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An experiment on the communication of expressivity in piano improvisation and a study toward an interdisciplinary research framework of ethnomusicology and cognitive psychology of music

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Index

Extrait

Cette étude est le résultat de mon stage de recherche dans le Laboratoire de Psychologie Auditive (CNRS UMR 8581, Responsable Scientifique: Mme Carolyn Drake) de l'Université Paris V et dans le Laboratoire de Ethnomusicologie du Musée de l'Homme (CNRS UMR 8574, Responsable Scientifique: M. Bernard Lorat-Jacob). Ce stage a été caractérisé par ma volonté de maintenir une continuité entre mon travail de fin d'étude d'Ingenieur realisé au CSC (Centro di Sonologia Computazionale) de l'Université de Padova (année 2001), et ma future thèse de troisième cycle débutant en Septembre 2003 sous la direction de M. Lortat-Jacob.

Le travail présenté ici est divisé en deux chapitres. Notre intention a été de choisir la forme la plus proche de celle utilisée dans les articles scientifiques. Dans le premier chapitre, nous avons analysé, grâce à une méthode empirique, comment l'*expressivité* est communiquée en musique. Deux expériences ont été realisées. Nous avions pour objectif de comprendre les relations entre les intentions expressives de l'interprète, les 4 paramètres hauteur, l'intensité, l'articulation et le tempo, et la perception des auditeurs. Le second chapitre cherche à comprendre comment les facteurs culturels, généralement ignorés dans la recherche en cognition et perception musicale, peuvent être integrés dans l'analyse de différents aspects de l'expérience musicale, l'un d'eux étant la communication de l'expressivité traité dans le premier chapitre. Nous avons analysé d'un point de vue épistémologique les domaines d'intersection entre la psychologie de la musique et l'ethnomusicologie, avec l'objectif de définir un approche interdisciplinaire à la recherche en cognition et en perception musicale.

Les deux expériences ont été conçues dans le cadre d'un cas particulier de la communication musicale: l'improvisation sur une seule note du piano (section 1.2). Ce choix a été motivé par la considération des problèmes qu'ont eu les précédents travaux sur l'expressivité musicale. Ces travaux et ces problèmes sont resumés en section 1.1. Nous avons considéré les deux aspects de la communication musicale, la production (Expérience 1, section 1.3) et la perception (Expérience 2, section 1.4) de performances expressives, avec l'objectif de rechercher la présence d'une "code" commun à la base de l'expressivité musicale. Dans les deux cas, nous avons analysé les différences entre le comportement de sujets musiciens et non musicians.

Dans l'Expérience 1, six interprètes ont été invités à produire des improvisations sur la base de huit groupes d'adjectifs représentant huit différentes intentions expressives. Nous avons utilisé une méthodologie soustractive: en 4 phases, nous avons progressivement fixé la hauteur (phase 2), la hauteur et l'intensité (phase 3), et finalement la hauteur, l'intensité et l'articulation (phase 4). L'objectif de cette méthode était de séparer l'effet de chaque paramètre sans manipuler artificiellement les performances obtenues. Dans l'Experience 2, trente sujets ont decrit, avec les mêmes groupes d'adjectifs que dans l'Experience 1, le contentu expressif des improvisations. Nous avons analysé les performances et les réponses avec la méthode d'analyse de la variance (ANOVA). Les résultats ont indiqué que les interprètes ont utilisé les paramètres acoustiques d'une façon systématique, et que les auditeurs ont été capables de reconnaitre les intentions expressives même quand peu paramètres étaient en jeu. Ces résultats supposent l'hypothèse de la présence d'une code commun pour la communication du contenu expressif entre l'interprète et l'auditeur, indépendant de la formation musicale des sujets. Ces résultats confirment aussi que ce code est analysable de façon empirique.

Une des critiques posées sur notre analyse expérimentale, analyse des différents aspects de la cognition et de la perception musicale et en particulier de la comunication de contenu expressif, est qu'elle ne considère pas l'importance du contexte socio-culturel où l'expérience musicale prend place. C'est pourquoi la psychologie musicale et l'ethnomusicologie se sont historiquement développées à partir de différentes bases. D'une part, la recherche en perception et en cognition considère la musique comme le résultat de procédés cognitifs et physiologiques universels. D'une autre part, l'ethnomusicologie approche le phénomène musical dans un contexte socioculturel spécifique.

Depuis peu, une collaboration de plus en plus étroite entre ces deux domaines scientifiques ouvre la voie d'un nouveau terrain d'étude. Il utilise leurs connaissances respectives mutuellement échangées. C'est de cette interaction que le deuxième chapitre de cette étude tente de décrire, ayant l'objectif de comprendre comment les facteurs culturels et psychologiques peuvent être intégrés dans un contexte de recherche interdisciplinaire.

D'un coté la psychologie de la musique commence à étudier la comparaison inter-culturelle comme un outil fondamental pour la recherche sur l'universalité des modes de perception et de cognition musicale. L'intérêt principal de cette approche, analysée en section 2.2, réside dans le problème de savoir si et comment la perception musicale diffère suivant les cultures. En cette perspective, nous avons traité l'application de l'approche culturelle à l'étude de l'expressivité musicale (section 2.2.1).

D'un autre coté, l'ethnomusicologie cognitive utilise les méthodes et les hypothèses du champ de la psychologie pour expliquer des phénomènes de l'expérience musicale qui ne sont pas abordable avec l'approche anthropologique (section 2.3). Alors que quelques expériences perceptives en laboratoire ont été étendues à des styles musicaux et des auditeurs non occidentaux, la perspective ethnomusicologique soulève le problème de savoir comment les procédures expérimentales pourraient être adaptées à une utilisation sur le terrain. La méthode anthropologique basée sur l'observation participative peut apporter à la recherche en psychologie inter-culturelle ce degré de sensibilité qui est nécessaire pour déterminer quelles méthodes expérimentales et quelles technologies sont culturellement les plus appropriées (section 2.3.1). Les méthodes de la catégorisation de pièces de musique selon leur similarité peuvent être un moyen de réaliser des enquêtes sur la perception musicale dans différentes cultures (section 2.3.2). Enfin, dans la partie 2.4, nous avons examiné comment tous ces éléments peuvent converger dans une approche interdisciplinaire vers l'étude des différents aspects de l'expérience musicale, comme par exemple la communication de l'expressivité.

Abstract

The present study is the result of a four months stage at the Laboratory of Auditory Perception (Scientific Director: Prof. Carolyn Drake) of Paris V University, and at the CNRS Laboratory of Ethnomusicology (Scientific Director: Prof. Bernard Lorat-Jacob). From on hand, the stage was directly related to my University final project (*Tesi di Laurea*) that I developed at CSC (Center for Computational Sonology) of Padova under the direction of Prof. G. De Poli, and from the other hand it represents a first step toward the Doctorate Thesis.

The present study is divided in two chapters. In the first we analyzed empirically how expressivity is communicated and perceived in music. Two experiments were designed in order to find relations between performers' expressive intentions, the acoustical parameters pitch, intensity, articulation and tempo, and listeners' perception of expressive content. The second chapter raises the problem of how cultural factors, so far widely ignored by research on music cognition, could be integrated to the analysis of different aspects of musical experience, one of them being the *communication of expressive content*. We analysed the domains of intersection of cognitive psychology of music and ethnomusiology, with the aim of approaching an interdisciplinary framework for the study of music cognition and perception.

The two experiments were designed with the aim of analyzing the communication of expressive intentions in a special case of musical improvisation: performers could play only one note of the piano. This choice has been motivated by the need of overcoming several problems outlined in previous studies with the musical score, such as the familiarity with the excerpts used as stimuli in perceptual experiments. We analyzed both the generative aspects (performing, Experiment 1) and interpretative ones (listening, Experiment 2) of the musical communication process, in order to explore whether performers and listeners share a common code for the communication of expressive content. In both experiments differences between musicians and non-musicians were object of study as well.

In Experiment 1 six performers improvised on a digital piano according to eight expressive intentions suggested by eight groups of adjectives. The experiment was planned in four phases, progressively limiting the musical means available to the performer. In all phases improvisations were limited to one note of the piano. The particular experimetal design allowed the separation of the effect of pitch, intensity, articulation and tempo without an

artificial manipulation of the improvisations obtained. In Experiment 2 thirty listeners described performers' improvisations by means of adjectives' ratings. The aim was to analyze how the same acoustical parameters influenced listeners' recognition of performers' expressive improvisations. An analysis of variance (ANOVA) has been used for the statistical analysis of performers improvisations and listeners ratings. Results indicated that performers used the acoustical parameters in a systematical manner and that listeners were able to recognize most expressive intentions even when few acoustical parameters were involved. The results bring evidence to the hypothesis of the existence of a common code for the communicaton of expressive content in music, independent from musical expertise.

One of critics often raised toward the empirical analysis of music perception and cognition, specifically when the object of study is musical expressivity, is that it does not take in account the importance of the context, local and cultural, where music is experienced. This explains why cognitive psychology and ethnomusicology historically grow on different basis: on one hand, the research on perception and cognition regards music as a product of universal cognitive and physiological processes, on the other hand, ethnomusicology approaches the musical phenomena as the product of a specific cultural and social context.

The aim of the second chapter of the present study was therefore to analyze the intersection between the two scientific domains, which expanded in recent years. In section 2.2 we analyzed how psychology of music started to look at the *cross-cultural comparison* as a fundamental tool for research on universal modes of human perception and cognition, since the validity of the work so far realized has been culturally restricted to Western modes of perception. In this perspective, we focused on cross-cultural research on musical expressivity (section 2.2.1). On the other hand, we analyzed in section 2.3 how *cognitive ethnomusicology* integrates psychology's methods for understaing music phenomena that are not reacheble by the antropological approach. In section 2.3.1 we considered the problems rised by the developement of cognitive and perceptual *experiments on the field*, and in section 2.3.2 we analyzed the *categorization of musical stimuli* as an instrument for relating the psychological and the cultural levels involved in musical experience. Finally, in section 2.4 we resumed the fundametal elements that may belong to a common research framework where cognitive psychology of music and ethnomusicology interact actively for the understanding of musical phenomena such as, for instance, the communication of expressive content.

1. Communication of expressive intentions by improvising on a single piano note: an experimental approach

1.1 Introduction

Can we communicate our expressive intentions by improvising on a single piano note? How is musical expressivity perceived in absence of a melody? Which role do the acoustical[1] parameters pitch, intensity, articulation and tempo play in the generation and perception of expressive performances? While empirical studies on expressive music communication always considered the musical score as a base of reference, the present work approaches the context of improvisation on one piano note.

The general model of musical communication composer-performer-listener, presented in Figure 1 (Kendall & Carterette, 1990), suggests that the analysis of expressiveness in musical communication is a complex task since it is determined by structural, performance, listener and contextual features (Juslin & Zentner, 2002).

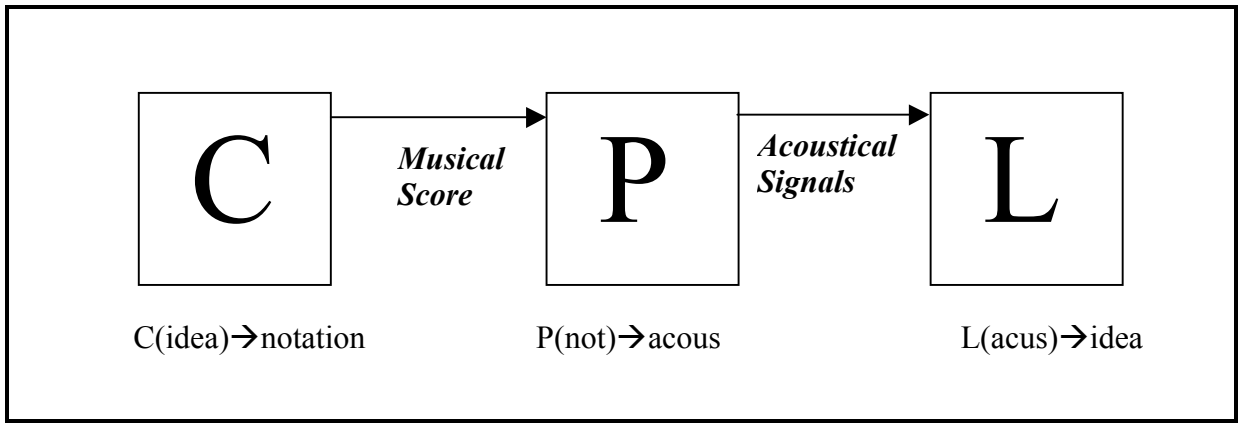


Figure 1: Model of musical communication (Kendall & Carterette, 1990). Composer (C) "transforms" his/her ideas in a musical score. Performer (P) interprets the score by producing acoustical signals and Listener (L) receives the sounds and may "decode" them as ideas, feelings, emotions. Each actor of the communication chain may belong to a different socio-cultural context.

[1] The terms "acoustical parameters" is used in the present study also for articulation and tempo, which are generally considered as *musical* parameters.

Historically, studies on the communication of affect, emotion, *expressive content*, by music have focused on the information given by the written score, either from the theoretical (Budd, 1985; Langer, 1957; Meyer, 1956; Narmour, 1991) or experimental point of view (for a review, cf. Gabrielsson & Lindstrom, 2001). While some studies searched for general relations between musical structure (the written composition) and acoustical patterns in performance (Clarke, 1988; Palmer, 1989; Sloboda, 1998), others analyzed the elements of musical structure in relation to listeners' perceptual experience (Imberty, 1979; Krumhanls, 1996; Lerdhal & Jackendorf, 1983; Tillmann & Bigand, 1996; Waterman, 1996).

However, composer's message, which is codified in the musical score, is not the only source of listeners' perception of expressive content. In fact, the performer is able to play the same notated structure in different manners, influencing listeners' impression of the music (Juslin, 2001). Recent research on music performance (for a review, see Juslin, 2001) has shown that musicians introduce deviations from the score values of parameters such as the pitch or the duration of the notes. Since these deviations occur systematically and influence listeners' impression of the music, it is believed that they are introduced as an expressive means, related to performer's *expressive intentions* (Gabrielsson, 1995). Expressive deviations are not random, since performers are able to reproduce them (Palmer, 1997; Shaffer & Todd, 1987) and may have the function of clarifying composer's ideas (Clarke, 1988; Sundberg, 1988), or of communicating performers' intentions to listeners (Canazza, De Poli & Vidolin, 1997; De Poli, Rodà & Vidolin, 1998; Gabrielsson, 1988, 1999; Gabrielson & Juslin, 1996; Juslin 1997a; Repp, 1998).

Different experimental methodologies have been developed for the empirical study of performer's expressive intentions. Some studies have confronted performances played "without expression" with expressive ones, produced by asking a performer to play the same musical excerpt "with appropriate expression" and "with exaggerated expression" (Kendall & Carterette, 1990). A different approach consisted in asking the performer to play the same musical excerpt with different expressive intentions, suggested by some affective (sad, happy, etc.) and/or sensorial (hard, soft, etc.) adjectives. A note-by-note comparison among the values of the parameters indicated in the score and the values recorded in the expressive interpretations has shown which deviations are introduced by the performer and how they are related to each expressive intention (Canazza et al., 1997; De Poli et al., 1998; Canazza & Orio, 1998; Gabrielsson, 1995; Juslin, 1997a).

Perceptual experiments aim to analyze how performer's deviations from score values influence listeners' perception of expressive intentions (for a review, see Juslin, 2001).

Previous results have generally shown that listeners and performers share a common code for the communication of expressive content, i.e. they tend to relate semantic categories to the same acoustical parameters (Bresin & Friberg, 2000; Juslin, 1997b; Sherer and Oshinsky, 1977). The sharing of a common code between performers and listeners may be partially innate and partially culturally inflected (Becker, 2001; Blacking, 1973; Juslin, 2001) and it may explain why non-musicians perceive expressive qualities in music as well.

1.2 The present study

Previous research suggests that in listeners' experience there is "A confounding of the properties of the composed structure and properties of the actual performance" (Gabrielsson & Lindstrom, 2001, p. 223). Confounding variables are related to: a) listener's familiarity with the musical excerpt (Sloboda, 2002), b) the different composer-listener cultural context (Imberty, 1979), c) the difficulty of performers to play, for experimental purposes, the musical score with different expressive qualities, since the score contains itself the expressive information related to structural features (Laukka & Gabrielsson, 2000; Juslin, 2001).

These considerations lead us to think that it may be useful and meaningful to study musical expressiveness in a new context: improvisation. For musical improvisation we refer to the situation in which the figure of the composer coincides with that of the performer (Figure 2).

