, with some sub-division. However, none of the categories thus formed corresponded to categories from any of the other dendrograms.



Dendrogram plotting the relationships between responses on items V2 (I find it hard to concentrate on my playing when I seemovement in the room), A12 (I find it hard to concentrate on my playing when I can hear other music playing) and K12 (I find it hard to concentrate on my playing when the physical environment (seating, temperature, lighting) is not comfortable). This dendrogram has the highest amount of similar responses of all the plotted dendrograms, but still no structure that could be predicted by perceptual learning style theory.



Dendrogram plotting relationships between responses on items V1 (One of my aims is to be able to visualise the score in my mind's eye), V11 (One of my aims is to remember what my fingers/hands look like when playing the piece), A2 (One of my aims is to be able to hear every note of the piece in my mind's ear), K3 (One of my aims is to be able to play the music automatically, without too much thought), and K4 (One of my aims is to be able to think through the movements I will make while playing). This dendrogram shows many nested clusters, and no great similarity between any large grouping of respondents.



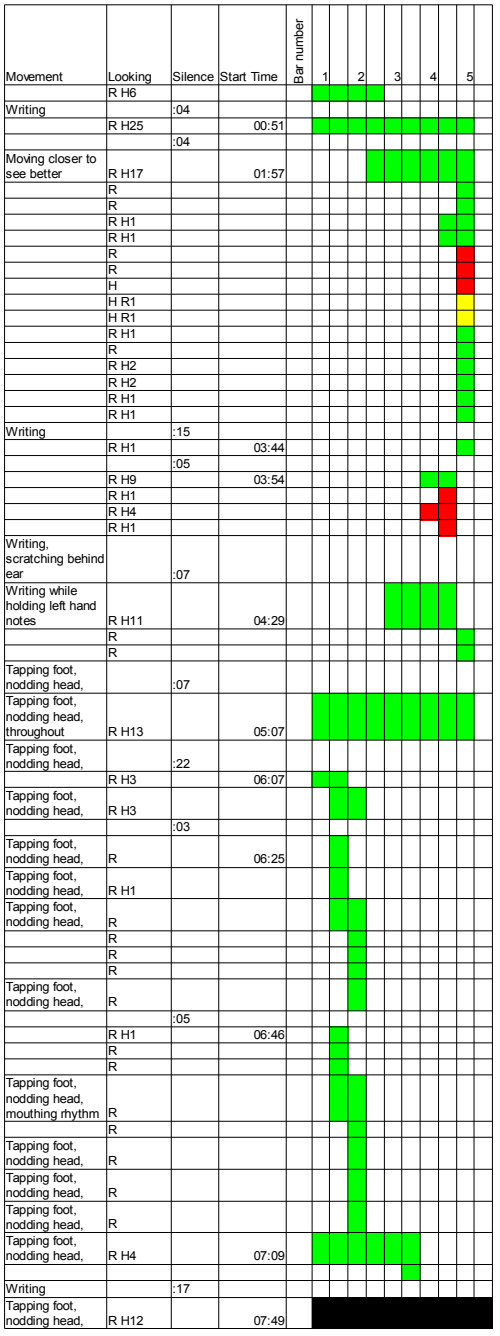
H) Tabulation of observation and interview dates and lengths

A tabulation of observation and interview dates for each of the works in the study. Lengths of the observation sessions are given together with the number of words in each interview. The observations amounted to 514 minutes, or just over 8 and a half hours. The interview transcriptions comprised a total of 45294 words.

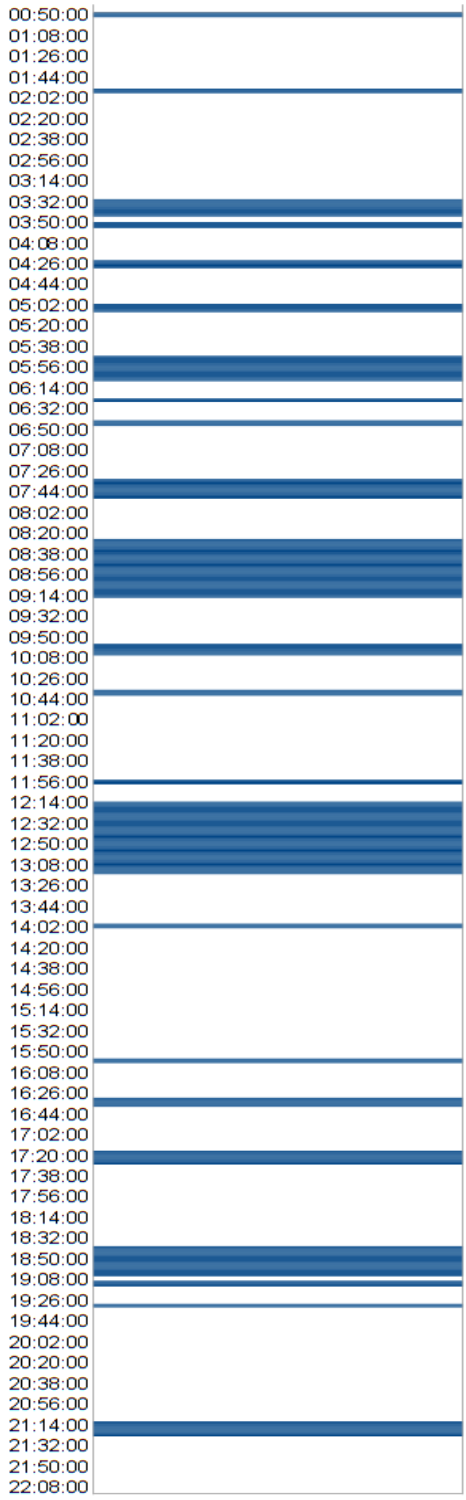
Participant	Work	Date	Length of observation	Number of words in interview	Work	Date	Length of observation	Number of words in interview	Total words and observation per person
Carlos	Clementi	05 April 2012	22 mins	2484	O'Byrne	10 April 2012	25 mins	1900	90 mins
		25 May 2012	20 mins	2429		21 July 2012	23 mins	2690	9503 words
Khatia	Bach	02 April 2012	25 mins	1404	Franck	26 March 2012	22 mins	1651	92 mins
		30 April 2012	23 mins	1083		30 April 2012	22 mins	844	4982 words
Martha	Beethoven	13 March 2012	25 mins	1748	Duttileux	10 April 2012	22 mins	1551	90 mins
		08 May 2012	22 mins	1529		01 June 2012	21 mins	1316	6144 words
Mauricio	Beethoven	13 December 2011	20 mins	4093	Bach	26 April 2012	19 mins	1987	79 mins
		11 April 2012	20 mins	2706		28 July 2012	20 mins	2173	10959 words
Rosalyn	Beethoven	09 March 2012	24 mins	2800	Brahms	25 April 2012	22 mins	2004	72 mins
		No second interview	---	---		03 August 2012	26 mins	3801	8605 words
Vladimir	Beethoven	11 April 2012	23 mins	1670	Ravel	12 April 2012	21 mins	372 (partial interview recording)	91 mins
		21 May 2012	25 mins	1437		22 May 2012	22 mins	1622	5101 words
Total			**249 mins**	**20276**			**265 mins**	**20289**	