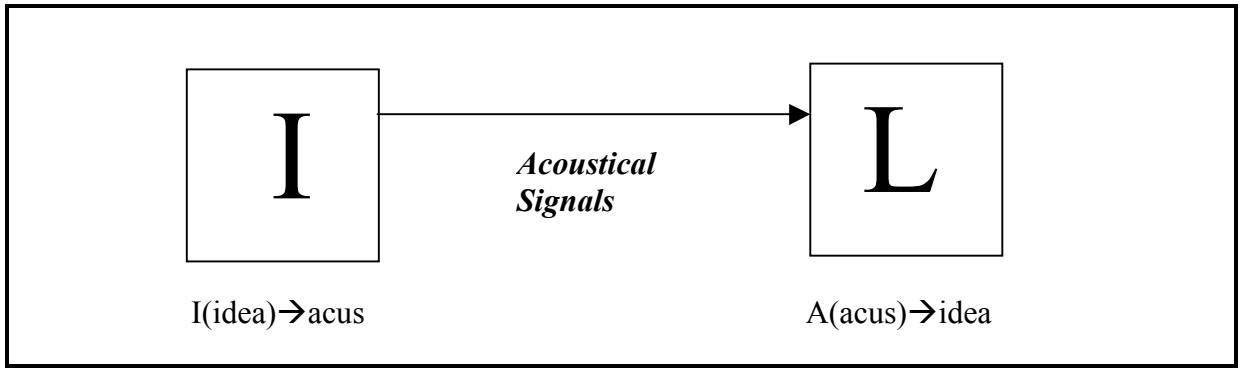


Figure 2: Model of musical improvisation. Composer and performer are "fused" in a unique subject, the improviser (I).

While the meaning of musical improvisation has been analyzed in many studies (Clarke, 1988, 1992; Gabrielsson, 1999; Nettl, 1974; Pressing, 1984, 1988; Sawyer, 1999; Welch, 1999), few empirical studies have been developed (Behrens & Green, 1993; Reinholdsson, 1987). Behrens & Green (1993), in a study on the perception of emotional content in solo improvisations, pointed out that empirical research on musical improvisation may overcome the confounding effect of structural and performance features since a) listeners' perceived expressiveness is not influenced by their familiarity with a musical excerpt, b) performers' intentions and listeners' perceptual experience may belong to the same context, and c) each performance involves a complete musical idea which belongs entirely to the performer.

However, the study of musical expressiveness in improvisation presents new methodological concerns. First of all, leaving a complete freedom of expression to the performer implies an increase in the number of variables involved, complicating the analysis of the performances; for example the meter may vary continuously, presenting rhythmical fragments that are not clearly understandable. Second, expressive improvisations may vary completely among each other, since the musical score no longer provides a point of reference. This implies that performances cannot be compared on a note-by-note basis but rather in terms of the statistical distribution of acoustical parameters.

Moreover, it is important to observe that improvisation is not synonymous of performance without score, as jazz music shows. Ethnomusicologist J. Baily (1999) remarks that in many traditions where music is transmitted orally, from generation to generation, without ever being “caught” by the written notation, the structure of the pieces is clearly present, and listeners are often very familiar with those pieces that are part of their tradition. The confounding properties between musical structure and performer's expressive intentions can be completely eliminated only by studying musical performances without any relation to any kind of structure, either explicit (score) or implicit (transmitted by oral tradition).

The present study analyzes the communication of expressive intentions in this last case of improvisation, where both performer and listener are not influenced by any pre-composed musical structure. Two experiments were designed, the first concerning the *generative* aspect of musical communication (production of expressive improvisations), the second the *interpretative* aspect (perception of expressive improvisations).

The first aim was to analyze how performers use the parameters of pitch, intensity, articulation and tempo as expressive means. In Experiment 1, six performers (three pianists and three non-musicians) were invited to improvise, in separate sessions, on a digital piano

according to eight expressive intentions suggested by means of eight groups of adjectives (cf. Table 2). A subtractive methodology, given by progressively imposing on the performer constant values of pitch, intensity and articulation, was designed in order to explore the role of each single parameter in the communication of expressive intentions. This methodology may highlight if and how the performer searches progressively new expressive strategies when fewer musical means are available. Moreover the method used does not require a particular musical skill, allowing therefore the analysis of similarities and differences in the production of expressive improvisations between two groups of performers (musicians vs. non-musicians).

The second aim was to explore whether or not listeners can recognize performer's expressive intentions when improvisations are produced using one single piano note. In Experiment 2, thirty listeners (15 non-musicians and 15 amateur musicians) described the expressive content of the improvisations by means of adjectives' rating using the same adjectives as for Experiment 1.

The third aim was to analyze how listeners' perception of expressive intentions is related to the parameters pitch, intensity, articulation and tempo. The subtractive methodology used for the collection of the expressive improvisations (Experiment 1) should highlight which role the acoustical parameters play in the perceptual process. As for Experiment 1, the role of musical expertise was object of analysis. Moreover, the combination of results from both experiments should suggest to what extent performers and listeners share a common code in the communication of expressive content.

The choice of the semantic categories for the experiments was inspired by Laban and Lawrence's *Theory of Effort* (Laban & Lawrence, 1947) and on Imberty's studies on listeners' semantic description of Western repertoire (Debussy's Preludes for piano solo) (Imberty, 1979). Laban and Lawrence believed that the expressive content of every physical movement is mainly related to the way of performing it, and it is due to the variation of four basic factors: time, space, weight and flow. The authors defined as *basic efforts* the eight combinations of two values (quick/sustained, flexible/direct and strong/light) associated with the first three factors. Each combination gives rise to a specific expressive gesture to which is associated an adjective, for instance a *slashing* movement is characterized by a strong weight, quick time and flexible space (e.g. a curved line). The basic efforts defined by Laban and Lawrence are reported in Table 1. Starting from Laban and Lawrence's theory of expressive movement, the set of adjectives for our experiments was derived by analyzing each of the eight combinations of the values *high* and *low* assigned to articulation, intensity and tempo,

and then by hypothesizing a group of three adjectives appropriate for each combination. Even if the use of affective adjectives can be supported by greater theoretical basis, for instance by studies on the so called basic emotions (Ekman, 1992), we supposed that the choice of sensorial adjectives could be more adequate for our experiment on musical improvisation, since they are more easily and directly related to physical gestures, which contribute to the communication of expressive content in a decisive way (Baily, 1985; Camurri & Coglio, 1998; Camurri, De Poli, Leman & Volpe, 2001; Gabrielsson, 1999). The final choice of the adjectives was then based on Imberty's (1979) research. In fact, Imberty's hypotheses on the correlation between the adjectives used by listeners for describing Debussy's Preludes and the musical attributes of the stimuli themselves lead us to the choices reported in Table 2. One of the aims of the present study therefore involved a qualitative and quantitative analysis of the improvisations in order to confirm the hypotheses on the choice of the adjectives.

Finally, we chose three adjectives in order to convey one expressive intention, with the aim of better specifying the intention itself. This choice was based on previous experiments where only one adjective was used (Canazza et. al, 1997; De Poli et al., 1998) and on a pilot study. We hypothesized that three adjectives would allow performers to identify each expressive intention in a more precise manner.

Adjectives	**Time**	**Space**	**Weight**
Slashing	Quick	Flexible	Strong
Gliding	Sustained	Direct	Light
Pressing	Sustained	Direct	Strong
Flicking	Quick	Flexible	Light
Wringing	Sustained	Flexible	Strong
Dabbing	Quick	Direct	Light
Punching	Quick	Direct	Strong
Floating	Sustained	Flexible	Light

Table 1: Laban and Lawrence's *basic efforts*. The expressive gestures are defined as combinations of opposite values of time (quick vs. sustained), space (flexible vs. direct) and weight (strong vs. light).

Descriptors	**Articulation**	**Intensity**	**Tempo**
1. Slashing, impetuous, resolute	High (*Staccato*)	High (*Forte*)	High (*Fast*)
2. Heavy, hard, rigid	High	High	Low (*Slow*)
3. Hopping, springing, galloping	High	Low (*Piano*)	High
4. Vacuous, hesitant, tired	High	Low	Low
5. Bold, torrential, unbridled	Low (*Legato*)	High	High
6. Hollow, solemn, obscure	Low	High	Low
7. Fluid, fluent, fleetly	Low	Low	High
8. Tender, sweet, simple	Low	Low	Low

Table 2: The eight expressive categories (descriptors), chosen as all possible combinations of the opposite values (high vs. low) of tempo, articulation and intensity.

1.3 Experiment 1: Production of expressive improvisations

The main aim of Experiment 1 was to observe how performers used pitch, intensity, articulation and tempo for communicating the eight expressive intentions (cf. Table 2). The experiment was designed in order to analyze the differences in performers' behavior when progressively fewer musical means were available. Moreover, we were interested in observing the role of musical expertise (musicians M, vs. non musicians NM) in the production of short expressive improvisations.

1.3.1 Method

1.3.1.1 Participants

Six subjects participated as volunteers to the experiment. Three of them were University students without any musical training. The other three were skilled pianists: two of them were recently graduated and the other one was a professional performer. The mean age of the pianists was 24.8 years (*SD* = 4.5 years).

1.3.1.2 Apparatus

Recordings were made at CSC (Center for Computational Sonology) of Padova University. A digital piano Real Piano GEM PRO 2 was connected to a Macintosh computer through a MIDI interface Steinberg PC MIDI-3. Each improvisation was recorded in MIDI format and audio files, stereo at 44.100 KHz. The digital piano was set on the *Grand Piano* timbre. Performers could listen to their improvisation through General Music MP2-A loudspeakers.

1.3.1.3 Experimental design

The experiment was planned in four phases, progressively limiting the musical means available to the performers. For each phase, performers were asked to record eight improvisations in order to communicate the eight expressive intentions suggested by each group of adjectives (cf. Table 2).

Phase 1: performers could choose a note of the digital piano and then should improvise only on the chosen note. The acoustical parameters they could use were: pitch of the chosen note, intensity, articulation and tempo.

Phase 2: the note to play was imposed as central C. Now, performers should improvise acting on intensity, articulation and tempo.

Phase 3: besides imposing the same note, central C, the intensity was fixed (MIDI key velocity = 100) by means of a special function of the digital piano. Performers, then, should express all eight expressive intentions by acting just on articulation and tempo.

Phase 4: finally the control of the duration of the note was inhibited and only the tempo parameter was available. In fact, a central C of fixed duration (260 ms) was pre-recorded in a PC connected to the piano, so that any piano key played would activate the pre-recorded sound. The 260 ms value was chosen, after a laboratory test, as the shortest duration of a note in order to perceive separately two notes played as fast as possible.

1.3.1.4 Procedure

Performers participated to the experiment in separate sessions. They were free to repeat at will their improvisations, until they were pleased with the recorded performances. The length of each performance was suggested as about 10-15 seconds, but performers could produce longer improvisations if they believed it a necessary means to better express their

intentions. Performers were prepared to the experiment by means of written instructions (cf. Apendix A.1) and they were invited to verbally express their comments at the end of the recording session.

1.3.2 Results

An analysis of variance (ANOVA) was conducted on MIDI data of each acoustical parameter, for the eight descriptors (expressive intentions) and the factors of musical expertise (musicians, M vs. non-musicians, NM) and phases (P1 to P4). Pitch and intensity MIDI values range between 0 and 127. Articulation was evaluated by means of the legato (L) parameter (L =D/IOI where D is the duration of the actual note and IOI is the Inter-Onset-Interval between two notes). L ranges between 0 (*staccato*) and 1 (maximum *legato*). For each performance, tempo was calculated as mean value number of notes per second.

For all parameters pitch, intensity, articulation and tempo, there was a significant main effect of descriptors (pitch: $F(7,28) = 9.90$, $p < .0001$; intensity: $F(7,28) = 24.36$, $p < .0001$; articulation: $F(7,28) = 5.66$, $p < .001$; tempo: $F(7,28) = 31.46$, $p < .0001$). This means that performers intended the eight expressive intentions as different from one another and used the musical means in a systematical way for communicating each one of them. Figures 3 and 4 show the mean profiles of pitch, intensity, articulation and tempo for all performers (Figure 3) and for the two groups of musicians and non-musicians separately (Figure 4). The next step of analysis consisted on verifying whether or not performers related the acoustical parameters to the eight descriptors in a way consistent with our hypotheses. To this aim, a planned comparison related the values hypothesized as high with those hypothesized as low. For example, intensity was hypothesized as high for descriptors 1, 2, 3, 4 and low for descriptors 5, 6, 7, 8. Planned comparison confirmed our hypotheses ($F = 41.21$; $p < .01$). The same result was found for articulation ($F = 17.85$; $p < .05$) and tempo ($F = 105.73$, $p < .001$) suggesting that our predictions in the choice of the eight semantic categories were consistent.

No mean effect of musical expertise was found, which suggests that the use of basic acoustical parameters for expressing the intentions is independent of musical training. The only significant interaction of descriptors and musical expertise was found on tempo ($F(7,28) = 2.55$, $p < .05$), suggesting that the effect of musical expertise on the use of tempo parameter is not the same for all descriptors. A comparison of professional musician's data in relation with the mean of all performers showed no significant difference for all parameters (pitch:

F(7,35) = .49; $p < .8321$; intensity: F(7,35) = .33; $p < .9359$; articulation: F(7,35) = .23; $p < .9749$; tempo: F(7,35) = .66; $p < .7008$). This result implies that the professional performer can be considered as representative of the manner how all subjects communicated the expressive intentions.

No significant mean effect of phases was found. This means that when some acoustical parameters were progressively fixed by experimental design (phases 2 to 4), the way of using the others parameters remained coherent with the previous phases. The interaction of phases and descriptors was significant for articulation, (F(14,56) = 2.02, $p < .05$), and borderline for tempo (F(21,84) = 1.60, $p < .0675$) suggesting that the effect of phases is not the same for all descriptors.

Performers' interviews suggest some qualitative considerations on the experiment. First of all, it emerged that they concentrated on the physical gesture for producing the improvisations conforming to the expressive intentions. One non-musician provided declarations such as: “Well, in this phase I’m not sure about how a X intention could sound, so I play with a X gesture and than I see if I’m satisfied with the sound.” The effort on gestures is strongly influenced by the particular methodology used (improvisations on one note). Nevertheless, it confirms that expressive intentions are directly related, mapped, on physical gestures, as they act as an intermediate between performer’s intentions and the sounds generated (Camurri et al., 2001). Finally, one musician affirmed that in some cases used specific musical structures – such as syncopation for intention 1 – in order to better express the intentions. One pianist admitted that sometimes was inspired by a piece of contemporary music where one note is played repeatedly. One non-musician reported that she tended to be inspired by images, such as a flow of water for intention 7.

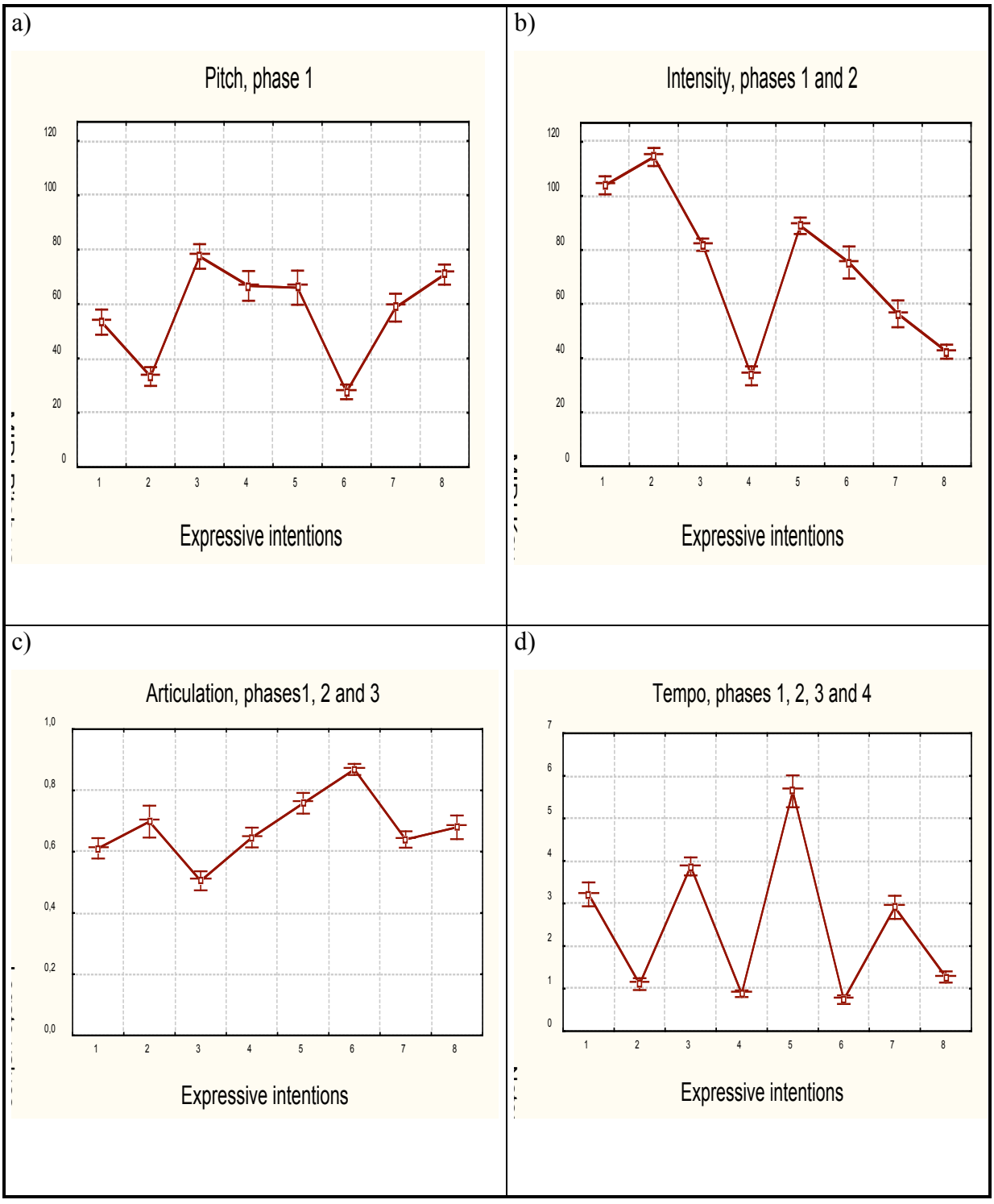


Figure 3: Mean values and standard errors of all performers' data for the four acoustical parameters: pitch (a), intensity (b), articulation (c) and tempo (d).

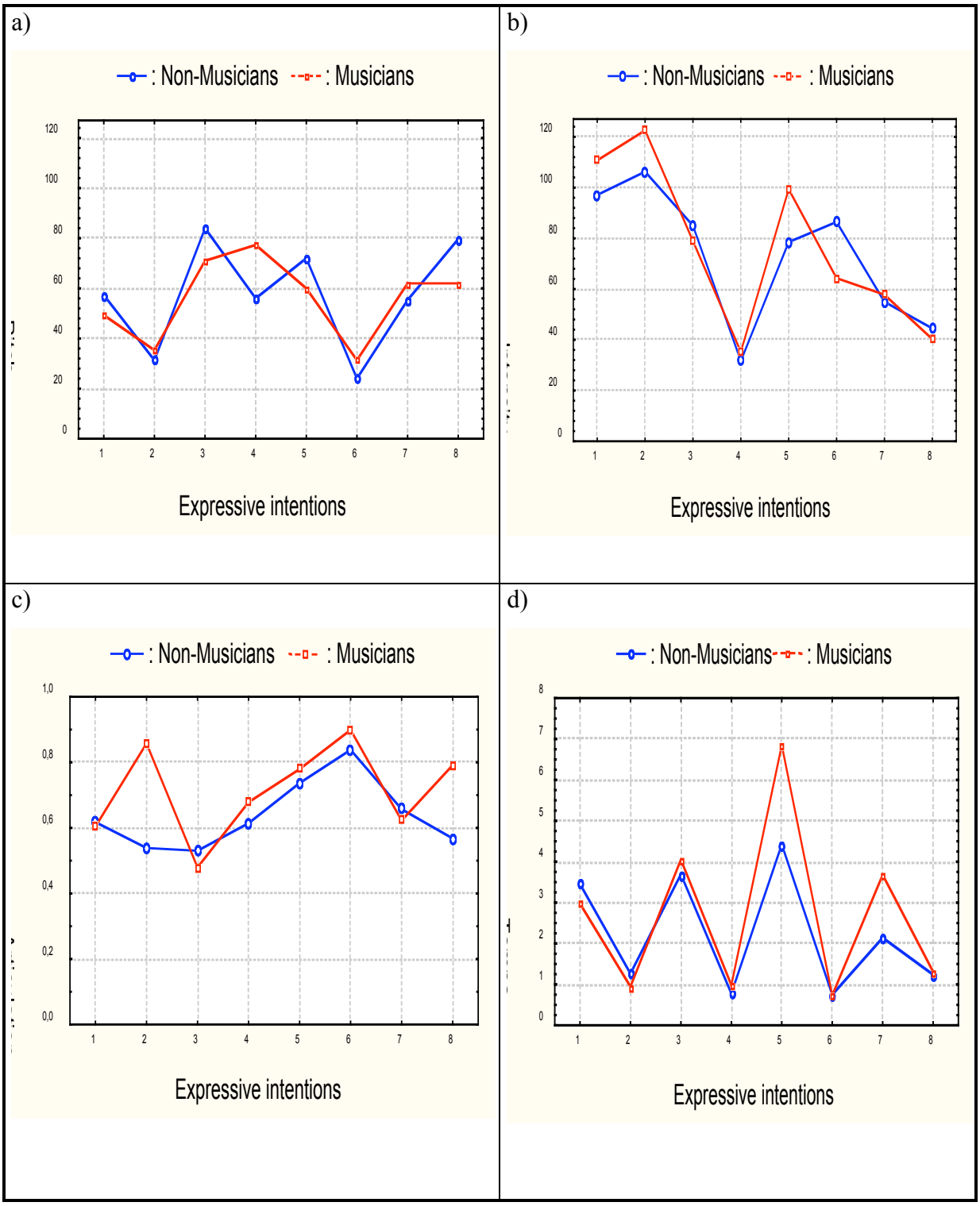


Figure 4: Mean values of performers' data for the four acoustical parameters: pitch (a), intensity (b), articulation (c) and tempo (d), divided in the two clusters of musicians and non-musicians.

1.3.3 Discussion

The main aim of Experiment 1 was to analyze how performers use pitch, intensity, articulation and tempo as expressive means. Results of ANOVA showed that performers used the acoustical parameters in a systematic manner. This suggests that it exists a common code of musical expressivity, confirming previous results obtained with the musical score (for a review, cf. Juslin, 2001). To what degree the code used is a product of a cultural convention may be explored by cross-cultural experiments with non-Western performers. In this perspective, Juslin (2001) hypothesized that tempo and intensity are used, as expressive means, in a similar manner in different cultures.

The relation between acoustical parameters and descriptors is very clear for tempo, as can be observed from Figures 3d and 4d. The subdivision of all expressive performances in two clusters (fast vs. slow, in concordance with our hypotheses, cf. Table 2) implies that performers have a consistent knowledge of how tempo should be used as an expressive means. One explanation for this result is that tempo factors play a fundamental role in human experience (Gabrielsson & Lindstrom, 2001; Gundlach, 1935; Hevner, 1937; Juslin 1997a; Rigg, 1964; Sherer & Oshinsky 1977); for example tempo is related to basic gestures such as the motor action, which is experienced by all human beings (Friberg & Sundberg, 1999; Friberg, Sundberg & Frydén, 2000). On the other hand, the higher variability in the use of the articulation parameter as an expressive means may be due to the higher-level nature of the parameter itself (L is defined as the ratio between the duration of a note and the IOI between two notes). Second, articulation seems to be related to musical activity more than to common human experiences: results show that musicians used a more varied range of L values to differentiate the eight expressive intentions one from each other, due to their more trained knowledge of the expressive potential of the articulation parameter.

ANOVA analysis showed that performers used intensity, articulation and tempo consistently with our hypotheses on the choice of the adjectives (cf. Table 2). This result suggests that semantic categories may be described by means of the values assigned to few basic parameters.

Finally, the experimental framework used, musical improvisation on one piano note, allowed us to analyze the role of musical expertise in the production of expressive performances. In relation to previous works on performer's expressive intentions, which analyzed the expressive deviations from the score values (for a review, cf. Juslin, 2001), this is, to our knowledge, one of the first attempts to approach non-musicians' production of

expressive performances in an empirical manner. Results showed that musicians and non-musicians used pitch, intensity, articulation and tempo in a very similar manner in order to communicate the eight intentions (cf. Figure 4). This result supports the hypothesis of a common code of musical expressivity, based on analogies with non-musical human experiences such as the motor action (Friberg & Sundberg, 1999; Friberg, Sundberg & Frydén, 2000).

1. 4 Experiment 2: Perception of expressive improvisations

The main aim of Experiment 2 was to analyse to what extent listeners are able to recognize performer's expressive intentions, obtained in Experiment 1. Second, we observed how the perception of the eight intentions varies across the four phases, when progressively fewer acoustical parameters were involved. This Experiment should therefore suggest which role pitch, intensity, articulation and tempo play in the perception of expressive intentions. Finally, the role of musical expertise (musicians M, vs. non musicians NM) on the recognition of the intentions was object of study as well.

1.4.1 Method

1.4.1.1 Participants

Thirty volunteers participated to the perceptual test. They were assigned to one of two groups on the basis of their musical expertise: group 1 consisted of 15 amateur musicians, group 2 consisted of 15 non-musicians. All of them were exposed to various music genres during their life; 21 listeners were University students, and 11 hold a University Diploma. The mean age of the participants was 24.6 years (*SD* = 5.7 years).

1.4.1.2 Apparatus

Listening experiment was run at IRCAM (Institute de Recherche et Coordination Acoustique Musique), Paris. Stimuli were reproduced in a laboratory setting by a Sony CD player and Tannoy loudspeakers.

1.4.1.3 Stimuli

Stimuli were given by the 32 improvisations (8 improvisations * 4 phases) produced by the professional pianist in Experiment 1. Stimuli were chosen considering the results of Experiment 1, which showed that professional pianist's performances were representative of the manner how all subjects communicated the expressive intentions.

1.4.1.4 Procedure

Two listening sessions were organized, the first with non-musicians and the second with musicians. For the listening experiment, the 32 stimuli were proposed as recorded, in order from the first phase to the fourth, but mixed internally in each phase. After a first listening to all improvisations, in order to give a reference framework of the stimuli used, each piece was proposed to the subjects two times. Immediately after the end of the second reproduction, listeners judged each stimulus indicating, on a graduated scale ranging from *nothing* to *extremely*, how much each group of adjectives (cf. Table 2) was appropriate for each improvisation. Listeners were prepared for the experiment by means of written instructions (cf. Appendix A.2) and were invited to write their comments at the end of the session.

1.4.2 Results

A first analysis of variance (ANOVA) was conducted, separately for each phase, on listeners' ratings of all improvvisations, ranging from 0 (*nothing* = the adjectives do not describe the performance) to 4 (*extremely* = the adjectives describe very well the performance), for the factors of musical expertise (M vs. NM), the expressive performances (eight for each phase), and the descriptors (the eight semantic groups, cf. Table 2).

Phase 1: Significant main effects of musical expertise ($F(1,28) = 5.66$; $p < .05$), performances ($F(7,196) = 5.11$; $p < .0001$) and descriptors ($F(7,196) = 4.76$; $p < .0001$) were found. This means that listeners recognized the difference between performances and that

they were aware of the different expressive meanings suggested by the semantic groups. Moreover, the only significant two-ways interaction was found between performances and descriptors ($F(49,1372) = 27.51$; $p < .05$) which suggests that the eight groups of adjectives were associated to the eight performances in a sistematic manner. The task of the analysis therefore is to understand if the semantic groups associated with the performances correspond to the expressive intentions communicated by the performer. If the highest rating is given to the correct descriptor, we can assume that the expressive intentions are correctly recognized. Figure 5a shows how listeners rated the eight performances of phase 1. Descriptors 1, 2, 3, 6 and 8 display the highest *absolute score* (in relation to all descriptors' ratings given to one single performance) on the corresponding performances. Moreover, descriptors 1, 2, 3, 5, 6 and 8 show the highest *relative score* (the score of a descriptor for a performance in relation to the score of the same descriptor for all other performances) while descriptors 4 and 7 the second highest relative score.

Phase 2: Significant main effect of musical expertise ($F(1,28) = 5.69$; $p < .05$), performances ($F(7,196) = 14.22$; $p < .0001$) and descriptors ($F(7,196) = 6.05$; $p < .0001$) were found, confirming the different use of the eight groups of adjectives for describing the performances. The significant descriptors by performances interaction ($F(49,1372) = 32.20$; $p < .05$) is plotted in figure 5b; it can be observed how six descriptors (1, 2, 3, 4, 7 and 8) were associated to the corresponding performances with the highest absolute score. Moreover, descriptors 2, 3, 4, 5, 6 and 8 show the highest relative score and descriptors 1 and 7 the second highest relative score. These results suggest that the expressive intentions have been well recognised in the second phase too, when all performances were played on the same note (central C).

Phase 3: Results of ANOVA showed significant main effects of musical expertise ($F(1,28) = 5.18$; $p < .05$), performances ($F(7,196) = 13.58$; $p < .0001$), descriptors ($F(7,196) = 14.07$; $p < .0001$) and significant descriptors by performances interaction ($F(49,1372) = 14.87$; $p < .0001$). Figure 5c shows how the 8 groups of adjectives where used to describe the 8 performances. It can be noted that four descriptors (3, 4, 5 and 6) were assigned, with both the highest absolute and relative score, to the corresponding performances. This means that, even if the recognition decreased in relation to the previous phases, four expressive intentions were correctly recognized when only articulation and tempo were used by the performer.

Phase 4: In the last phase no significant main effect of musical expertise was found, while there still was significant effect of performances ($F(7,196) = 19.63$; $p < .0001$) and descriptors ($F(7,196) = 19.63$; $p < .0001$). Again, a two-ways descriptors by performances

interaction (F(49,1372) = 14.00; $p < .0001$) suggests that the groups of adjectives proposed to the listeners have been used systematically in order to differentiate the eight performances one from each other. Figure 5d shows the associations of the descriptors with the performances: expressive intentions 2, 3, 4 and 5 were correctly recognized (highest absolute score given to the correct descriptor). Descriptors 2, 4, 5 and 6 have been associated to the corresponding performances with the highest relative score.

A comparison among the four phases of the ANOVA results above presented suggests that listeners' behaviour was similar in phases 1 and 2, and that there was a decrease of recognition in phase 3, when pitch and intensity were constant for all expressive intentions. In phase four, recognition was maintained at a level similar to phase 3. The gap between the first two phases and the last two means that intensity plays an important role in the recognition of the expressive intentions. We were therefore interested in understanding if this result is true for all intentions or just for some of them. In fact, it may be possible that each acoustical parameter plays a different role in the perception of each expressive intention.

To investigate this issue, an across-phases ANOVA analysis was conducted on listeners' ratings of a descriptor for the corresponding performance. Thus, the values assigned by listeners to descriptor 1 (*slashing, impetuous, resolute*) for rating the performance played with a *slashing, impetuous, resolute* intention were compared in the four phases. The same analysis was done for the others intentions. ANOVA showed that the effect of phases on listeners ratings is significant for all intentions except intention 5 (*bold, torrential, unbridled*). (Intention 1: F(3,84) = 8.90; $p < .0001$; intention 2: F(3,84) = 6.64; $p < .001$; intention 3: F(3,84) = 32.63; $p < .0001$; intention 4: F(3,84) = 5.21; $p < .01$; intention 5: F(3,84) = 1.09; $p < .3598$; intention 6: F(3,84) = 25.56; $p < .0001$; intention 7: F(3,84) = 6.56; $p < .001$; intention 8: F(3,84) = 62.89; $p < .0001$). Results are shown in Figure 6. It can be observed that the across-phases patterns of recognition depend on each specific expressive intention. Specifically, the recognition of expressive intentions 1 (*slashing, impetuous, resolute*), 2 (*heavy, hard, rigid*) and 8 (*sweet, tender, simple*) clearly decreased from phase 2 to phase 3, suggesting that intensity played an important role in the communication of these intentions. For intention 3 (*hopping, galloping, springing*) the decreasing of listeners' ratings appeared only in phase 4, which implies that articulation clearly influenced recognition (Fig. 6c). Conversely, intention 6 (*hollow, solemn, obscure*) was well recognized only in phase 1, when the pitch was used as an expressive means. Finally, patterns of intentions 4 (*vacuous, hesitant, tired*), 5 (*bold, torrential, unbridled*) and 7 (*fluid, fluent, fleetly*) do not suggest a clear relation with one single parameter. This means that the recognition of these intentions may have been

biased by a more complex interaction between two or more acoustical parameters. Nevertheless, it should be noted that the mean value of listeners' ratings for these last intentions resulted high also in phase four, when only the manipulation of tempo was available to the performer.

Finally, the second ANOVA analysis showed a significant effect of musical expertise only for intentions 6 (*hollow, solemn, obscure*, $F(1,28) = 4.61$; $p < .05$) and 7 (*fluid, fluent, fleetly;* $F(1,28) = 4.86$; $p < .001$). This result should be related to the first ANOVA, where an overall significant difference between musicians and non-musicians was found in phases 1, 2 and 3. In general, we may conclude that even if the two groups of subjects displayed a different behaviour in the first three phases, the recognition of expressive intentions was independent of musical expertise.