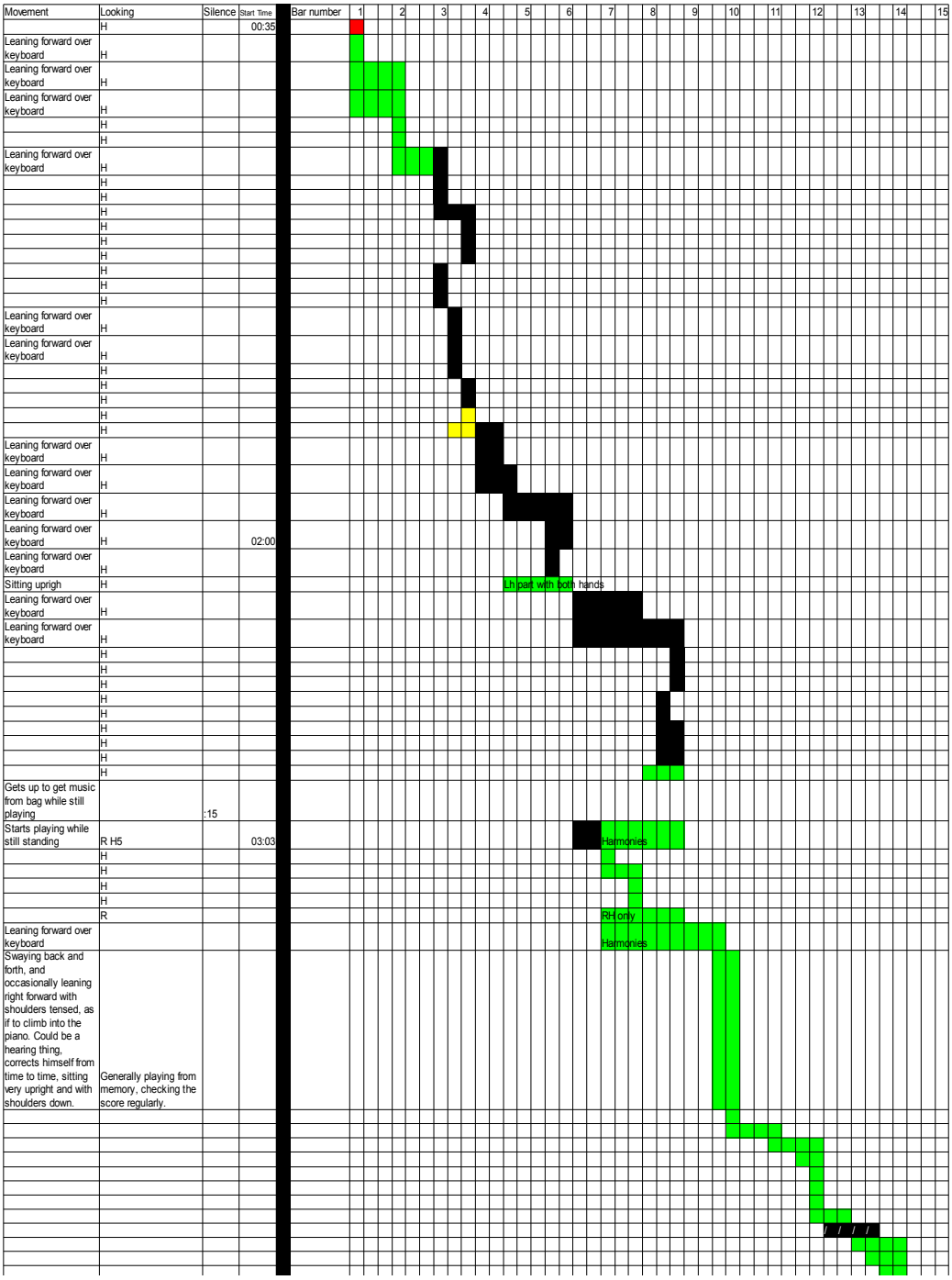
I) Two examples of the graphic coding of video data and of timelines of playing vs. not playing in a practising session.

The first seven minutes of Martha's first session with the Dutilleux. Blocks marked green refer to a simplification of the texture or rhythm. Blocks marked red refer to using of the right hand alone, and yellow to the left hand alone. Blocks marked black refer to attempting to play in the target tempo with both hands. The code in the looking column refers to reading (R) and looking at hands (H). The first letter is the predominant activity, and the number refers to the amount of alternation between the two.



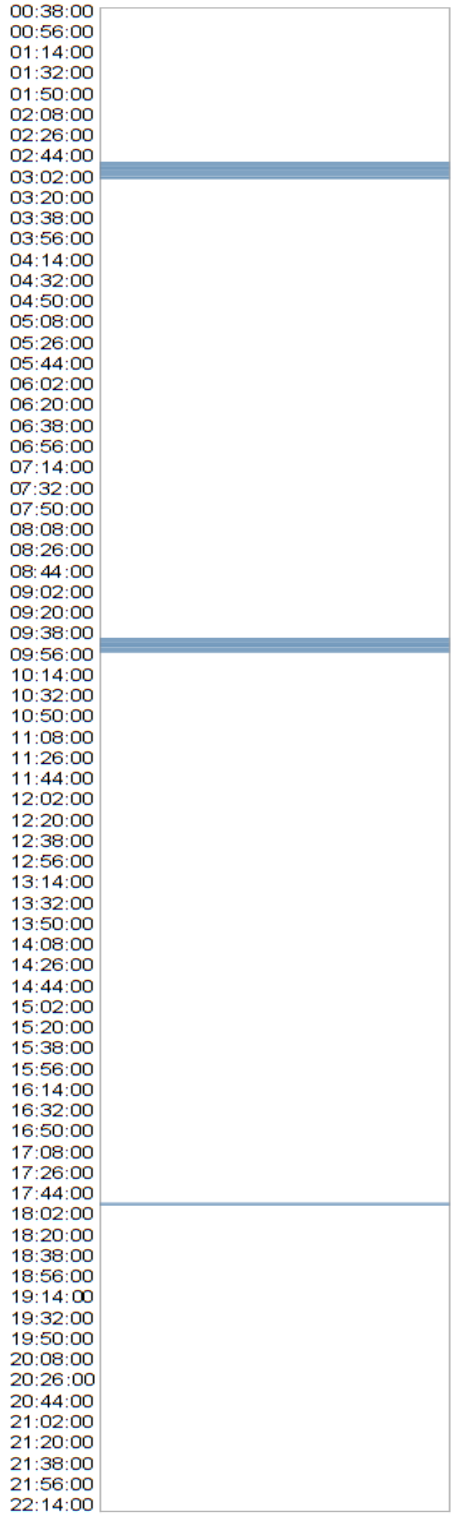
From Martha's first session with the Dutilleux, a time-line plot of the relationship between playing (white) and not playing (blue). Contrast with Carlos' below for the amount of pausing.





The first three or so minutes of Carlos' first session with the Clementi. Blocks marked green refer to a simplification of the texture or rhythm. Blocks marked red refer to using of the right hand alone, and yellow to the left hand alone. Blocks marked black refer to attempting to play in the target tempo with both hands. Blocks with slashes (/) in them mean playing slower than target tempo. Carlos only fetches the score after 3 minutes and mostly looks at his hands.

From Carlos' first session with the Clementi, a time-line plot of the relationship between playing (white) and not playing (blue). Contrast with Martha's above for the amount of pausing.