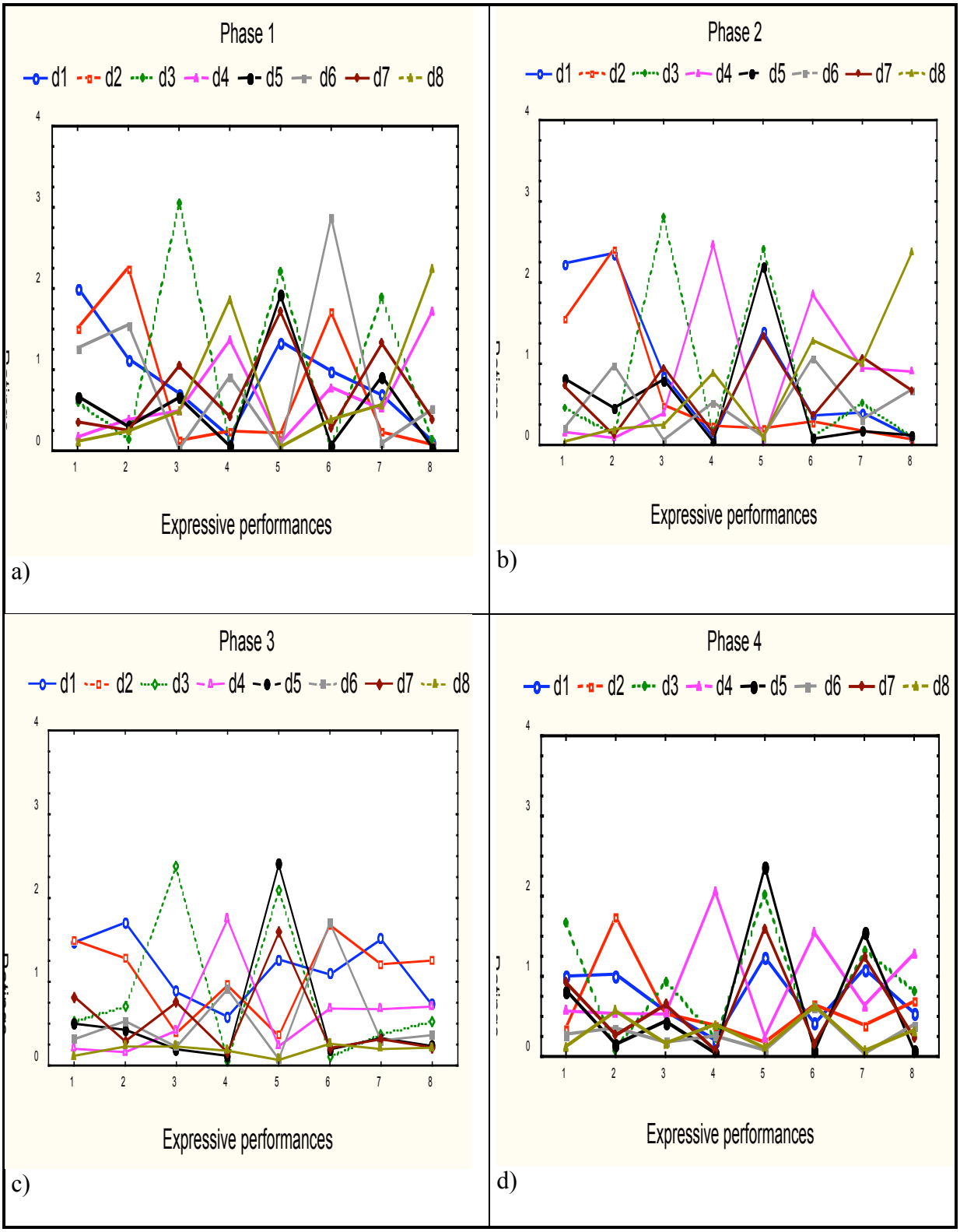


Figure 5: Listeners' ratings of the improvisations, ranging from 0 (*nothing)* to 4 (*extremely)*. The eight expressive performances and the eight descriptors (d1-d8) refer to the eight semantic groups chosen for the experiment (cf. Table 2).

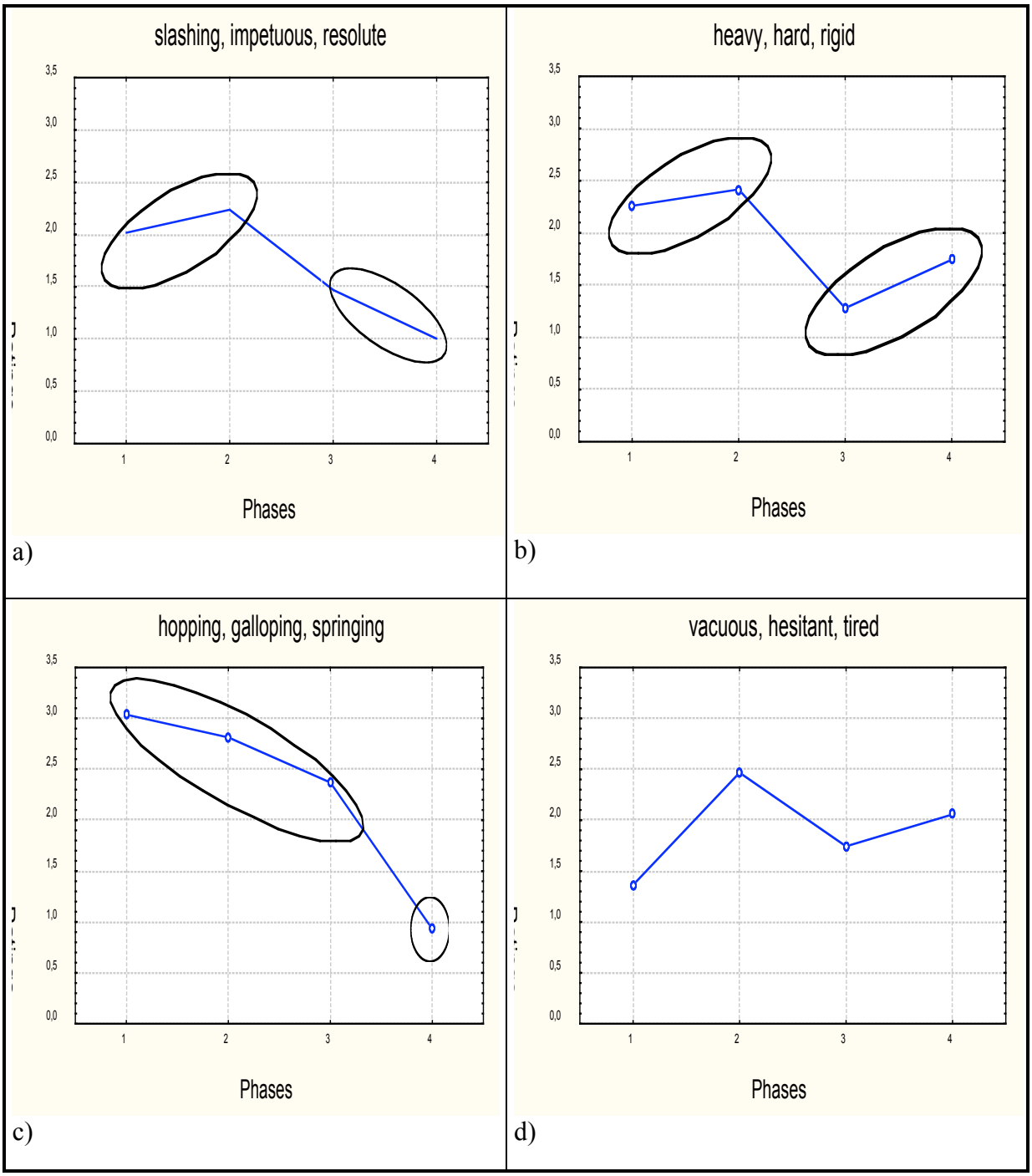


Figure 6: Listeners' ratings of performer's improvisations. From a) to h) are shown the values given to the eight descriptors for describing the corresponding performances. The circles drawn show the phase in which listeners' recognition decreased.

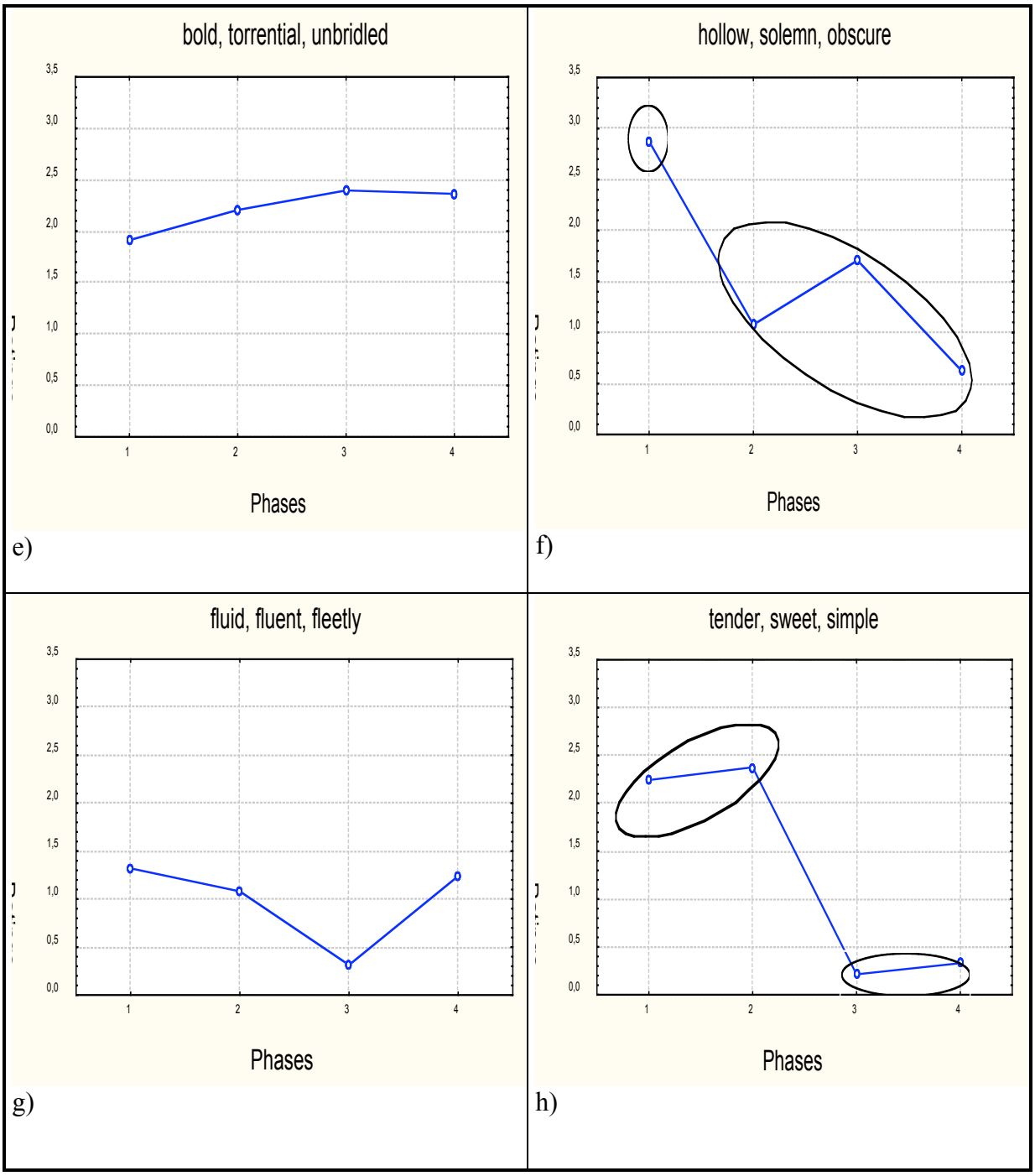


Figure 6: Listeners' ratings of performer's improvisations. From a) to h) are shown the values given to the eight descriptors for describing the corresponding performances. The circles drawn show the phase in which listeners' recognition decreased.

1.4.3 Discussion

The main aim of Experiment 2 was to explore whether listeners can recognize performer's expressive intentions when improvisations are produced using one single piano note. Results suggest that listeners can recognize most performer's intentions even when very few musical means are used.

A work by Juslin & Madison (1999) analyzed listeners' accuracy in recognizing the emotional expression of piano performances played with different expression (*anger, sadness, happiness, fear*) by artificially removing various acoustical parameters (tempo, dynamics, timing – defined as sequence of inter-onset intervals – and articulation). Their results indicated that "timing patterns alone were capable of communicating at least some emotions with better than chance accuracy" (Juslin 2001, p. 319). Our research, which used real, not manipulated, performances, seems to confirm Juslin & Madison's hypothesis: in phase 4, tempo alone was sufficient for the recognition of four expressive intentions. This result is limited by the fact that listeners' responses were collected by means of the same closed list of adjectives proposed to performers in Experiment 1, nevertheless, given the difficulty of the recognition task, it may be considered as significant.

The second aim of Experiment 2 consisted in an empirical analysis of how listeners are influenced by pitch, intensity, articulation and tempo in the perception of expressive intentions. An open research problem regards the combined effect of more acoustical parameters in the communication of expressive content. While most empirical research report the *interactive* effect on listeners' judgment (Gabrielsson & Lindstrom, 2001; Juslin 1997a; Shellemberg, Krysciak, & Campbell, 2000), other experiments with synthesized stimuli showed that more parameters contribute in an *additive* manner (Juslin, 1997b). In this perspective, the subtractive methodology in an improvisation context may be particularly suitable for research on cues interactive vs. additive effects because it allows having real performances even by progressively fixing one parameter. In the present study, we analyzed whether listeners could recognize performers' expressive intentions when progressively fewer musical means were involved. Intuitively, we could think that listeners' recognition would decrease along the four phases, since the musical means available to the performers decreased along the phases. This would imply that the four parameters pitch, intensity, articulation and timing have an *additive* effect on the perceived expressiveness. Figure 6 shows that this happens only for expressive intention 3. On the other hand, expressive intention 5 is recognized with increasing precision along the four phases (Fig. 6e). The dependence of the

recognition patterns from each semantic category implies that the use of more musical means may either clarify (additive effect) or confuse (interactive) the listeners' perception of expressive intentions. The overall results of Experiment 2 showed that listeners' ratings decreased between phases 2 and 3 (fig. 6), which confirms the fundamental role played by intensity for the perception of expressive content found in previous experiments with the musical score (Canazza et al., 1997; De Poli et al., 1998; Juslin 2001).

1.5 General discussion

The two experiments were designed with the aim of analyzing the communication of expressive intentions from the performer to the listener in a special case of musical improvisation: performers could play only one note of the piano. The analysis of both generative aspects (performing) and interpretative ones (listening, responding) is of great importance for understanding whether performers and listeners share a common code for the communication of expressive content (Juslin, 1997a, 2001). In this perspective, the present study introduces two main advantages for the empirical analysis of the relation between performers' expressive intentions, acoustical parameters and listeners' perceptual experience.

First of all, the improvisation model (cf. Figure 2) is a useful approach toward an understanding of the communication channel that goes from the performer to the listener since it overcomes "The confounding of the properties of the composed structure and properties of the actual performance" (Gabrielsson & Lindstrom, 2001, p. 223). In relation with previous studies where expressivity was analyzed in relation to a musical score (for a review, cf. Juslin, 2001), the improvisation context allows to limit sources of variability such as listener familiarity with a musical excerpt, the confounding expressive intentions of the composer and performer and the socio-cultural distance between composer and the listener. We considered a special case of musical improvisation, where performers could play only one note, since we were interested in analysing the role of basic acoustical parameters, more then complex musical structures, in the communication of expressive content. Future research should explore the possibilies given by such an experimental context for the empirical investigation of other aspects of the musical communication process.

Second, through the subtractive methodology used in Experiment 1 we collected a set of expressive performances characterized by progressively fewer acoustical parameters (Phase 1: pitch, intensity, articulation and tempo; phase 2: intensity, articulation and tempo; phase 3:

articulation and tempo; phase 4: tempo). This method allowed us to analyze how each single acoustical parameter is used for the generation (Experiment 1) and the perception (Experiment 2) of the expressive intentions. Comparing to an artificial manipulation of the stimuli used in previous studies (Juslin, 1997b; Juslin & Madison, 1999), the advantage given by this kind of subtracive methodology is that expressive intentions are always produced by performers, even when one single parameter is used. All stimuli used for the perceptual experiment were in this manner directly related to performers' expressive intentions without being manipulated by the experimenter.

In our study we considered only few acoustical parameters, while others, such as timbre, intonation, vibrato, tone attacks, tone decays and pauses seem to play an active role for conveying performer's intentions to listeners (Juslin, 2001). Moreover, the active vs. interactive effect of acoustical parameters may change when more parameters are involved. For this reason, future research should extend the range of musical features used in the experiments.

Finally, future research may introduce continuous measurements techniques of the perceived expression in order to analyze how the time-dependent patterns influence the communication of expressive content in the case of musical improvisation (Clynes, 1977; Krumhanls, 1997; Madsen, 1997; Shubert, 2001; Sloboda & Lehmann, 2001).

2. *Music, cognition and culture: an analysis of the convergence of music cognitive psychology and ethnomusicology.*

2.1 Introduction

Cognitive psychology of music and ethnomusicology grow up on different basis. In general, we can say that the first regards musical perception and cognition as a product of universal cognitive and physiological processes. In both generative (production) or interpretative (perception) aspects of musical cognition, psychology of music focuses on the mental activities involved and uses experimental procedures in order to explain musical experiences. On the other hand, ethnomusicology approaches the musical phenomena as the product of a specific socio-cultural context analyzing the relation between musical information and cultural information. The basic assumption of ethnomusicology is that musical experience is structured by functional and symbolic factors, which give a meaning to the sounds (Merriam, 1964).

The two different approaches to the study of music as a (human) experience use different research design, collection and interpretation of data, which are a reflect of different basic epistemological assumptions. E. Tolbert, in a study concerning the theoretical analysis of musical meaning (1992), observes that a former epistemological controversy is given by *reductionism,* in the way that "From the point of view of most ethnomusicologists, the nature of musical meaning is inapproachable by empirical studies". (Tolbert, 1992, p. 7). It is a matter of fact that while cognitive psychology relies on the empirical-reductionist paradigm, ethnomusicology grow up as a social science based on interpretations of phenomenological observations. Therefore, even if both approaches are accepted as useful for explaining different aspects of the musical experience, the problem of comparability of data and methods should be taken in consideration if we wish to analyze the domains of convergence of the two disciplines, since "Interdisciplinary research [...] appears to be considerably limited by the different methodological approaches used by the respective discipline." (Wegner, 1993, p. 201).

In this perspective, it should be observed that the former distance between cognitive psychology of music and ethnomusicology has been nowadays reduced by new research paradigms - in both domains - that moved toward new theoretical assumptions, which tend to

remove the old scientific vs. humanistic controversy. Along with the development of experimental procedures and technologies for ethnographic research, theoretical and empirical work has been done in the direction of an integrated analysis of the *natural* and *cultural* aspects of perception and cognition. The effort toward an interdisciplinary approach stimulated the emergence of new scientific domains such as those of *cognitive anthropology* (Tyler, 1969) and *cultural psychology* (among others: Stigler, Shweder, & Herdt, 1990).

Focusing on music research, the advantages given by an interdisciplinary approach are addressed explicitly by both psychologists of music and ethnomusicologists. J.Baily (1988) is explicit in this sense: "While it may be argued that the differences between the "orientation, methods, analytical techniques, and goals are so vast as to be perhaps unbridgeable" [quoting Koskoff, 1988] I venture to propose that the future study of musical cognition does require an integration of these approaches [ethnomusicology and cognitive psychology] to specific problems." (Baily, 1988, p. 115). E. Tolbert proposed that the advantages are reciprocal for the two domains: “Ethnomusicologists need psychology of music to establish empirical baselines of perception and preference and to elucidate cognitive processes, information that can then be integrated with cultural information and used as evidence for the construction of musical meaning; likewise, psychology of music needs ethnomusicology not only to provide it with data from cultures other than our own, but to guide it to appropriate levels of specificity, form and function in the search for musical meaning.” (Tolbert, 1992, p. 9).

The aim of the present chapter is to analyze the existing domains of interaction between cognitive psychology of music and ethnomusicology in order to bring in evidence the directions of future interdisciplinary research. Our analysis, following Tolbert's consideration, is divided the in two parts, which reflect the different "weight" that each domains has in a interdisciplinary perspective, as shown in Figure 7.

From one hand, psychology of music started to look at cross-cultural comparison as a useful research tool on universal modes of human perception and cognition, since the validity of the work so far realized has been culturally restricted to Western modes of perception. The main concerns are centered on the problem of verifying if and how musical perception and cognition differs among cultures. This approach, called *cross-cultural psychology of music* is discussed in section 2.2. Particular attention is given to the application of a cross-cultural approach in research on the communication of expressive content (section 2.2.1).

On the other hand, a growing number of ethnomusicologists started to incorporate knowledge, methods and results from the field of musical perception and cognition with the aim of explaining some aspects of the musical experience that are unreachable by

anthropological methods. In all his studies, J. Baily stressed the importance of this approach: "Some of the most significant research in ethnomusicology has resulted from anthropologically oriented inquires into the nature of musical cognition. We have witnessed the development of a "cognitive ethnomusicology", based on the exploration of emic notion about music." (Baily, 1988, p. 114). *Cognitive ethnomusicology* is discussed in section 2.3; the important concerns related to a "transfer" of experimental methods and technologies from the laboratory to the field are analyzed in section 2.3.1. A topic of specific interest is given by the techniques for determining categories of similar musical stimuli, considered in section 2.3.2.

Finally, in section (2.4) are proposed some hypotheses on the possibility of an integration of cross-cultural psychology and cognitive ethnomusicology in a common research framework.

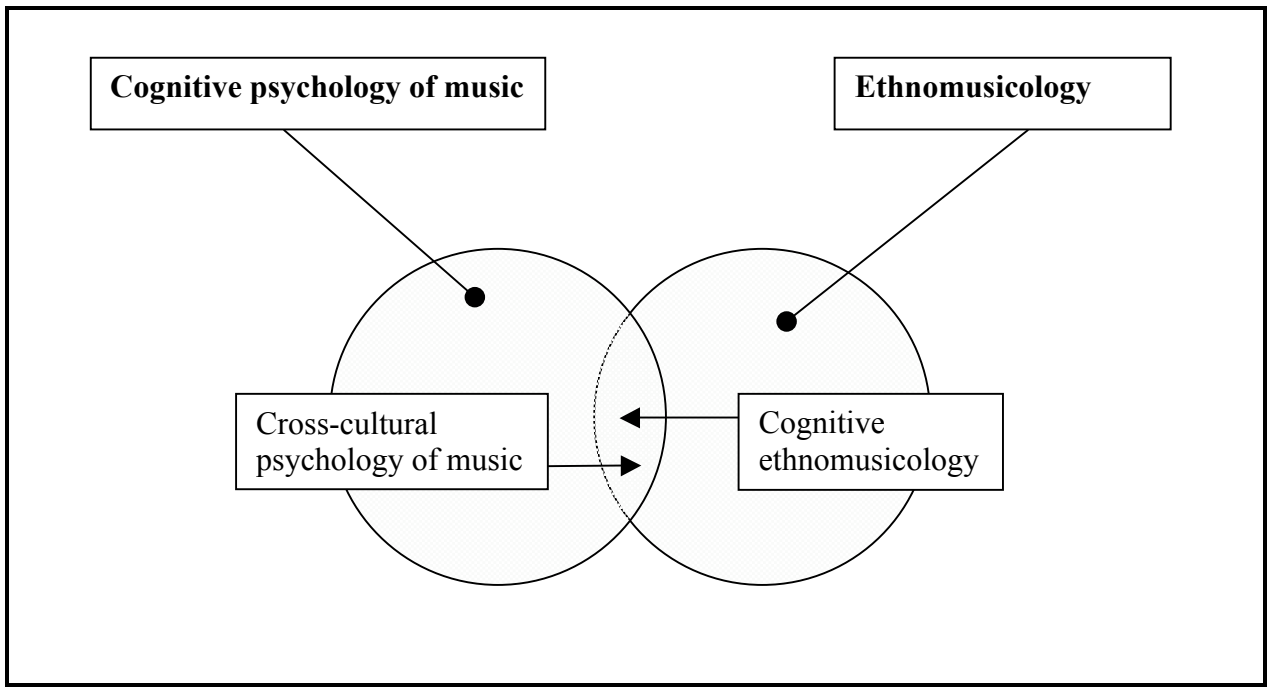


Figure 7: The intersection of cognitive psychology of music and ethnomusicology gives rise to two different interdisciplinary approaches which reflect the reciprocal "weight" of each discipline: *cross-cultural psychology of music*, discussed in section 2.2, and *cognitive ethnomusicology*, analyzed in section 2.3.

2.2 Cross-cultural cognitive psychology of music

Dowling & Harwood's book "Music Cognition" (1986) is one of the fundamental references on the field of music perception and cognition. The functioning of the mental activities involved in musical listening is analyzed from the perspective of the cognitive sciences' "information processing" paradigm. Even if the focus is on psychology of music, Dowling & Harwood's study is one of the first attempts to explicitly build a "bridge" toward ethnomusicology, as stated in the preface: "Ethnomusicology for us has been a rich source of anthropological theories, methods and descriptions of musical experience." (Dowling & Harwood, 1986, p. xiii). The way in which ethnomusicology may be integrated in psychological research is explained in the same paragraph: "We believe there is a need to extend the study of music cognition to a range of the world's cultures wider than those of western Europe." (Dowling & Harwood, 1986, p. xiii)

The need for an integration of non-Western cultures into the field of cognitive psychology of music founds its basis on the assumption that culture does influences at *some level* human cognitive processes, such as the formation of mental representations of the external world. This assumption arises the problem, for psychologists, of understanding at *what level* and to which degree mental activities are *universal* or *culture specific*. In fact, while the idea that culture biases all basic mental processes, such as analogy-making, has been criticized ("To make such an assumption would be almost as silly as thinking that every physics experiment done in America must be repeated in Australia and Tibet to check whether the same laws of physics hold there as well." (Hofstatder, 1995, p. 365-66)), on the other way, the fact that mental information processing is in some way context is widely accepted sensitive ("Would African and Indian drummers [...] replicate the results attained [...] from pianists at the Lycée La Fontaine in Paris, whose perception and performance of simple polyrhythms changed according to tempo?" (Kippen, 1987, p. 175)).

The well-known problem of the "universals vs. culture specific" nature of cognitive processes, which is the core concern of cross-cultural psychology, applies as well to the field of music perception and cognition (Harwood, 1976), as stated very clearly by Kippen (1987): “Experiments conducted in the field of music perception have resulted in many valuable and interesting observations. Yet, as most researchers have no doubt realized, the validity of such work has so far been culturally restricted to what may generally be termed “Western” modes

of perception. In order to ascertain the extent to which these modes of perception are shared by people of non-Western cultures, and ultimately to assess whether certain kinds of cognitive processes are universal in humans, there is a need to extend experiments to those whose musical perceptions and conceptualizations seem to differ radically." (Kippen, 1987, p. 174). The principal aim of cross-cultural research on music cognition is therefore to individuate, and possibly explain, the universal vs. cultural attributes of human musical behavior. In this perspective, the general hypothesis is that "Cultural variability is constrained by some underlying properties of the human information-processing system" and therefore "A psychological theory of musical behavior must be applicable across these differences" (Dowling & Harwood, 1986, p. 4). The method used by cognitive psychologists in order to verify this hypothesis relies on the two following approaches.

From one hand, previous results obtained by ethnomusicologists' analyses of different musical traditions are taken into consideration. Dowling & Harwood (1986) analyzed a variety of musical repertoires in order to get insights in different ways of organizing the sound. In this way they hypothesized that some general principles, such as "(1) the use of discrete pitch intervals, (2) octave equivalence, and (3) the presence of four to seven focal pitches in an octave" (Dowling & Harwood, 1986, p. 4) seem to apply universally. Such an approach, which focus on the musicology (analysis) part of the studies developed by ethnomusicologists, is based on inductions on the way people from different cultures organize, and therefore conceptualize, musical attributes such as pitch, melody, rhythm and metric.

The second approach, nowadays spreading out in the field of psychology of music, consists in developing cross-cultural experiments. Empirical comparison of perceptual experience can be obtained through experiments with: a) listeners of different cultures attending to the same musical material; b) different musical stimuli (familiar and unfamiliar musical systems) proposed to the same group of subjects and c) both a) and b). This approach, which aims to "bring the field into the laboratory" (Lortat-Jacob, personal communication), generally uses the same methods and procedures developed for the experiments with Western listeners and musical stimuli. For this reason, we can say that part of the ethnomusicological "material", non-Western music and listeners, is adapted to laboratory settings in order to allow the comparability of the data.

A wide range of aspects of musical perception and cognition has been explored through cross-cultural experiments. Perlman & Krumhansl (1996) found intercultural differences in the cognitive representations of musical intervals through a magnitude-

estimation experiment (six Javanese and six Western musicians, 36 intervals ranging from 60 to 760 cents). Hopkins (1982) analyzed cross-cultural perception of the rhythmical structure of Norwegian traditional repertoire (Western, Greek, and South-Indian musicians). Results of her study suggest that differences in tapping along the stimuli reflect the different musical concepts of each musician, influenced by each culture's repertoire. Drake & Ben Hani (in press) confirmed the role of acculturation in synchronizing (tapping) with music in an experiment with French and Tunisian repertoires and subjects, showing that people synchronize at a higher hierarchical level with music from their own culture. Drake & Bertrand (2002) recently proposed an experimental framework for intercultural research for "The quest of universals in temporal processing in music" (Drake & Bertrand, 2002). To this aim, they combined previous results obtained in developmental research (comparison across age), comparisons across musical skill (musicians and non-musicians), and intercultural research for identifying five possible candidates to the status of universals cognitive of tempo perception. Ayari, (2002) analyzed how the role of acculturation with the Arab musical system influences the segmentation (in real time) of modal improvisations (subjects: 25 Arab musicians, 15 Western musicians).

These examples suggest that either if cross-cultural experimental efforts are directed toward the analyses of universal cognitive musical processes or toward the acquisitions of capacities through cultural exposure, in both cases the focus is on the *psychological mechanisms* of musical perception and cognition. As previously stated, psychology "uses" to this aim people and musicological analysis of other cultures' repertoire, without accessing the ethnographical knowledge that is at the core of an *ethno*musicology. In any case, the interaction between the two scientific communities is strengthen by the need of accessing "material" of other cultures, material that often is unavailable to psychologists' "hands". In this sense, if music is accessible through recordings, the subjects for the experiments are not "in commerce". The ethnomusicologist represents therefore the natural partner for the psychologist since he/she is constantly in contact with people who often are not exposed to musical genres other than their own. Ethnomusicologists may participate actively to cross-cultural research, developing perceptual and cognitive experiments in the field. The implications of this possibility, which would imply to "bring the laboratory to the field" (Lortat-Jacob, personal communication) are explored in section 2.3.1

2.2.1 Cross-cultural research on expressive content communication

As described in chapter 1, cognitive psychology of music has been characterized in the last decade of the XX century by an increasing interest toward the generative (creation) and interpretative (perception) processes underlying the communication of emotions, feelings, or more in general *expressive content*, by music. Scholars who deal with this topic (cf. Sloboda & Juslin, 2001) start nowadays to be interested by a cross-cultural approach, motivated by a simple question: are listeners from another culture able to recognize the expressive content of a unfamiliar musical system?

In relation with other topics of music perception and cognition, cross-cultural research on expressive content arises a number of theoretical and methodological problems, which analysis would require a work on its own, out of the scope of these pages. Nevertheless it is important to outline here some of the basic concerns, as they may serve for the present discussion.

The first fundamental question is: do the concepts of musical expressiveness, emotional content, expressive intentions, apply to other musical cultures? Evidence from ethnomusicological research demonstrated that many traditions do not intend music as an esthetical source of emotional communication. In this case, experiments on expressive content perception may be not pertinent.

A second concern, related to the previous one, regards the different role played by music in many traditional societies. Ethnomusicologists reported that in many traditions music assume an emotional meaning only when it accomplishes a functional role in a specific context. Just to give an example, music can induce strong emotional reactions, such as trance, only when it is associated to a ritual that takes place in a determined spatio-temporal context, where complex socio-cultural conventions are involved. (For a complete analysis of the relations of music with trance, cf. Becker, 1994; Rouget, 1985). The fundamental relation between music, the context where it is experienced, and the emotional response should therefore be submitted to extensive analysis if cross-cultural comparison is envisaged.

The previous concern suggests that the western mode of listening to "classical" repertoire (sitting quietly in a concert hall) is in some way suitable to be replicated in laboratory setting. This is why perceptual experiments with Western listeners and music are widely accepted by the scientific community. We may say that in this case the laboratory setting belongs to the same cultural environment from which music and listeners are taken. But are these experimental methods adaptable to other musical cultures? This topic, which is

important for any attempt to realize cross-cultural experiments, will be discussed in section 2.3.1.