J) The vignettes composed after analysis of the video and interview data

Carlos

The four sessions observed were each quite different in approach. Generally in these sessions Carlos tended to follow a similar working pattern, consisting of working on small details in a highly repetitive fashion. It was common for Carlos to play half a bar at a time, to repeat a chord ten or fifteen times with different kinds of attack or balance, and to work his way slowly through a passage, playing a bar or less at a time, and often overlapping these short sections in order to pay attention to the connections between each event and the one following it. Longer uninterrupted runs were very rare in these sessions. The first session with the O'Byrne added a striking difference in that it involved long periods of looking at the score, analysing and memorising it prior to attempting to play it, using mental practice. Slightly less than half the session was devoted to this kind of study, while the other half consisted of playing through the memorised passages. The goal here seemed clearly to be able to play the passage in question, and through the session it is noticeable that the runs get more fluent. Another difference was the second Clementi session, where he was clearly highly frustrated with his inability to attain the nuance he was looking for. He had recorded the piece two weeks prior and had not played it since that time. Thus his motivation levels were lower than for the other sessions, and he was addressing this issue throughout the interview.

He spoke of two processes, knowing what you want, and knowing how to execute it. They are not separate, and inform each other. Sometimes they are explored through playing and sometimes by exploring an inner soundscape or emotional state. “And then I already have this idea to phrase the first, kind of what to do with the beginning but then I just have to find it.” Part of his frustration with the second Clementi session was that he was “not really sure what [he wanted] - and that is even worse.” He spoke of “finding the sound”, this happened through experimentation with different attacks, different finger angles, different movements, different amounts of finger action. “And then after that, after I have found the sound, then I try to see if how can I do it. Just to be aware of what did I do, and then kind of concentrate on how did I do it and then it sticks to the memory much faster than just when, I think, if you would be relying on only kinetic memory. I don't know where I, kind of the spot where I save this information is different, I don't know where is it but...” So there is a physical exploration, but that is then coupled with an analytical understanding which allows him a more secure memory. He also spoke of finding the “idea” of a piece, and that this can be done walking or riding the tram. The “idea” has to do with the phrase structure and the sound and emotion of the piece, but is more abstract than those facets alone. So there is a physical experimentation that leads to finding the sound, and another, abstract, experimentation that leads to the “idea” of the piece.

Throughout these practising sessions, his tempo was predominantly slow, but tended to vary a lot. Within one continuous section he could move from playing *a tempo* to a very slow rendition of one or two beats. These slow renditions are also often highly repetitive. “There are some occasions […] where I just repeat some chord some little while just to hear that the melody actually fits [...] the bass, so that [… it] is kind of inside the sound.” The slowness of

much of the playing was strongly related to his preoccupation with sound. He was determined to listen to every detail, both in terms of phrasing and line and connection between harmonies – what he called the structure, and in terms of what he called the interval – the sonic relationship between the bass and the melody. His aim in playing slowly was "to concentrate and listen to the sound, [...] you know, instead of kind of listening or just being aware, 'Ok, the attack is there,' but then not listening to what comes after: the actual sound."

This preoccupation with the sound was a fairly recent development for him, and one of the main difficulties in re-learning the Clementi. Previously his concern had been more technical, "I was just too […] focussed on the actual technique, not the sound." He had changed his technique and his orientation towards sound in the years intervening his previous performances of this work, and this caused serious difficulty for him in this work. As a result he found that, since he had first learned this work in a different state of mind and with a different technique, he was reverting to that previous state when playing it. Moreover, the previous state was also affecting the other pieces that he was practising. "If I played [the Clementi] and then practised some other pieces, some new ones, the old technique has moved to even the new pieces. Some days [...] I thought I can't play anymore. And then I took a pause, just didn't play [the Clementi] for a day or two - playing just other pieces, and then it started to feel [...] easier again."

Throughout the practising sessions he can also be seen to move his upper body a considerable amount. At times he leans right over the keyboard, his back bent and his head low near the top of the fallboard, at other times he sways from side to side. He was surprised to see how much movement he was making, saying that it was "maybe too much, I need to get all this movement into the music." His experience of the music was very physical, and expressed physically. He also described how he "used to have this bad habit of when I wanted a line I would do it with just tensing my wrist," another expression of the same tendency to have strong physical expressions of musical emotions. There is a strong connection with really intense slow practice and the bent over position that he assumes. From investigating his practising it seems that especially when he tries to listen, playing very slowly and intensely, he tends to lean forward and to put his head near the sound source. So, while some movement is related to strong physical experiences of emotion, others seem to be related to a desire to hear more. He is also working to eradicate these kinds of movements from his playing, wanting the emotion to be expressed musically rather than through movements unrelated to the playing, and can be seen 'correcting' his posture and shoulder position several times during the sessions. This takes the form of a sudden change to upright posture and a sudden drop of the shoulders from a raised position. He noted that it was "difficult to remember, difficult to notice" these physical positions, which he described as "bad posture."

Another element to the physicality of his playing was that he had an aim of avoiding "letting the physical limits, the physical movements affect the way I phrase." He wanted to get the "physical part of it as far away from the music making as possible." By this he seemed to mean that if he would be able to think in purely sonic terms, understanding the phrasing and musicality of the piece, the physical means of execution would follow. He gave one example of this in the second O'Byrne practice. Near the end of the session, he asked that we go back to where he is practising a fast passage consisting of single notes and clusters descending in a kind of zig-zag pattern. He pointed out that the first attempt of this was "without the feeling of the overall shape, the second one was with it, and when that happens I somehow, I don't really pay attention to how I move my hand, and then for some reason it becomes much faster." If he is able to really concentrate "it is just the sound" that is foremost in his mind. However, it should

not be imagined that he is flippant about the physicality of playing, he is very mindful of what his fingers do, and spoke a lot about the importance of feeling the finger move to the bottom of the key, and being aware of that vertical element to playing. It seems that he feels that, as important as that verticality is, it needs to be superseded by the musical, the horizontal aspect of playing in order to be truly in its right place. “It should go in this order: [...] you are listening to the previous sound, [...] after the previous sound you feel the next keys under the finger, then you must imagine what this next sound should sound like in connection to the previous one and then playing it - [...] being aware of the finger movement. [...] The whole journey from the top to the bottom of the key just somehow feeling it just a short while and then just listen to the sound if it is right and relaxing.”

A final aspect of his use of movement emerged in the first O'Byrne session, where he used mental practising techniques. After looking at the score for some time, he then usually took some time walking slowly to the keyboard, clearly still pensive, or otherwise walking around a bit. “When I am looking at the score, it's of course easy to remember what is in there but then I need to kind of, it needs to be in my head, that's why I like to walk around a bit and think, [...] what are the chords, how to approach the piano and what is the sound.” It is interesting to note that he seems to need to move in order to accomplish this task. Movement seems to facilitate his thinking process, as it does his emotive and expressive processes. He can also often in this session be seen making conducting gestures, or swaying gently while reading the score.

During these mental practice sessions, he reads the score and tells himself what he sees. He looks for patterns in the melodies and harmonies and relates them to things that he knows well, grouping them together if possible. Even in music not based on a tonal system, he tends to relate harmonies and melodies to tonal centres. They can be “chords that are close to something. Or a chord that is 'that' but then you have 'this and this' added. [...] Another thing that is quite common is combinations of chords. It is something that is here [… points to the score] the easiest way to remember this is, that is D seven chord and then the e minor under it.” He puts the unfamiliar in familiar categories, and going through this process improves the quality of leaning “because otherwise there might be some things [...] when I'm playing I feel can't, especially when it's complicated... I can't necessarily concentrate on everything.” The mental practice is thus an important reduction of complexity exercise, allowing him to concentrate more clearly on the sound and movement when he gets to the piano, rather than having to spend time reading and figuring out at the piano.

Throughout three of the sessions he played completely from memory, and in the fourth (the first Clementi session) he had the sheet music flat in front of him on the grand piano, rather than standing up on the music stand. This is a different kind of relationship to the sheet music than the other participants. He also did not write anything on the music “not even fingerings”. His teacher sometimes made notes, but he would only write after he had performed the piece and is listening to the recordings. Then he might write down some things to pay attention to. His sheet music consisted of loose printouts of the two pieces. He does not aim to remember what the score looks like at all, but rather the positions of the hand.

When learning a new work, he says that hearing is the most important first step. He knows this because of an experiment that he did with his teacher, preparing a piece without listening to it or playing it, purely through mental practice. This helped him in several ways, one realisation was that “I need to hear it, hear the piece:” this enables him to have the sound in his mind, and then he can play with phrase lengths and directions while going about his daily business. He

uses recordings in the very early stages to help his learning, although he is weary of using recordings too much, and stops when he starts to play the piece. He remembers the difficulty he had when learning a very well known piece: “I found really difficult - because you hear it a lot - just to get the feeling that it's your piece, it's my piece, it took some months.” He does however experiment with recording himself during his practice sessions, as a tool to help his learning.

Khatia

Khatia did not listen to any recording of the Bach either before or during her learning of the work, but had heard it performed by colleagues and was familiar with it. Even though she was not familiar with the Franck, she had only listened to it once before starting to learn it. She avoided listening to other interpretations of the work because of her desire to find her own interpretation of the music. She recorded herself during public performances in order to review her playing, but had not made it a habit to record practising, and found the process of this research very helpful, both in terms of the immediate feedback on her playing, and in terms of the use of recording as a learning tool during practice. For her, to join in this research opened a new strategy which she will “have to do” because “it is very useful”. She used the interview sessions as ways of getting feedback on her own playing, often remarking on some details that she had overlooked while practising and that she needed to work on. Her comments on her own playing were not so much a meta-narrative of thought processes as a critique of playing.

An intentional organisational strategy is for her to play through a section, identify difficulties and then isolate those. This is clear from the graphs where she almost invariably plays through a section, works on some aspect of it, and then plays through it again. A clear example is in the second Bach session, where she systematically works on a problem section by isolating different aspects of it - playing short sections with the left hand only separate and then applying different rhythmical variations to the material. She then proceeds to play through the problem section, continuing onto the material that follows, and then makes sure of the approach by playing some bars before the problem section. She concludes by playing the whole section again with hands together. In the first observation of the same work she seems to be attempting to play through the movement but then stops at various points when something troubles her. Each of these disruptions happened on transition sections between different textures, but she rather focussed her comments on dynamic aspects, a desired *subito piano*, and perceived unevenness. She worked on unevenness by regularly using rhythmic variation of passages in order to develop her muscles, especially in passages that are scalar or arpeggiated.

She plays almost without stopping during the observed sessions, often switching the metronome on or off while the last notes of the previous section are still being played. She makes very fast transitions between practising different sections, hardly ever pausing for anything other than rearranging music or switching the metronome on or off. During her practising her attention was focussed on specific issues, and while watching the video she became aware of several other aspects of her playing. For example she noticed chords that are not sounding together, the movement of her arms and hands that are counter-productive to sound production, tempi she did not like or rhythms that were not to her liking. While her practising is structured, as discussed earlier, it seems that there would be a level of metacognition that is missing in these rapid moves from one thing to another, unless she is incredibly fast at recognising problems and finding solutions to them.

In the early sessions she was focussing mainly on the tempo, “because I rush very much”, often using a metronome and externalisations of the pulse such as tapping her feet, nodding her head, bouncing her torso in order to try and gain control. Her goal was to be able to play in regular pulse without any help, either from the metronome or from putting the beat in her body somewhere, “it does not fit here, in Bach.” However, playing without the metronome made her feel “not safe” in these earlier practice sessions, and she relied heavily on it. When the metronome is playing she doesn't “have to remember the tempo or something and it [helps her] because [she knows] how much time [she has] in one bar.” A further reason for using the metronome was that it forced her to keep going when little slips happened. So this helped here prepare for the examination situation where she was expected to keep going despite what happens. For her the sound of metronome is in the background while she practices and she rather tries to pay attention to the music and its flow. She tends to work with the metronome in larger sections rather than for small technique-oriented work. Her reliance on these measures was drastically reduced in the later sessions, where she still used the metronome once or twice while playing, and occasionally tapped her foot (usually together with the metronome), but she seemed to find ways of controlling the pulse internally.

In the early sessions she can also often be heard singing with some melody, or seen mouthing something (probably rhythms or melodies) too softly for the camera to pick up. In the Bach this is often together with contrapuntal figurations where she is trying to accentuate one voice over another. She also once sang each of the first notes of a series of descending sequences, trying to hear the larger line inherent in the material. In the Franck she sang with the more melodic parts, giving expression to the desired phrasing, while also another time highlighting a difficult hidden melody by singing it. She was ambivalent towards this strategy, noting that it does help her with phrasing, but not in every case, laughingly pointing out that “sometimes it is not useful”. Singing of this kind happened noticeably less in the later sessions.

Her memorisation process for these works consisted of reading through the pieces, and then analysing them structurally, and harmonically in some places, especially in the Franck whose harmonic language was unfamiliar and “difficult” for her. She also relied heavily on finger memory in addition to the analytical work, acknowledging that in the Bach fugue she had not been able to develop as clear an analytical memory as she would perhaps want. She works at memorisation with the score in front of her, trying to remember sections, but having the option to check where she goes wrong. She described her memory as a mixture of consciously trying to remember what parts of the score look like, what her hands look like on the keyboard, some parts of the harmonic analysis she conducted and the memory of finger movements. In the earlier sessions, when trying to play through a section by memory, she usually glances at the music 3 or 4 times in the first couple of bars. This kind of orientation behaviour confirms her reliance on what the score looks like. Another telling incident happened in the Franck where she had a brief concentration lapse and could not remember the exact notes of a short ascending passage that was notated in the first bar of the next page. After trying a couple of times, unsuccessfully, to remember, she flipped the page and remembered the notes, but throughout she is clearly looking only at the keyboard. There are several explanations possible for this, but it brings to mind the kind of mental rotation exercises in which it takes an individual time to mentally traverse from one part of a structure to another. Perhaps she has an image of the notation in her head, but is unable to access it without physically turning the page. (but this is a big conjecture on my part) This does fit with her description of consciously trying to remember what the page looks like.

Despite this strong visual memory for the score, she does not like writing too much on it, and neither does her teacher (partly because it is the libraries copy). She wrote some chord symbols quite small and in light pencil in the score but nothing else. One of her previous teachers wrote copiously, especially for Bach, and that helped her when she was getting familiar with the style and form of the music, but now that she has familiarity, she no longer feels like she needs to follow that route. She also does not make notes of her teachers comments, preferring to carry them in her memory.

Martha

Martha did not listen to these works prior to starting to work on them, and also did not consider listening to recordings of others as a tool that aids learning. She emphasised that she knew both pieces well from hearing them performed on several occasions, and that she always "kind of know[s] it in some way" when starting a piece. "Why [would] I start a piece that I don't know?" Particularly the Beethoven was familiar to her, she was able to hum parts of the music prior to starting to learn to play it, and acknowledged that she was partly playing by ear. With the Dutilleux, however, even though she had listened to it many times two years prior to starting to learn it, she had not heard it again since that time, and did not remember much, noting that "you cannot remember anything about this kind of texture (points to score) if you have not heard it recently so, so I don't know this very well." She spoke about occasionally recording herself as a learning tool during practising, but did not do this during the observation sessions. When comparing the two pieces, Martha noted that the Beethoven has a clearer texture, and simple harmonies and melodies, aspects that make remembering the work much simpler. This difference is clearly observable in the different approaches that she took in the respective first sessions.