Along with these methodological problems, we can still argue if it would make sense to study perception of expressive content with a cross-cultural approach. Ethnomusicologists suggest that "All musical sound structures are socially structured in two senses: they exist through social construction, and they acquire meaning through social interpretation." (Feld & Keil, 1994, p. 85, quoted by Balkwill & Thompson 1999, p. 44). If emotional meaning in music is determined by cultural convention, does it make sense to explore how listeners unfamiliar with that culture perceive it? The question is important, but it could be argued that a response should come from cross-cultural comparison itself. Moreover, it is important to observe the difference existing between *having* an emotional response to music and the capacity of *perceiving* the emotional, expressive content of the music itself (cf. Sloboda & Juslin, 2001). Therefore, cross-cultural studies, as it is for those with Western music and subjects, should clarify the terms in which they consider musical expressive content.

Balkwill and Thompson (1999), who run one of very few experiments on cross-cultural emotion perception, observed that "Empirical evaluation of this issue has been complicated by the unicultural focus of previous research", and they advance the hypothesis for which "Although no one would deny the influence of culture on individuals' judgments of emotion in music, there may also be universal influences underlying musically expressed emotion. In addition to the conventions of a specific tonal system, listeners may be influenced by variations in psychophysical dimensions of music, such as tempo, timbre, and stimulus complexity." (Balkwill & Thompson, 1999, p. 44). To what extent some basic psychophysical cues (tempo, melodic complexity, rhythmic complexity, pitch range and timbre) influence the emotional perception of music from an unfamiliar tonal system?

The model proposed by these authors, reported in figure 8, relies on the idea that performers and listeners use both culturally determinated conventions and basic perceptual cues as sources of (perceived) emotional meaning. Attaining to the model, the statistical distributions of basic musical factors, such as tempo and stimuli complexity, can give information on the intended expression to a listener who is not familiar with the cultural cues. This hypothesis is based on previous research on the relation between emotional perception and acoustical parameters (Beherens & Green, 1993; Gabrielsson & Juslin, 1996; cf. also chapter 1) and on cross-cultural experiments on pitch perception in North Indian music (Castellano, Bharucha & Krumhansl, 1984) and Balinese music (Kessler, Hansen & Shepard, 1984). Moreover, cross-cultural research on the so-called basic emotions (*anger, gear,*

sadness, happiness, disgust, surprise) in the context of facial expressions (Ekman & al., 1987) lends support to the hypothesis of the existence of "cultural transcendent emotional responses to music" (Meyer, Palmer & Mazo, 1998). Finally, common experience suggests that we are able to perceive *some kind* of expressive information from unfamiliar musical traditions.

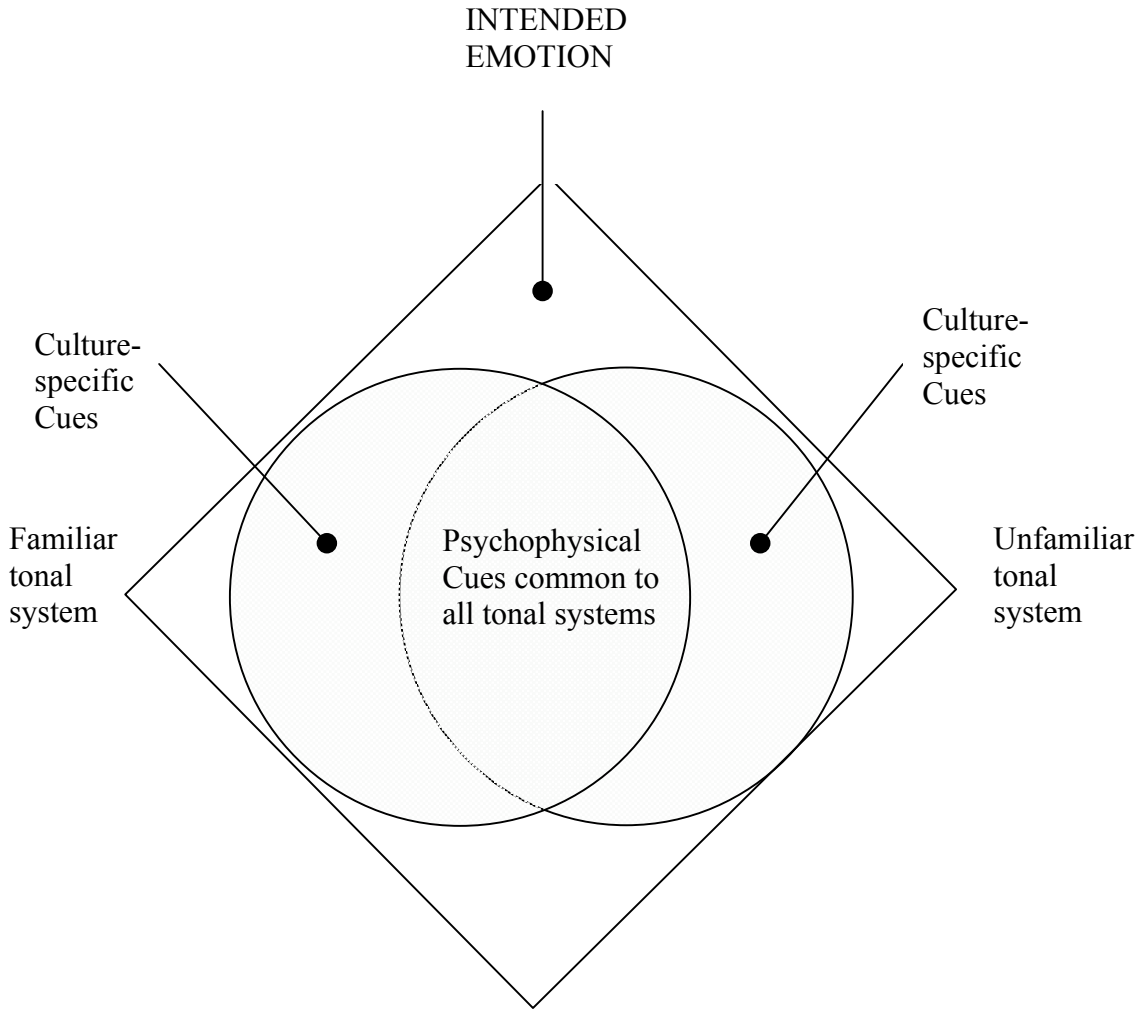


Figure 8: Model of cross-cultural communication of emotion, as presented by Balkwill and Thompson (1999). Each musical system has its own distinct cultural cues, but there are psychophysical cues present in all musical system, which facilitate cross-cultural recognition of musically expressed emotion.

Nevertheless, the model proposed by Balkwill and Thompson does not assure that listeners of different cultures make the *same* associations between the psychophysical cues and the intended emotions. In this case, psychophysical cues would be assigned of a different emotional meaning depending from the specific culture as well. The aim of the cross-cultural experiment developed by Balkwill and Thompson is to explore this last possibility. Thirty Western listeners rated the degree of *joy (hasya), sadness (karuna) anger (raudra), peacefulness (shanta)* in 12 Hindustani *raga* excerpts, obtained in field recordings. The *ragas* were chosen for their explicit relation between music (*raga*) and emotion (*rasa*): according to the classical Hindustani music theory, each raga is intended to convey a mood (*rasa*). Listeners rated how each stimulus could convey the emotions and how it was characterized in terms of tempo, melodic complexity, rhythmic complexity, pitch range and timbre. The analysis of listeners' responses was therefore based on the correlations between the emotional content expressed by the Hindustani musicians, the one perceived by Western listeners, and the perceptual role of the five psychophysical dimensions. Results indicated that “The psychophysical cues for joy, sadness and anger were salient enough to enable listeners to overcome their unfamiliarity with culture specific cues and to make an accurate assessment of the intended emotion." (Balkwill & Thompson, p. 58). Tempo, more than timbre and stimulus complexity, was found to have a strong relationship with the perception of the correct emotional content, confirming results with Western music and Western listeners (cf. Juslin, 2001). These results contradict Kivy's (1980) assumption for which Western listeners are unable to perceive emotion of north Indian ragas, and Gregory & Varney's (1996) results for which differences in Western and Indian raga's perception demonstrates that emotional response to music is, to a higher degree, culture dependent.

A similar experiment was developed by Meyer, Palmer and Mazo (1998) with the aim of analyzing the culture-specific and culture-transcendent influences in listeners' affective responses to Russian village music (laments). The specificity of this study is that the hypotheses on the culture specific cues were made on the basis of previous ethnomusicological research on Russian laments (Mazo, 1994). Results indicated that "Effects of gasps characteristic of crying on listeners' emotional responses transcended differences in their musical cultural experiences. Laments with gasps sounded sadder than laments without gasps for both Russian and Western listeners, providing evidence that at least some nonverbal vocal gestures convey emotions similarly across cultures." (Meyer, Palmer and Mazo,1998, p. 145)

The examples given suggest that a cross-cultural analysis on expressive content communication is a topic of increasing scientific interest. The lack of research in this domain complicates the task of advancing hypotheses on how the perception of expressive content is culturally inflected. Nevertheless, a starting point has been put forward. The attention toward cross-cultural approach is increasing nowadays, and a high development of theories and methods in this direction will characterize future research (Drake & Bigand, personal communications).

2.3 Cognitive ethnomusicology

As it has been put forward in section 2.1, Baily's definition of "cognitive ethnomusicology" relies on the idea of "Anthropologically orientated inquires into the nature of musical cognition" (Baily, 1988, p. 114). The basic reason for which ethnomusicologists are interested in this kind of inquiries is rather simple: sometimes they face situations that require a cognitive explanation, and "cognitive psychology is, in principle, able to explore those subconscious and quasi-conscious processes which lie beyond the reach of anthropological methodology." (Baily, 1988, p. 114).

The aim of the present section is to describe cognitive ethnomusicology by analyzing a) which are the cases in which a psychological explanation is needed and b) why this explanation should be *anthropologically orientated.*

Ethnomusicology requires the method of participant observation in order to analyze and explain a specific musical culture *from the point of view of the people that belong to the culture itself* (Merriam, 1964, Blacking, 1973). The two points above outlined should therefore be explained by the need for the ethnomusicologist to take en *emic* perspective on the manner how people conceptualize, perceive and represent their own musical knowledge. A perspective to be emic needs (participant) ethnographic knowledge; an analysis to be emic needs an adaptation of its instruments to the emic perspective (cf. for instance, some examples of "culturally adapted" musical transcriptions in Hood, 1982).

The aim of ethnomusicology is to study music as a cultural product, and to study culture through its musical manifestations. As Baily observed, not all musical manifestations are accessible through anthropological methods. Therefore, ethnomusicology needs psychological methods in order to study those musical experiences that are not totally explainable only by ethnomusicological analysis. In other words, the relation between music

and culture, when it is structured by psychological processes, needs to combine ethnographic and psychology methods. In this perspective, the analysis of musical phenomena is *anthropologically orientated* in the way that psychological methods are adapted to the emic perspective assumed by ethnographic participant observation.

Scientific literature reports several examples of how ethnomusicologists integrated perceptual/cognitive methods in the analysis of musical experience (DeWitt, 1999). Moreover, it should be noted that research in ethnomusicology includes other "outsider instruments" as well, such as acoustics and psychoacoustical methods and results, in order to go beyond the reach of anthropological methodology (cf. for instance, Lortat-Jacob, 1998; Tran Quai Hai, 1991). In the following discussion are given few examples of the different situations in which a perceptual/cognitive approach is used in ethnomusicology.

While previous studies considered the way people conceptualize its own music through an analysis of how music is verbalized (Feld, 1981; Sakata, 1983; Zemp, 1979), Baily (1988) hypothesized that the role of verbalized music is in some cases *operational* (it influences actively the way music is performed) more than being *representational* (it describes musicians' knowledge without influencing performance). In the first case, as for the Indian Tabla *bol* system (onomatopoeic representations of drum sounds), oral notation "Becomes a mode of musical thought" (Baily, 1988, p. 118) which controls music performance. Cognitive psychology, in this case, can give insights in the way compositions are stored in the verbal memory, rather than in the auditory memory, and are accessed via verbal processes of thought. The operational influence of cognitive activities other than the auditory system on music performance is not limited to verbal processes. Baily (1985, 1991) observed the importance of human movement in Afghan music and approached the topic of creativity through the analysis of the *spatio-motor modes* of musical cognition. The basic hypothesis of Baily's studies is that since a particular musical structure is influenced by patterns of movements on the instrument, the cognitive representations of motor action may guide musicians' choices with equal importance as the auditory system does. Insights on the functioning of the cognitive processes that guide motor action, combined with ergonomic consideration about the instrument being played, should therefore explain how the sonic product is structured. An implication of Baily's hypotheses is that the verbal and motor systems have, in some cultures, a strong influence on the learning processes. Moreover, auditory information is often combined with visual memorization of the gestures on the instruments (cf., for instance, Baily & Driver, 1992; Helmlinger, 2001).

Another well-known example of a cognitive approach used in ethnomusicology is given by Kubik's research on Buganda inherent patterns (Kubik, 1964). In order to explain the incongruity between the musical input (*amadinda and akadinda* xylophone music) and listeners' perception, Kubik used hypotheses and concepts taken from Gestalt psychology. Later on, Wegner (1993) conducted field experiments with real and synthetic sounds, with the aim of "Re-assess from an emic point of view the musical importance of auditory streams/inherent patterns".

Blacking (1973) observed that: "At some level of analysis, all musical behavior is structured, whether in relation to biological, psychological, sociological, cultural, or purely musical process, and *it is the task of the ethnomusicologist to identify all processes that are relevant to an explanation of musical sound* [italic added]″ (Blacking, 1973, p. 17). To this consideration, we might add that the effect of developing "Anthropologically orientated inquires into the nature of musical cognition" (Baily, 1988, p. 114) is to reinforce the emic perspective for the analysis of human musical experiences, as stressed by ethnomusicologists. Finally, in relation to Blacking's statement, Baily makes an important step forward: "It is necessary not only to *identify* "all processes" but to *investigate* [italic added] how they interact and integrate. The importance of ethnomusicology as a field of human knowledge depends precisely on the inter-disciplinary synthesis it demands, challenging traditional Western epistemological categories as too arbitrary and culture-bound to cope with understanding one of the most highly complex forms of human behavior known" (Baily, 1988, p. 122).
In order to analyze how the interaction between cultural and cognitive factors could be investigated, we will focus in the next sub-sections on two topics: the problems raised by experimental field research (section 2.3.1) and the methods for the categorization of musical stimuli (section 2.3.2).

2.3.1 Experimental field research

While a number of perceptual experiments in laboratory settings have been extended to non-western listeners and musical styles (cf. section 2.2), the ethnomusicological perspective raises the problem of whether experimental procedures can be adapted for use in a field situation. In fact, it may ùbe argued that the value and accuracy of rigorous experiments may be *culturally inappropriate* in most traditional social contexts, "Unless they embody

ideas that are some way meaningful to those with whom the experiments are made" (Kippen, 1987, p. 175).

The problem of how experimental procedures could be applied in the context of field research is a central concern for cognitive ethnomusicology, since such an approach may require the use of psychology's experimental methods. Thus, when it is not possible to "bring the field into the laboratory", the laboratory need to be taken on the field. The problems raised by the displacement of experimental procedures, methodologies and technical apparatus into the field are not only of practical nature but they also imply a number of important theoretical considerations (cf. Arom, 1991).

The aim of this section is therefore to analyze the main epistemological concerns raised by experimental field research in music cognition. As each single experimental situation arises different concerns, practical and theoretical, we will focus here on those that apply in a more general manner. Without the pretension of being exhaustive, we will approach the main implications of experimental field research, which are an effect of both: a) leaving the laboratory and b) experimenting on the field.

a) *Leaving the laboratory*. Experiments are run in laboratory in order to assure the highest degree of rigorous control on the variables object of study. Moreover, empirical research relies on the assumption that experiences should be replicable, which explains the need for a replicable experimental setting. Thus, "leaving the laboratory" may imply both an increasing of uncontrollable variables and of unreplicable conditions. This fundamental concern, together with practical reasons, is one of the main factors for the maintenance of a "distance" between cognitive psychology of music and ethnomusicology: "It is generally agreed that the pitfalls associated with the transportation of experimental paradigms from western laboratories to non-western context have precluded many from testing the applicability of their hypotheses more widely." (Kippen, 1987, p. 175).

On the other hand, it is generally believed that the laboratory setting may introduce an artificial modification in the object of study. This is particularly true for research in musical cognition and perception, since the context (local and cultural) plays on important role on the way musical information is experienced. Thus, "leaving the laboratory" may represent an explicit effort toward a need for higher *ecological validity* of the results. The balance between the first problem and the second advantage are well outlined in a personal consideration by Vaughn (1992), who run perceptual experiments in North-India: "To reach participants of both music cultures I took these experiments into the field. Implementation of this sort brings with it many more uncontrollable variables than would normally occur in a laboratory setting

using synthetic sounds. On both counts, the critical concern for scientific reliability has been tempered by an increase in the relevance of these results for further research on problems in music cognition concerned with music at it is performed." (Vaughn, 1992, p. 116).