After the end of the first session of the Beethoven, Martha was able to comfortably play most of what she had looked at, and had attempted to play 81 of the 112 bars of the movement. In contrast, she only managed to attempt 17 bars of the Dutilleux by the end of the first session with that piece. When comparing graphic representations of time spent per bar in the two early practising sessions it is noticeable that much more time was spent focussing on short fragments in the Dutilleux. Much of the focus of this fragmentary work was spent figuring out rhythmic difficulties. The shortness of these sections reflect an attempt to work with manageable amounts of complexity, and I consider it to be a simplification, and a part of the chunking process. The evident difference in average length of section between the Beethoven and the Dutilleux reflects either the complexity of the latter, or the familiarity of the former (and hence a greater number of pre-formed chunks), but in either case is a good indication of the amount of work that has to go into processing each.

The complexity of the task of playing the dense textures, fast notes, large jumps and complicated rhythmic interaction of the Dutilleux resulted in Martha simplifying many parts of the piece, much more so that in the Beethoven. Apart from the fragmentation already discussed, she also "started without taking the rhythm" and played very slowly. Especially complicated was the rhythmic coordination between hands in the Dutilleux: Martha noted that, "it would be really easy to play only the right hand or only the left hand (pointing at the score) but it doesn't make sense because the rhythm is... (she indicates the interaction between the hands)" This accounts for the much fewer hands-separate practice in the Dutilleux, since the complexity lies

in the coordination, whereas in the Beethoven the difficulty is much more focussed on phrasing melodies and passages, hence the dominance of the right hand in the hands-separate work. Since the difficulty in the Beethoven is more melodic, this also affected the kinds of simplification employed. For example Martha would choose to play a simplified version of the left hand or to leave out some detail, such as repeated notes, or accompaniment figurations, in order to focus on other details. “I first started to hear the melody or the top voice, so I practised that and I skipped the left, I kind of played it in a simple way the left hand, [...] so I had time to concentrate on the melody.”

The difference in the nature of the complexity between the two pieces also affected the way that Martha externalised some of her mental processes. In the first session with the Dutilleux she wrote notes on the score 8 times, either fingerings or markings to show where the beat lay, while in the Beethoven she did not write once. She could also be observed tapping her foot and nodding her head to the beat, and occasionally mouthing words, presumably counting. None of these behaviours occurred in the Beethoven. In the first session with the Dutilleux she also twice spent more than a minute mentally rehearsing some aspect of the piece. She can be seen tapping the pulse while following the notation with her finger, most likely rehearsing or clarifying the rhythm in her mind. In contrast, the longest period without playing in the first session of the Beethoven was seven seconds. These externalisations of her mental process are ways of reducing the complexity, of distributing her thoughts to other objects or processes (Hakkarainen, 2012). The writing of fingerings or of rhythmic stress in the bar means that those processes do not need to be kept in active working memory, but can be called upon when needed by looking at the relevant marking. Similarly with tapping the rhythm while playing. Rhythm is usually internalised by classical musicians, and thus requires some attention, but a continuously repetitive movement may be relegated to a more subconscious process (similar to habituation), thus freeing attention slightly.

For Martha, simplification as a learning strategy thus seems to be dependent on the nature of the complexity of the task. Using hands-separate practice, simplifications of texture and/or rhythm, and fragmentation of the phrases, all seem to be related to the task at hand, rather than being fixed strategies to be applied to every situation. Similarly, externalisations or distributions of her thinking processes are only used on a basis of need. When the complexity is high, some kind of distribution is used. It is notable that in the later practice session with the Dutilleux, there is very little of this kind of externalisation. The complexity has been sufficiently chunked and automated so that she can pay attention to the relevant details without recourse to external help.

Throughout the four practice sessions it is noticeable that Martha works in a highly structured way. It is rare for her to stop in the middle of a phrase during an attempt to play through something. Throughout she sits still and upright, although she does move more expressively in the second Beethoven rehearsal, especially in those moments when she is “trying to be kind of free and play in my own way or something like that.” She seems to work according to a plan, attempting to play some section and then working on aspects of it before moving on to another section. In the early sessions this usually means the next section, as she slowly works her way through the piece. In the later sessions, she jumps around more, especially in the Dutilleux. The contrasts in the piece afford a more varied approach, and she first practised all the fast passages, before moving on to the loud passages. They each required a specific way of moving, and she was rehearsing those because, “the challenge in this kind of

music is the..., to be able to change the way of playing very quickly. First be very light and clear and then in the other second play a very loud forte and with a very much muscle."

In all of the sessions she hardly looks at anything other than the score or her hands on the keyboard. Only in the last session of the Beethoven does she occasionally look around while playing, during those times when she is looking for a certain kind of expression, or when she is consciously trying to play by memory and thus not look at the score. As she becomes more free of the score she is able to spend more time looking at her hands, which seems to be an important aspect of her memorisation. "I am not sure, I perhaps think about the hand positions, yes I kind of see the keys and when I, for example, try to practise, try to memorise something without the piano I think I see the keys, and sometimes the score, but..." It is important to also note her hesitancy about clearly describing the memorisation process. While she knows what to do in order to memorise, like working section by section or reading the score without playing, the mechanism of that memory seems to remain hidden to a large extent. She found the Beethoven easy to memorise and did not spend any significant time focussing on memorising it, "I think it is not necessary to start the memorising very early because it is kind of extra work then, if you first work with the music then you get the memorising almost for free because it comes when you work on the piece."

The variability of Martha's use of practising habits makes it difficult to give a clear answer to the question of her use of her senses in the practising environment. She seems to prefer applying a method or strategy to the problem that it is appropriate for.

Maurizio

Writing featured prominently in Maurizio's practising and in his discussions about his work. In the first Bach session, he devotes a lot of time to finding a fingering that is appropriate, and carefully notates it, by the second session, he has marked entries of the theme in each of the voices of the fugue in different colours. While the colours did not play a significant part of his performance of the piece from memory, "when I play through with the music it is really helpful in separating voices, like especially here [bb. 67-76] where the you get the stretto and it is just insane how close it is." In the Beethoven, his fingering decisions often diverged from those of the editor, and he wrote his own fingerings on top of those of the editor. It's "quite messy cause I'm trying to cover up their fingering." Not only does he write fingerings, but he also has other marks indicating repeated patterns, or similarities in the music. This writing predominantly takes place in the early stages of learning, in the second sessions with each of the pieces he did not write anything, and did not look at the scores at all (although he did have a pencil handy in the second Beethoven session). He said that he would mark the score when he listened to recordings of the work in the final stages of preparation, but that this marking served a different purpose, "but then yeah I guess I might write something in the score then, like circle something you know, but that would only be, it wouldn't kind of be for me to remember forever. It will only be as I listen to this now this is the thing that I did so just when I go back and I look I remember to fix that." An early teacher encouraged this diversity of visual cues by colouring his music to indicate form or melody, and using colours to help him remember scale patterns.

The importance of writing in the early stages of work seems to be because he is using the markings as a way of building larger memory groupings. He notes that when he is looking at the

sheetmusic, after a certain point he is no longer looking only at the notes themselves, but is also reading the markings he has made. “I can see that bigger picture like 2.. 4.. 3.. [sings] 4.. 3.. like it gives you a bigger kind of framework and its its not, you don't have to look at every note, ok 423424, you know, it just gives you reference points and that's, and when you are playing fast, that's a whole lot easier. So and also I think if I write it in, then um, especially if it's something like this, that's kind of messy and awkward, then that actually serves as a memory tool.” This is further borne out by his remark that although the fingering might be put in by the editors, they tended to only indicate where a finger placing would be different from expected, but he found “it easier if you know what's on the beat.” Grouping the music into beats, marked by the first finger of that grouping seems a sure indication of the formation of a memory cue for those beats. He also would write in fingerings that were obvious to him, in an effort to ensure that they are secure in his understanding. “It's very clear that if its 5 and its coming down here its going to be 4 3, and [...] I've never played anything different there, but it was kind of like just so that [...] I was really sure that this was 4 3 here and not just kind of, 'yeah, its the next notes,' or, 'whatever comes next'.”