The need for a higher ecological validity has the effect of stimulating new empirical methods based on *context sensitive* experimentation. For instance, recent trends on music cognition research include the adaptation of technologies for collecting listeners' responses in settings such as concert halls, in order to measure listeners' perceptual responses to music in real-time and real-situation (McAdams et al., 2002)

Moreover, ecological concerns influenced theoretical approaches to cognition and perception. An emerging paradigm, the so-called "situated cognition" approach, aims to replace artificial settings (laboratory) with systematic investigation in "everyday" settings (for a review of the theory of situated cognition, cf. Resnick et al., 1991). The general assumption of situated cognition is that knowledge is a result of the environment; specifically "the social and physical context in which cognitive activity takes place is seen as an integral part of that activity - not as an inert, insignificant background for the individual functioning." (Davidson & Torff, p.126). Research on situated cognition includes therefore information on the local conditions and the cultural setting as a fundamental part of the experimental procedures.

The implications of such a theoretical paradigm find a direct interests in the domain of musical research. Davidson & Torff (1992) stressed the importance of experimentation on cognitive activities in "life-like" circumstances, and proposed a speculative model for the analysis of musical experience, where three forces of musical cognition - individual, local and cultural - contribute to the constitution of an "integrative unit of analysis that captures the multiple forces affecting musical behavior" (Davidson & Torff, p. 131) (cf. Figure 9). The procedure for the analysis of such a "unit", should include ethnographic investigation of the local and cultural settings, from an emic perspective, followed by "Ecologically sensitive experimental procedures designed to reveal how [people] think under particular circumstances" (Davidson & Torff, p. 132) The effort made by the authors for bringing the cultural factors into the research of musical cognition is explicit: "A cognitive science based on context and culture questions the isolation of cognitive psychology from ethnomusicological work. The emerging view of cognition as situated action makes cognitive work an integral part of ethnomusicology. This view enables ethnomusicologists to move toward an integrated view of musical practice which looks at the three critical levels of musical forces: the culture that organizes and gives meaning to cognition; the localized contexts of support for activity which assist and guide individual functioning; and cognition

as it is seen in the individual". The theory of situated cognition may be viewed as a sort of "extreme" manner of merging cognitive and cultural factors; nevertheless it witnesses the increasing attention of cognitive psychology toward a higher ecological reliability, as stressed by Koskoff (1992): “The basic units of study moves away from the individual within a controlled environment towards the interaction between individuals within specific social contexts." (Koskoff, 1992, p.6).

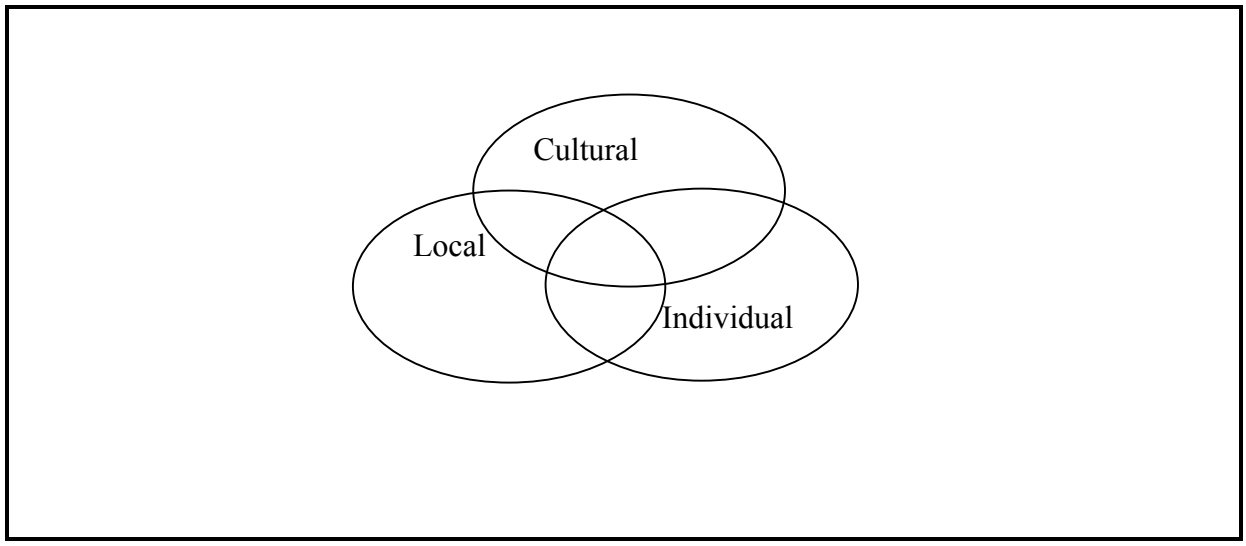


Figure 9: The three forces of musical cognition (Davidson & Torff, 1992)

b) *The laboratory in the field.* From an ethnomusicological perspective, the efforts toward an ecological approach to musical cognition do not assure that the experiments on the field would be *culturally pertinent*, as observed by Kippen: "The cultural insensitivity of the researchers’ approach to residents of a remote Balinese village, however appropriately they believed their experimental procedures had been adapted for use in a field situation, leads one to question the accuracy or value of any resulting comparison between Western and Balinese musical perception." In this perspective, the artificial factor given by laboratory experimental procedures is not removed by a simple displacement of the laboratory to the field, and "It may be argued that attempting to elicit analytical responses to musical stimuli [...] is a culturally inappropriate task." (Kippen, 1987, p. 175). More than arising the problem, Kippen (1987) proposes the anthropological research method of participant observation as the only way of determining which experimental methods and technologies are culturally relevant and appropriate. Ethnomusicologist's *cultural sensitivity* (and knowledge) should therefore

prevent and control the impact of "Western-laboratory" techniques (and concepts) in the context of traditional cultures. The key for achieving relevant context sensitive results is given, in Kippen's propositions, by an active interaction between researcher and informant through all stages of the research.

To resume, the three main concerns: “a) that experiments be rigorous and culturally relevant b) that experimental situations be context sensitive, and c) that dialectic in the research process be promoted by involving informants as co-workers and analysts,” (Kippen, 1987, p.176-77) may found the theoretical basis for field experimental research. This framework well reflects what Baily calls "Anthropologically orientated inquires into the nature of musical cognition" (Baily, 1988, p. 114), in the case where these inquires need experimental procedures, methods, and technical apparatus.

2.3.2 Categorization and similarity perception

The notions of "category" and "similarity perception", at the core of Gestalt psychology, are still of central interest in cognitive sciences. The reason is that the task of grouping objects on the base of their similarities is believed as being fundamental to many mental activities, since it constitute the basic way of organizing and thinking about the external phenomena. "All perceptual experience is necessarily the end product of a categorization process" (Bruner, 1957, quoted by Deliège, 1993, p. 236).

The importance of these concepts in the field of music research has been stressed by many scholars (for instance, Deliège, 1993, Imberty, 1979), since it is believed that they play a fundamental role in the way humans perceive and organize musical sounds. As for all others topics related to music cognition, it is unknown to which extent the processes of categorization and similarity perception are universal or culture specific. In this perspective, "Research in the field of ethnomusicology is particularly revealing, because it has shown that similarity may be developed differently in other cultures. According to Gilbert Rouget (1990), similarity perception may be more - or at least differently - developed in certain ethnic groups. Shima Arom (1985) has also highlighted this issue, showing that the perceptual scales in relation to the concepts of *similarity* and of *identity* in some African countries are more flexible than in Western culture and go beyond what would customarily be included under these headings in Western everyday perceptual experience." (Deliège, 2001, p. 234).

In this section we whish to show that data-analytic methods for studying categories and similarity perception may be a useful tool for developing "Anthropologically orientated inquires into the nature of musical cognition". (Baily, 1988, p. 114). We will analyze: a) why and in which cases these methods are useful tools and b) why, in the perspective of cognitive ethnomusicology, their use should be *anthropologically orientated.*

Categorization deals with the problems of understanding which objects belongs to the same category (*aggregation issue*) and how can the categories be characterized in terms of their attributes (*characterization issue*). (Feger & De Boeck, 1993). A fundamental distinction is whether we refer to a *subjective* category or an *objective* category: "The notion category covers both cognitive-psychological ("subjective") categories, which are associated with how people conceptualize a given domain, and scientific ("objective") categories in which objects of a domain of interest can be subdivided. " (Feger & De Boeck, 1993, p. 203).

When the objects are musical sounds or excerpts, subjective categories are formed on the basis of how people perceive the sounds as similar or different. The method for obtaining this type of categories is based on perceptual experiments, for example asking a group of subjects to rate the degree of similarity between a set of sounds. The methods for the collection of subjects' ratings should overcome the problem given by the verbalization since the linguistic level (naming the categories) may not coincide with the perceptual level. When the aim is to analyze the cognitive processes involved in musical listening, the focus is on psychological categorization.

On the other hand, objective categories are formed through the analysis of the musical excerpts in terms of the statistical distribution of acoustical parameters such as pitch, duration of the notes, and others. This method relies on "The identification and the opposition of distinctive musical features" (Olivier and Rivière, 2001, p.483) and it is used by systematic musicology for characterizing musical sounds and excerpts on the base of their intrinsic properties.

Ethnomusicology introduces a third way of making categories, which is based on socio-cultural factors, such as the circumstances in which music is performed. If this way of forming categories relies on ethnographical observations, it may be considered as being objective as well.

The three different kinds of musical categories are represented in Figure 10 by three blocks named psychological, musical, and cultural. The next step of the analysis consists in analyzing how the three blocks can be related one to each other. This happens when one of

the three approaches is used for the aggregation task and another one for the characterization task, as it will be described in the following discussion.

1) *Psychological aggregation - musical characterization.* Psychological categories are related to musical categories by analyzing how the objects categorized through subjective evaluation are characterized in terms musical (objective) attributes. This is a standard procedure used in psychoacoustics and music cognition research. For example, when the aim is to understand the role musical factors play in the perception of similarities among musical excerpts, it is first observed (through perceptual experiments) which excerpts are perceived as similar, and than (musicological analysis) they are analyzed in terms of their objective attributes. This analysis can be done "by hands" when with few objects are considered; when the number is high, one common method used is *multidimensional scaling* (MDS). This statistical analysis method is based on the construction of a spatial representation of the degree of *perceived* similarity between objects: the more different they are perceived, the higher is the distance between them. For the fact that it is obtained with measures on similarity *perception,* the result of multidimensional scaling is generally called "perceptual space". Once this geometrical representation is obtained, the characterization task consists in interpreting the dimensions that determine the space in terms of musical features. Multidimensional analysis is therefore a simple and powerful method to determine and graphically represent the relations between perceived similarities and musical features.

This method is widely used in perceptual experiments with Western listeners and repertoire, while it has been applied in ethnomusicology just in few cases. Among these last, Vaughn (1992) used MDS in order to confirm the hypothesis formulated by Jairazbhoy (1971) on the circular properties of particular North-Indian musical modes called "*th_t*". Jairazbhoy proposed that ten *th_t* differ (*musically*) one from the other in a gradual way, thus their difference may be graphically represented by placing them as equally spaced points on a circle. The "Circle of *th_t*" (Jairazbhoy 1971) is in some way analogue to the Western circle of fifth. Vaughn, then, realized perceptual experiments (subjects: 28 musicians, Indian or Western professional interprets of North Indian music) in order to explore how the ten *th_t* differ *perceptually*. The perceptual space obtained with MDS showed a remarkable resemblance with Jairazbhoy's "Circle of *th_t*", furnishing therefore empirical evidence that "This system [the circle of That] is far from arbitrary and has a basis in the perceptual and cognitive processes involved in musical pattern categorization." (Vaughn, 1992, p. 116).

Multidimensional scaling has been used as well by Eerola, Jarvinen, Louhivuory and Toiviainen (2001) for analyzing to which extent melodic similarity (a musical attribute) is a

salient dimension to which listeners pay attention while categorizing folk melodies (Melodies used in the experiments, as defined by the authors: North Sami yoiks, Finnish Spiritual hymns, Irish hornpipes, German folksongs and Greek folksongs. Subjects: 17 Finnish music students).

2) *Musical aggregation - socio cultural characterization and viceversa.* Ethnomusicology analyses the relations between musical and cultural factors. Categories of similar musical excerpts may be constructed (aggregation task) on the basis of relevant socio-cultural factors, such as the geographical origin of the pieces, the context in which they are performed, and others. Categories may be described by means of musical attributes (characterization task), but in some cases the excerpts may be very different one from each other, in terms of their musical features, even if they belong to the same category. The relation between cultural and musical factors can be applied also in the other sense: excerpts are grouped on the basis of the statistical distribution of musical parameters, then the ethnomusicologist analyses whether the categories can be described in terms of socio-cultural factors. A well-known example of this last procedure is given by the cross-cultural researches developed by Lomax (1968). Lomax applied large-scale statistical analysis in order to relate the most salient musical features (*cantometrical data*) of 233 different cultures to the measures of socio-cultural factors such as economic complexity and social stratification of the same cultures (*societal data*). The aim of Lomax's research, which has been strongly criticized for the broad-grained cultural categories used, was to find groups of musical and social attributes that varied together.

3) *Psychological aggregation, musical and cultural characterization.* The third manner in which musical categories may be determined, considers the relation between all three psychological, musical and cultural attributes of similarity. This method relies on the introduction of socio-cultural attributes in the characterization of psychological categories. It is therefore a generalization of the first method (relation between subjective ratings and musical features) to non-Western cultures. In fact, we may say that studies on cognition with Western subjects and repertoires do not consider the cultural attributes because these are not relevant features for categorizing musical excerpts as similar. To give an example, let's consider the socio-cultural attribute given by the *social circumstance* in which a piece is performed. In a measure of perceived similarity between a Mozart Sonata and a Beethoven Symphony, this factor does not play any role because the social circumstance in which listeners experience the two excerpts is the same (concert hall or CD reproduction). On the other hand, in many traditional cultures, the social circumstance in which the repertoire is

performed plays a fundamental role for determining the similarities among musical pieces. Two excerpts that are very different in their musical attributes may be in this case categorized (psychologically) as similar on the basis of the social factor. The same situation may happen for the factor of the geographical origin of a repertoire: two pieces may be categorized as similar because they are part of the traditional repertoire of a specific geographic area. In several musical traditions, cultural factors can be therefore more important than musical factors for perceiving two pieces as similar.

Statistical techniques for the analysis of similarities, such as multidimensional scaling, may be used as well for this third type of classification. In fact, the dimensions of the perceptual space obtained through perceptual ratings of similarities between musical excerpts may represent cultural factors and/or musical factors. The post-hoc analysis of the perceptual space has the aim of interpreting these dimensions; this analysis can be complete only if the cultural factors are known through an ethnomusicological study.

The relation between psychological, musical and cultural factors forms the core of the so-called cognitive ethnomusicology. Data analytic techniques such as multidimensional scaling allow relating the factors one to each other in order to understand which role the play in the conceptualization of musical repertoire. For this reason, they are fundamental tools for realizing "anthropologically orientated inquires into the nature of musical cognition". (Baily, 1988, p. 114).