Unsurprisingly, given his reliance on his own writing and the aid that is gives to his memory process, he had a strong attachment to the physical score. He recalled situations where he had to use different scores to the one he had initially used, and found it difficult to play from them. However, this attachment only lasted as long as he had not memorised the work. “From then [...] on like anything that I do - if I am changing a phrase or doing something like, having a, putting an accent somewhere or something - then my frame of reference is more kind of the keyboard and how it sounds than the page and what it looks like.” Although he relies heavily on visual cues to form his memory at the early stages, his memory is not visual in the sense of remembering the score and 'reading' from it. In fact he builds his memory very consciously through an established process.

Throughout the sessions he can be seen often practising hands separately. This is part of a conscious process to build a strong understanding of what each hand is doing. In the first Bach session, he plays through the first couple of bars several times with each hand, and keeps on alternating them to remind himself of what each hand is doing. His aim is to “get it kind of smooth and kind of problem free” prior to attempting to play with his hands together. Once he can play through the piece with both hands while reading the score, he returns to memorise each hand on its own in shorter sections. When the whole piece is memorised in this way, he then puts it back together again, “and that is like memorising again.” This memory is firstly strongly linked with fingering and finger placement. “I won't think, 'I have to play a D flat there,' and my brain will automatically assume, 'Ok here I am in this position and I need to play D flat here so I need to flip something,' to me its really like, 'it's finger two that has to go here'.” With fugal textures he claims to have sometimes memorised the voices separately, although he did not attempt this for the fugue we observed. His memory is also, secondly, linked with harmonic labels which form cues for sections of music. He analyses the music harmonically, in the Bach fugue, for instance, he had written in one harmony for each bar, labelling it with jazz notation rather than functional harmonic notation. These harmonic labels form cues as to what is coming next in the music, “for example if I'm in this bar, and so this bar kind of stays the same harmonically and then I'll say to myself halfway through this bar, 'Ok, B flat 7 is the next bar', you know, and then I get there and I go 'yes, it is there it is: next bar...'.” However, in fugal textures, he relies more on the movement of voices than on the harmonic progression. “The harmonic is kind of like, I use it more as a support memory tool than the main one. Whereas if I

am playing a Beethoven Sonata or something then the harmony is maybe much more of a memory tool than the melody."

A part of the focus of learning the music hand separately is initially to make some of the movements automatic. In passages where both hands are playing the same figurations an octave apart, as often occurs in the Beethoven, it is easier to play if one hand can play fairly automatically, so that attention can be focussed on the other hand. "If at least one hand knows it […] muscularly […] you can think of the other hand." He judges whether this has been achieved through two criteria, how it felt and sounded: "it felt comfortable, and it it sounded right." However, the feeling of comfort he described also had to do with conceptual comfort. This is seen in how he describes being uncomfortable, "sometimes my fingers would have been a little bit ahead of my brain, or or or even the other way round, […] my fingers are a little bit behind my brain." So feeling comfortable is not just a physical attribute, but a relationship between physical and cognitive processes. This process needs to be reversed at some point, however, since "the left hand kind of can ghost, […] you don't actually know the left hand so much so then, you know, you might play the wrong interval or, you know, clip a different note." So for this reason, working with hands separately at a later stage is as important as working in the first stages. Working hands separately also forces him to play the left hand more musically than he would if it was just depending on the phrasing and sound of the right hand.

In the second Bach session he had problems remembering how to play a certain passage with his right hand only. Instead of going to the score, however, "but I knew that if I played hands together […] I would get it. And then I could look and see 'Ok that is what it is'." He knew the feeling of playing the notes, but did not have a clear grasp of what they were intellectually. This was one of the reasons why he plays hands separately, in order to discover those places where he is not sure of certain notes. He wants to have an intellectual understanding of each of the notes so that he can have the freedom to pay attention to any part of his playing. "There comes a moment in a performance when you go 'Ok I really want to make those inner voices quiet' and then you think […] what are the inner voices (laughs). If I just play it you know and don't worry about actually splitting anything up it is fine, […] but you need to be able to think about those things in order to, especially for the phrasing and dynamics and agogics and those kinds of things." However, knowing what each note is does not mean that he thinks about each note as he is playing. They get subsumed into larger groupings as his attention is focussed on other aspects, but he wants them accessible for the occasions when he does want to think about them.

As a habit he listened to recordings of the pieces he was planning to learn prior to starting to learn them, unless they were unrecorded. He had listened to the Beethoven while following the score, he had to choose a Beethoven sonata to learn, and identified this particular one after hearing it. The Bach he had not specifically listened to, but knew from colleagues and friends who had performed the fugue. It was a fugue "that I know, like I have heard it a lot." He then listened again to a number of recordings when he was close to performing the work. This listening always took place while following a score, and he would note interpretative ideas that he wanted to incorporate, often marking them in the score. Prior to the second Bach session he had already done this and when we watched his practising session together, he was disappointed with the way a certain passage sounded. He then noted that an interpretative detail he had heard in several recordings, and had rejected, would have probably served better at that point. Comparing recordings he had heard to his live playing was a different experience to comparing recordings he had heard with a recording of himself. The comparison became easier when the

medium was the same, and he could have the same distance from the events. He mentioned that he would still listen to the Beethoven after the second session. “I'll listen to a couple of recordings and then I'll also, either tomorrow or Friday, I'll record myself and listen back. And whenever I record myself then I do that, like looking at the score as well.”

Early on in the first Beethoven session, there are two types of passages he stopped to work on for a while. The first was the ascending arpeggio in b. 2 and 4, where he especially worked on the left hand, and the second was the right hand trill in b. 3 and 5. What was interesting in these passages is that he noted for the first kind of passage the problem was mechanical, he wanted his fourth finger to be more active. The sound quality, a crescendo, while important, was secondary to his purpose in repeating the passage. “I think that [the crescendo] was more subconscious, like, 'Ok there is a crescendo here'.” However, he is moving his upper body forward and down and then suddenly up again on most repetitions of this passage, an action that mimics the direction and intensity of the crescendo, and that he often does in other, similar, places. It is not really possible to separate the sound from the mechanics of playing, but his attention can be focussed on one or the other. For the second kind of passage he was focussing on a sonic quality that he was looking for, “this is a sound thing.” Again, the sound is related to how he is moving his fingers, this time a trill with his third and fifth fingers. But in this case the mechanics of playing were not so problematic. He does not repeat the passage as many times, but tries it four times for the first trill and three times for the second, compared to more than 20 times for the first arpeggio and 12 for the second. This seems to support his statement, that in the first instance he is working to develop a specific muscle movement, while in the second he has that form of muscle control and can think of the sound while allowing his muscles to execute the trill itself more automatically.

We spoke of the changes that the conception of the piece goes through. For instance, in the scale passage in the Beethoven which is isorhythmic, he at first played accents on every third note, which was the start of each new pattern, however later on, when it comes to performance time “I'll change my thinking to be which finger is on the beat, and that will be my kind of anchor. But at the moment, it's definitely which finger is on the start of each pattern.” In the early stages of work, he was aware of aspects of his playing that were unsatisfactory, but was prepared to let them pass until another stage of work. “I imagine I'll come back and work on this at some point […] it should be like a nice kind of gradual thing and now […] its kind of suddenly loud.” There were also moments where he was concentrating so much on other aspects that something would fall from his attention. “I was really thinking of fingering in that, I can hear my brain kind of working it out. So I didn't play like (sings) rest, it was kind of like (sings all legato without rest).”

He did not use a metronome in any of the sessions I observed, but said that he does use a metronome in the early stages of work, when there are rhythmical difficulties. He avoided it, however, because he felt that he had a tendency to play with heavy accents on certain parts of the bar which get accentuated when he plays with a metronome.

He spoke to himself a couple of times during the practice sessions, most clearly when he had made a mistake, and can be heard saying “no, no, no.” On another occasion, his actions imply an internal narrative, as if he were underlining a statement with a physical action. This internal narrative is also consciously used in his memorisation process. He spoke about an internal narrative with regards to the harmonic progressions he is playing, and about the fingerings that he is using. At key points in the piece he sometimes speaks to himself about a cue. The narrative

also extends to his scores. He told of a piece where he had written “Maurizio, it's a C you fool” to remind himself of a note he had repeatedly played wrong.

Rosalyn

Rosalyn's first words to me were about the strangeness of the situation, a theme she would return to a couple of times in that session. The research situation “feels very funny”, and caused her to be nervous. “I was getting frustrated because it is not a really difficult place but I was still like uuuh [tense], 'this should be so easy I should not actually need to practise this but now its all terrible'.” She was aware that the camera was recording her every move, and that a stranger was going to carefully look at everything she was doing. Practising is usually the most private part of a musician's musical life, and now that privacy would be invaded. There is also evident in this statement the idea of performance which is so deeply ingrained in musicians' ethic. When someone is watching then the musician feels like they need to give of their best, and yet the definition of that best is vague, especially in the first session with a piece not studied before, and when you are not sure what the stranger is looking for. It cannot be a fluent performance, although it is strange when it isn't one. It is brave indeed to allow for this kind of examination.

She described her process of memorisation as multi-faceted and depending on a number of strategies. “I pretty much rely on the keyboard, not so much the fingerings but the harmonic structure of the chords.” These are analysed not primarily functionally, but rather in terms of chord name, much like jazz musicians think of harmonic progression. Especially in complex music, she works a lot with these kinds of labels. She tends to be aware of the position of the chord, in terms of inversion and spacing. “I remember the chords first and then maybe some of the actual notes.” She is further also aware of decorative notes or non-chord notes in the tonal music that we looked at together. So these two forms of remembering are more akin to analytical memory, although it does not depend so much on traditional functional or structural analysis, but rather on a more pragmatic labelling of chords and additional notes. Based on this knowledge she breaks down the music into patterns. “The patterns are also movements, one movement is one pattern, from here (holding her shoulder). I mean [the fingers] can do whatever, but one movement is from here. I go with the movement and then I go with the patterns I see on the keyboard.” This visual element of the memory does not extend to remembering fine details of the score, however. “Usually when I play something by heart I can almost tell what page and around what bar I am on but I don't usually see the score or the music very much.” This process also changes depending on the technical difficulty of the music to be memorised. The more challenging pieces need less active memorisation because they require so much work to be able to play that they are memorised as part of that process, while the slower pieces sometimes require more active memorisation.

Movement was an important theme in our discussions. Rosalyn used movement in several ways. She had, by her own admission, small hands and has needed to be conscious of movement and to let her arms and hands feel “loose and relaxed” is something that she said she always needed to do. She was very consciously using movement as a way to aid memory, and as one of the things that needs to be remembered. This movement is not limited to hand movements only. In the 16th Brahms variation the hands perform fast and large jumps in turns. Coming back to this variation after some weeks of not playing it, she had forgotten some of the details and needed to look at the score occasionally. This caused some difficulty: “when you

learn [this kind of music] you have to learn also where to look at what point, and if you had to actually look up […] it disturbs the whole thing." She understood that it was important for the movement in this variation not to consist of separate "jerky" movements, and was working on getting a continuous movement, "when you make it into a whole kind of choreography it is easier." In the Beethoven, her background in playing harpsichord added another dimension to her understanding of movement. She was aware of different styles of fingering scalar passages; what she called the classical piano fingering which emphasised smoothness and the harpsichord fingering that emphasised groupings. Several times during her practice of the Beethoven she was experimenting with these different fingering styles, trying to decide which would suit her playing of the piece better.

The relation between movement and sound also appeared in the Brahms. Of Variation 13, she said that "this variation is quite a lot about movement and the feel." The accompaniment in the left hand is very low, and in rolled chords on the off-beat, while the right hand plays a melody in parallel sixths. This difference results in "very different feeling, very different weight, very different feeling of motion and very different motion patterns" between the two hands. The left hand should be "just very relaxed" here she demonstrated a loose swinging motion, while the right hand should be "much more stable, it is much more fingery." Although the sound is the final product and aim of these movements, attention to how the movement happens seems to be equally in the attentional space, "what I usually just think when I am listening, doing this variation is also the sound - which I do a lot - but also just the feeling of the motion and different kinds of hand movements." However, there is not always this direct relationship between sound and movement. In Variation 14 "you have to practise in a very different atmosphere than what the actual music is, I mean the final product is." The final product should be "bright and happy and snappy [...] but you cant practise with this kind of state of mind because it would actually destroy the movements. So you actually need to practise it as it were very serious and very slow music and very melodic and very like big wash of things, […] and then you just kind of add the [sparkliness]." In this variation, looking at her hands causes distraction, because of the strange positions into which they are forced by the speed of the movement, "so what I actually try to do quite a lot is not to look at my hands" but just to "listen and try to feel that it feels relaxed and also think a lot about my […] arms instead of fingers."

She did not take many breaks in the practising sessions, but did often pause on a chord for a brief moment, these were "usually […] either to think of the movement or then to just listen to the sound." She does not often use mental practising in a focussed way but when she does she tends not to take the score in hand to read it but rather to "go through the thing in my head which involves kind of like thinking of the score, I mean the visual score but also of the keyboard and of the movements." Undoubtedly the sound world that these things evoke are also present in the moment of mental practice, but this aspect came up less prominently in the discussion.

She was careful in her use of recordings of the works that she was learning, and tended to make decisions on whether to listen to something in the situation. "Well if there is like a piece that I don't know at all, then if I know there is a good recording then I might listen to it. And if it is contemporary and there is a recording I always listen to it because it makes it so much easier. But occasionally, like right now I haven't been intentionally listening to any recordings of [the Beethoven concerto] for like a few weeks 'cause it affects me a lot, [...] I mean if you already have some kind of image in your head how the piece goes too well with someone else then you

don't necessarily read the score as detailed as you would otherwise, because you are just 'Oh this is the part [that goes like this], ok, next part'. So it depends, it varies." Having an aural image of the piece speeds up the learning process, although this is a two-edged sword and also might influence decisions made regarding interpretation in a negative way. Much of her practising of the Beethoven was exactly this kind of decision making regarding the sound that she would eventually want to play with. This resulted in playing many short sections over and over, and not playing even a couple of bars without stopping and repeating something. The fragmentary nature of her practice in this session caught her by surprise when we reviewed the recording, but can be understood as a searching action, trying to find the right mental and emotional state, atmosphere, sound and movement. In the first Brahms session, this work was already done by the time we viewed it, and she noted the difference between the two sessions. "When I read [the] Beethoven it was very slow because I didn't have a clear image of what I was looking for. This is a bit different because I already know what I want to play and I just need to fix it."