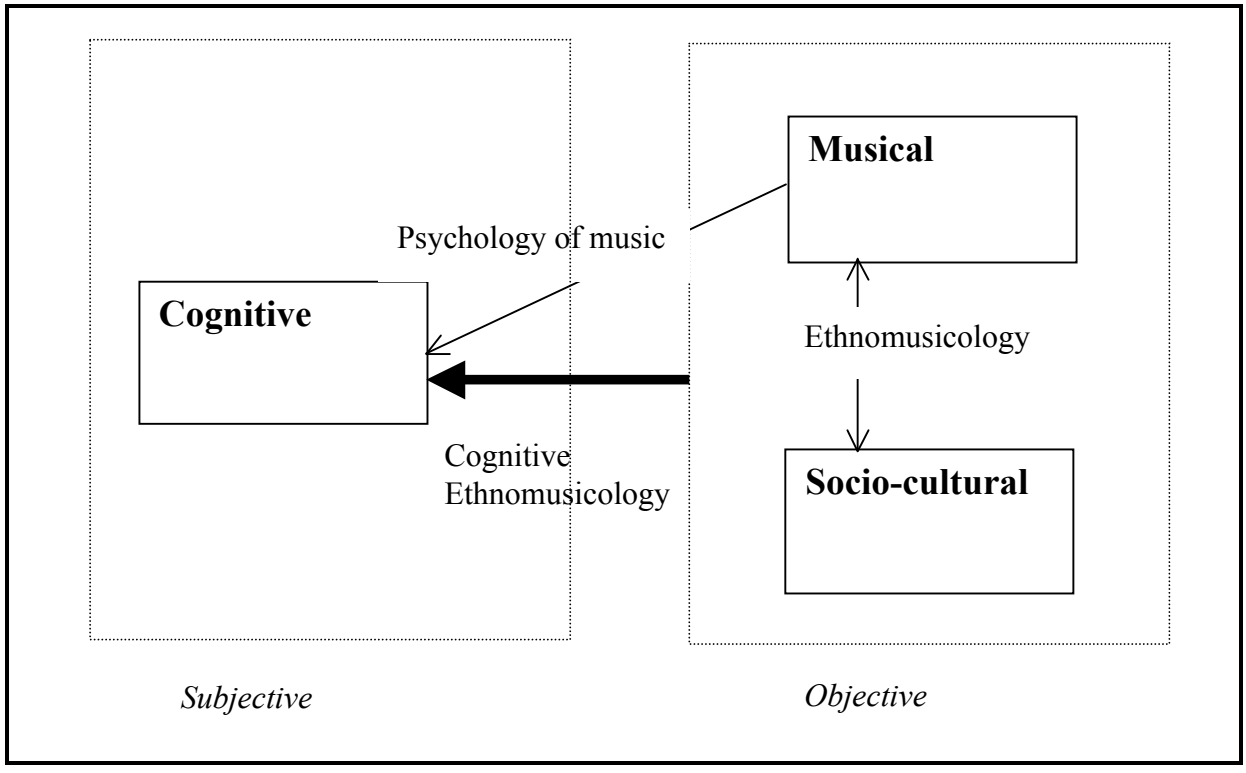


Figure 10: Categories may be formed on the basis of subjective or objective data. The relations between the aggregation task (making categories) and the characterization task (defining the categories on the basis of the attributes of their elements) are used in different manners by the fields of ethnomusicology and psychology of music. Cognitive ethnomusicology may consider both musical and socio-cultural factors for describing cognitive categories

2.4 Cross-cultural psychology of music and cognitive ethnomusicology: toward an interdisciplinary research framework

In the present chapter we analyzed some aspects of the interaction between cognitive psychology of music and ethnomusicology. The analysis was subdivided in two sections, titled "cross-cultural psychology of music" (section 2.2) and "cognitive ethnomusicology" (section 2.3), which correspond to two different interdisciplinary approaches. The first founds its origins in cognitive psychology and regards ethnomusicology as a source of unexplored information which may have an important impact on the laws of music cognition. The second approach is motivated by a need for ethnomusicogists to explore those aspects of musical experience that are not completely reachable by the anthropological methods. The development of "*Anthropologically orientated* inquires into the nature of musical cognition" (Baily, 1988, p. 114) has the effect of improving researcher's *emic perspective* on the way people conceptualize and perceive their own music. The two approaches reflect the relative "weight" that cognitive psychology and ethnomusicology maintain in their convergence, as graphically represented in Figure 7.

In general, we may say that the effort toward interdisciplinary research proceeds as it follows. Fist of all it improves the knowledge on both domains, since the respective "frontiers" are expanded toward unexplored directions. Researchers start to include hypotheses, methods and results "borrowed" from the neighbor field, adapting them to their specific concerns. Collaborations among researches of the two domains are in this way strengthened by the need for mutual exchange of knowledge. This process has the effect of developing progressively new specific hypotheses and methods for interdisciplinary needs. If

they are well founded, the new concerns will constitute the bases for the outgrowth of a field on its own (for instance, this is how ethnomusicology was born from the convergence of musicology and anthropology).

This idea is represented in figure 11, where the block named "interdisciplinary framework" represents the formation of a new research context, defined by its specific objectives, methods and domains of application. It is nevertheless important to observe that the interdisciplinary framework may include other domains as well, not considered in the present study, such as neurosciences and biology (cf. Becker, 2001).

The emergence of the interdisciplinary framework between ethnomusicology and cognitive psychology is witnessed by the creation of specific University Departments (such as the Cognitive Ethnomusicology Laboratory at Ohio State University) and scientific conferences and publications focused on the new domain (cf. DeWitt, 1999)

As repeatedly stressed in the present chapter, the core of the interdisciplinary framework is the need for relating information pertaining to three different levels: cognitive, musical and cultural. The integration of these three levels would have the effect of improving the knowledge on how music is thought, perceived and experienced in a universal manner and in specific socio-cultural contexts. How to relate the three levels, is an open problem of increasing interest among scientists.

The aim of the present study, far from having the pretension of defining a new scientific discipline, has been limited to the analysis of those elements, those "ingredients", that may form some of the bases for a pertinent interdisciplinary research framework, resumed in the following discussion.

We believe that a fundamental component of the interdisciplinary framework is given by the anthropological method of participant observation. Without extensive ethnographic research, the influence of cultural factors in music cognition would remain in a second place, as it has been so far. This is why we stressed in several occasion the importance of Baily's idea of "A*nthropologically orientated* inquires into the nature of musical cognition". Music is a product of humans: the understanding of musical experience cannot be done without the insights on human activities given by ethnographic methods. Ethnomusicology showed that musical behaviors are extremely varied and give rise to different way of organizing sounds. The explanation of how sounds are organized, in music *and in the way music is thought,* needs cultural information at its base.

Cognitive and perceptual "inquires" may need experimental procedures, and experiments may need to be developed on the field. Therefore, field research should include

experimental procedures. Cognitive psychology of music developed reliable instruments and techniques for the analysis of different aspects of music perception and cognition. A *context sensitive* adaptation of the techniques needed for each specific task may assure the *ecological validity* of the experiments and the comparability of the data for cross-cultural comparison. The practical transportation of the laboratory in the field may be reduced to few instruments, in many cases a laptop PC and a pair of headphones is enough for running perceptual experiments. These instruments are less than what an ethnomusicologist usually brings to the field (recording instruments); a perceptual experiment is not more invasive than a recording session. The problems related to experimental field research are therefore of theoretical nature, as observed in section 2.3.1. We proposed that the method of participant observation should allow the overcoming of these difficulties: the researcher should be able not only to talk with the people, possibly in their language, but also to acquire sensibility toward situations, concepts and beliefs that may be very different from his/her own.

Finally, *cross-cultural* investigation should be envisaged. This method allows the acquisition of knowledge on the universality vs. culture specific nature of music cognition and perception. Cross-cultural comparison is an instrument for verifying hypotheses on the psychological mechanisms underlying several aspects of musical experience. Moreover, cross cultural comparison may act as a "pointer" toward those culture specific features of perception and cognition that need knowledge on cultural factors in order to be explained.

The domains of application of the interdisciplinary framework touch all aspects of music cognition and perception so far investigated with Western music, such as, for instance, rhythm perception and production, timbre, pitch perception, and *expressive content communication,* considered in chapter 1 and in section 2.2.1. All these notions should be submitted to theoretical analysis before running experiments in other cultures in order to determine if they are pertinent in different cultural contexts, as observed in section 2.2.1 for the case of expressivity. Moreover, others domain of interest may emerge from particular music cultures, as the case of Kubik's "inherent patterns", for example, with the effect of importing new elements at the study of music perception and cognition.

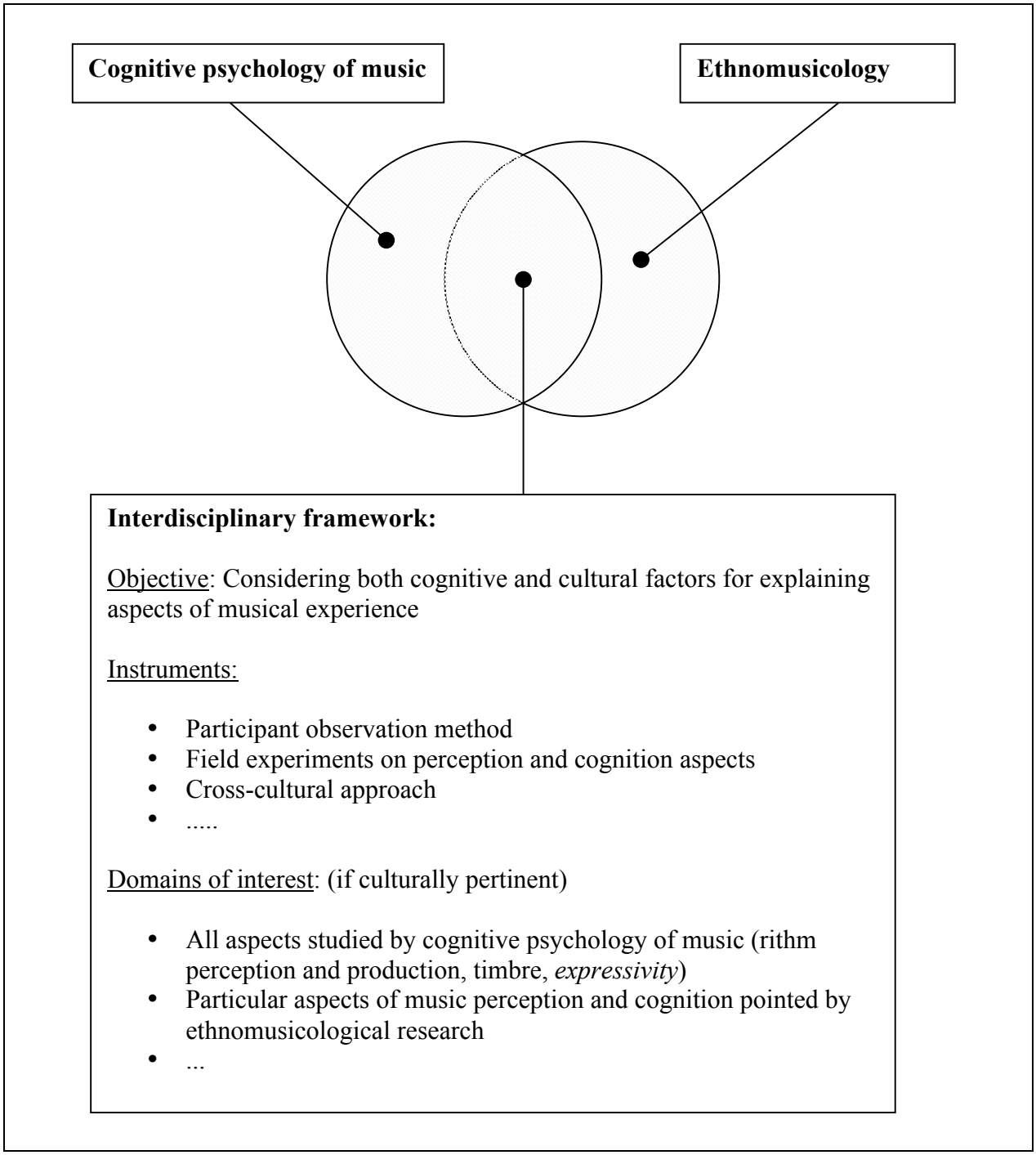


Figure 11: The interdisciplinary framework given by the intersection of ethnomusicology and cognitive psychology of music.

Appendix A.1

EXPERIMENT ON PIANO IMPROVISATION: INSTRUCTIONS FOR THE PERFORMERS

This experiment regards the analysis of musical expressiveness in short spontaneous performances, i.e. without the reference of any musical score, or melodic or rhythmic structure given as base for improvising. The aim of the experiment is to investigate if, and in which measure, it is possible to communicate *expressive intentions* using just few acoustical parameters: *tempo* (intended as the temporal interval between one note and the following one), *articulation* (i.e. the possibility of playing two notes with a different degree of *legato* or *staccato*), *intensity* (playing with more or less volume, *crescendo* and *decrescendo*) and *pitch* (the various notes available in the piano). To communicate the various expressive intentions, you cannot use the pedal.

We will look, then, for some relations between these parameters and the intentions that you will try to communicate.

The experiment is planned in four phases. For each phase, we will ask you to realize eighth performances (for a total of 4*8=32 executions) trying to communicate as many expressive intentions, that we will suggest you by means of the following eighth groups of adjectives:

1. ***Slashing, impetuous, resolute***
2. ***Heavy, hard, rigid***
3. ***Hopping, galloping, springing***
4. ***Vacuous, hesitant, tired***
5. ***Bold, torrential, unbridled***
6. ***Hollow, solemn, obscure***
7. ***Fluid, fluent, fleetly***
8. ***Tender, sweet, simple***

1st phase: You can choose the note from the piano, but you can play only this note, so you will not be able to develop any melody. Choose the note that you feel more adequate for expressing each expressive intention; you may then act on tempo (temporal interval between two notes), articulation (more or less legato) and intensity (volume, *crescendo* and *decrescendo)*

2nd phase: Now the note is imposed, central C, so you can use only tempo, articulation and intensity. With these limitations try to communicate each of the eighth expression intentions suggested.

3rd phase: Together with the note, central C, also the volume is fixed; therefore try to communicate each expressive intention using just tempo and articulation.

4th phase: In this last phase, you can use only the tempo, since the note (central C), the volume, and the articulation are fixed. It will be no difference, then, if you touch the piano key rapidly, or if you keep it pressed longer. This is a special situation, specifically prepared for this experiment.

Try, as for the previous phases, to communicate each of the eighth expressive intentions suggested by the adjectives above reported.

Feel free to repeat each improvisation, at will, before the recording, until you are completely satisfied with your expressive output. Respecting the succession of the four phases, in any moment you can listen again to any performance, do it again, and choose the one that better communicates the expressive intention. Always respecting the order given by the four phases, you are free to choose the order of execution of the eighth expressive intentions suggested by the adjectives.

We will record your performances in MIDI format files, and they should last a minimum of six seconds.

The total duration of the experiment is dependent from the time you need to reach a satisfactory (for you!) result.

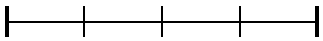
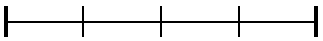
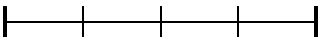
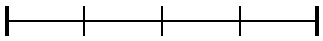
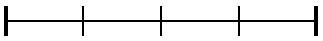
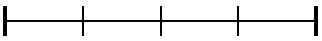
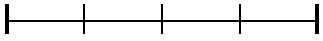
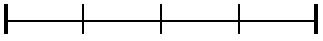
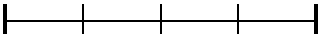
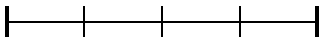
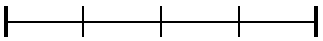
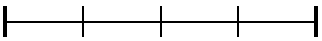
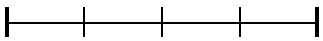
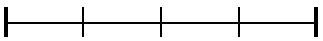
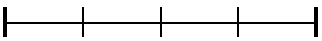
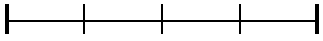
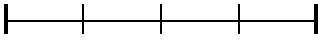
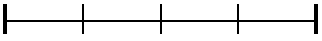
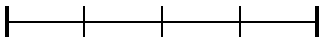
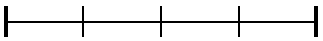
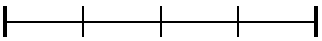
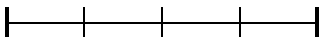
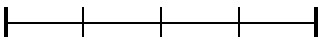
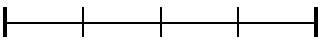
It is not part of our study any qualitative or aesthetic evaluation of yours performances.

Appendix A.2

EXPERIMENT ON PIANO IMPROVISATION: INSTRUCTIONS FOR THE LISTENERS

The subject of this experiment is the analysis of musical expressiveness in the context of improvisation.
Short *spontaneous improvisations,* produced by a professional pianist without the reference of any musical score, have been recorded and are now proposed to your *semantic description*. The aim of the experiment is to investigate if, how, and in which measure, it is possible to communicate *expressive intentions* using just few acoustical parameters: rhythm, articulation, dynamics, and pitch. By means of your answers, we will look for relations between performers' expressive intentions, the acoustical parameters object of study, and your perception of the recorded musical excerpts.

We will present you 32 short musical excerpts. First of all, you will listen to all pieces one time, in order to gain a little of familiarity with the musical context. Then, you will listen to each piece twice. In the table annexed to these instructions, you will find eight groups of adjectives. For each of these groups we placed a measured line, from “nothing” (rien) to “extremely” (extrêmement), that you can mark in any point, if you feel that one or more groups of adjectives are appropriate for describing each musical excerpt. If you do not mark the line, your answer will be interpreted as “nothing”.
The approximate duration of the experiment is 45 minutes.
Thank you for participating!

	Piece 1 ***Nothing>>>Extremely***	*Piece 2* ***Nothing>>>Extremely***	*Piece 3* ***Nothing>>>Extremely***
Slashing ***Impetuous*** ***Resolute***			
Tender ***Sweet*** ***Simple***			
Bold ***Torrential*** ***Unbridled***			
Hollow ***Solemn*** ***Obscure***			
Hopping ***Galloping*** ***Springing***			
Vacuous ***Hesitant*** ***Tired***			
Fluid ***Fluent*** ***Fleetly***			
Heavy ***Hard*** ***Rigid***			

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