Her attitude to writing on the score was similarly dependent on the situation. In the Beethoven, "when you have like thirds and fourths then you need some kind of pattern there." But otherwise she did not write much. "Of course more with contemporary music when it's not like a ready pattern: you don't need to write fingerings for a G major scale, but if it's just random notes then you always have to have some fingerings there." In more complicated music, like a Scriabin work she was learning, the writing extended beyond fingering and also included chord symbols "because that is completely impossible to remember if you do not have any markings there." The markings are unnecessary in music that is tonal, because of her great familiarity with the conventions of the music, but also because of previous work in finding or learning fingerings that work for certain passages, these can be called upon without need for an external reminder. Similarly, in complex music like the Scriabin, the chord symbols serve as reminders of simpler, previously learned formations. "When you look at it very quickly you have this horrible amount of notes, […] but when you break it down to: ok, first there is like a D flat major seventh chord then you have something that is actually in C minor with a twist of A flat minor and then... So this is actually what I write down there."

She did not use a metronome in our sessions, and said that she very rarely used one, except sometimes in contemporary music. "I don't like it, it feels stupid."

She regularly 'warmed up' prior to the day's practising, using pieces that she knew well or that she had firm control over sonically. In the second Brahms session we discussed the fact that she had not warmed up, and that the observation was actually the first time she touched a piano that day. Having played through the couple of variations she wanted to practise, pausing regularly and fixing various aspects of her playing, she went back to the beginning. Now the playing was smoother "mostly because I have already played for 15 minutes it is a bit easier, I don't have to control the sound as much any more, I can just listen I don't have to think about my hands too much." This points again to the relation between sound and movement. When her muscles are warmed up and attuned to the task, she can move her attention to other parts of her playing, in this case to listening more carefully. The limited human processing of complex information such as playing a piano requires that some things be automated. In this case warming up is part of the automation of movement that allows for attention to be on listening more actively.

Vladimir

Vladimir's attitude to listening to the music prior to learning it was strongly influenced by a previous teacher who forbade him to listen to the works that he was studying. Thus he did not actively listen to the Ravel prior to starting to learn it, however, it was familiar to him from hearing colleagues and friends performing and practising it, and from recordings he had listened to "a few times". The Beethoven he had listened to "many times" and he had a good aural picture of it, "I think it helps alot, alot" was his assesment of this (for him) novel strategy.

He extensively used singing/saying the sol-fa note names of the variations he was learning during the first session with the Beethoven. Whether he sang or said the note names depended on the range or sing-ability of the lines. This is a method that he was taught "to use always", and one that he finds "really helpful, especially when I am sight reading. When I am sight reading I am saying the names of the notes all the time." Apart from his training to use the method he had the additional advantage of having perfect pitch, "so when I hear a note I hear the name of the note." And conversely, when he said the note name he could easily find it on the keyboard, learning with this strategy makes "it [go] faster." He did not use it at all in the other sessions, all of which were in more advanced stages of work. When asked about which other situations he would use the same strategy in, he responded, "sometimes I can sing like if I think that I am not reading the melody right, like in the right way, so then I sing the melody. For example if it is really like virtuoso and the melody is like some random notes in the middle or..." Again here, however, singing/saying the note names is strongly linked with correction or re-learning, rather than with finding expressive ways of playing the phrase or other musical considerations.

In attempting to describe how he remembered the music that he is playing, the sol-fa note names again featured prominently. He emphasised the varied nature of his musical memory, saying that he remembered "the notes of the melody and the harmonies, and then I can also have a picture of the score in my head." Also, "sometimes, I don't know why, but your hands know it." In remembering the "notes of the melody", his perfect pitch links the sound of the note and the sol-fa note name, and both of these aspects form part of his memory. This has been reinforced through training that emphasised this link very strongly. He described remembering the harmonies as involving remembering the name of the harmonies. He noted that during his practising of a piece he automatically memorises some sections well while others are not so secure in his memory. "I really have to work on it if I want to know everything by heart."

He did not write in his score while practising, and claimed that it was something that he "never" did, except perhaps in an "emergency, or when really I practised it and then I discover that I don't remember the fingering." During the observations I only saw him writing twice, once when he found that he had learned a chord wrongly and realised what the right chord was. Then he took a pencil to circle the chord on his score. The other time was to copy a fingering that his teacher had written on the photocopies that he gave her during lessons onto his own score. He always had his score in front of him, and for the second Ravel session had both the score and the photocopies on the note stand. He could be seen at times looking from one to the other. As he described it, he had some notes from his teacher on the photocopies, and had made notes himself on the score during the lesson and was trying to remember all that his teacher had said in the previous lesson based on the notes that she had made, but also some things that she had not notated but only said. Even though he had memorised the music by this stage, the score was still on the music stand, and served as a reference to which he could turn.

In the Beethoven sessions he twice uses playing in rhythms, referring to a method in which he pauses on certain notes in a regular pattern. So he can be heard pausing on the first note of each beat, and later on the first note of each bar in the third variation during the first Beethoven session. This pausing gives him time to “anticipate as much as I can where each of my fingers are going for the next bar.” He is trying to “think the whole bar in one movement.” The Beethoven variations number 3 and 8 were the places where he used this method, and both are suited for this approach because of the repetitive patterns that each uses. He does not use this technique in the sessions we had on the Ravel at all, partly perhaps because the texture does not call for it. In the Ravel he plays through the harmonic progression slowly once, and spends significant amounts of time on very short passages, two or three beats, repeating them over and over.

This focus on really short passages is a method he is trying to use consistently, but “it is very difficult for me, very difficult, like I am always going further.” This is something that he is working on with his teacher. She is “trying to teach me how to practise focussed and not just like play through as I was doing.” He was seeing some results in this work, noting that he “concentrated a bit more and [took] more little moments.” He felt, however, that he was impatient, often skipping difficult bits and leaving the work for later. In the sessions we had together he did not use a metronome, but he said that it was something that he used “all the time, all the time.” He would take a passage of some length and start really slowly, working it up to speed over the course of some twenty minutes. This highly systematic way of working helped him to concentrate and keep going, and also forced him to play slowly, giving him “the time to think about everything” he needed to think of during playing. He did not use the metronome during our session out of concern that it was not very interesting, and would fill the whole session. It was also not something that he would use with every kind of passage, but with passages that have specific difficulties that he is trying to address. For instance in the very fast fourteenth variation he had not used the metronome, because it “fit[ted] to my fingers” without much effort.

He commented on his posture, noting that he often sat “in [a] really bad way, [...] crossing my feet.” He claimed to even sometimes put his foot on the chair and his elbow on his knee when practising with one hand. He could not give a reason for this, it was not something that he consciously thought about doing. However, these posture changes seemed to be related to his level of frustration. In the sessions where he worked hard and concentrated, his posture generally remained that of the typical concert pianist, upper body upright and still and feet positioned a little apart underneath the keyboard. When he became frustrated, however, this changed and his body language reflected his frustration. It was only in this situation, during the second Beethoven session, that he crossed his legs in various postures, eliciting the comment about his posture quoted above.

He did a significant amount of technical work, isolating a specific problem and repeating it many times until it gained some fluency. The most intentional of this work was with the repeated note figure of the Ravel. Here he tried in the first session to play an extract from Bach's first Two Part Invention, in C major. His teacher had recommended it to him. He had, however, abandoned this idea by the second session, and rather worked for a shorter time focussing on specific finger combinations. So he would play a repeated note using 5-4 then using 5-3 and then using 5-2, making different combinations in this way, also using three fingers.