What's Music Got to Do With It?

Why does music move us so directly? What makes the timing of a certain performer so special? Why do some melodies stick in our minds? These are only a few of the intriguing questions with which music cognition research is concerned and which are now becoming a part of the research agenda at the ILLC. We asked the Music Cognition Group to tell us more about their interests in this newly developing field of research.

As of October 1, 2005, a new group is working at the ILLC. The Music Cognition Group (MCG), led by Henkjan Honing, is part of a multi-national research project entitled 'Emergent Cognition through Active Perception' (EmCAP), funded by a grant from the Sixth Framework Programme of the European Union. The ILLC magazine talked with the members of the new Music Cognition project—Henkjan Honing, Olivia Ladinig and Leigh M. Smith—about mechanical shoes, listening machines, what music cognition research is all about and what the ILLC has got to do with it.

Henkjan Honing: Music cognition is a sub-discipline of the cognitive sciences that focuses on phenomena related to music perception and production. An example is the cognitive process of *beat induction*: how do people pick up a beat or a pulse in music that allows them to clap to it or synchronize among one another? It is a fundamental mechanism that allows us to make music collaboratively. Interestingly, chimpanzees do not have this talent.

Beat induction was one of the central topics of the NWO-PIONIER project 'Music, Mind, Machine' (MMM), a research project that finished about three years ago (dare.uva.nl/en/record/117783). In this project we further developed a methodology of computational modeling for music research. A somewhat overexposed visualization of that research was the *mechanical shoe*: a contraption that, when

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connected to a computer model, taps to the beat of the music, allowing for comparison with what humans would do.

Music as a domain of research gets a fair amount of attention, for instance, in high-impact journals. Until recently it was unclear in which ways music could illuminate fundamental issues in cognition. Nowadays, it is clear that it is a worthwhile domain for studying cognitive phenomena including representation, memory, attention, expectancy and emotion, and I'm sure it will become an important subject area in the cognitive sciences alongside vision and language.

Giving Music the Place It Deserves

HH: After the MMM project finished, I had to make an important decision: to continue the research abroad by accepting a professorship elsewhere, to do a restart in the Netherlands and form a new group from scratch, or, but this was quickly rejected, to start a small restaurant. I chose the second option and spent the major part of 2003/04 on writing research proposals, and lectured a lot—to all who wanted to hear it—on music cognition. It resulted in receiving two large grants: one from the Dutch Science Foundation (NWO 'Foundations of the Humanities' programme) and one from the European Commission (Sixth Framework FP6/IST Programme), both in the field of music cognition. This is when Olivia Ladinig and Leigh M. Smith came to join the team. They started in the winter of 2005, and now, barely five months later, it already feels like a real group. A dream coming true.

Our research focuses on the temporal aspects of music, such as rhythm, timing and tempo, using theoretical, empirical and computational methods. Some recent research topics include the relation between human movement and the use of timing in music performance (can elementary mechanics explain timing patterns found in music performance?), rhythmic complexity (what makes one rhythm sound more exciting than another?), the relation between rhythm production and perception (can the differences between rhythm production and perception be understood in a Bayesian way?), a large-scale listening study on timing in music (is timing indeed independent of tempo as some models suggest and what is the role of expertise and exposure?), and the modeling of rhythmic expectancy (how do rhythmic expectancies emerge when being exposed to different types of music?).

My personal goal—it actually feels more like a mission—is to give music the place in scientific research that it deserves. While music was mostly studied in the humanities (i.e., music in its cultural and historical context), in the last two decades an important reorientation has occurred: a small-scale 'cognitive revolution' in music materialized in the margins of psychology, computer science and the humanities. Our group is in the middle of this interdisciplinary challenge.

Music, Language and Computation

HH: While our group is relatively new, there has been a long-standing working relationship with the ILLC. I started in 1992 at the UvA as a KNAW research fellow in the group of Remko Scha, who was later also a board member of the MMM project and who is currently in charge of the Language and Computation group. With Rens Bod and Menno van Zaanen, I worked on a DOP alternative to the beat induction models mentioned earlier. Bayesian modeling is a recurring topic in this work, one that I hope we can further expand upon in collaborations with other ILLC researchers, including Remko Scha and Khalil Sima'an. Next to these concrete ideas, topics like, for example, evolution and music are too intriguing not to explore in future collaborative projects.

I see the role of our research best subsumed under the last two letters in ILLC: language and computation. Like most topics studied at the ILLC, music cognition is characterized by being

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essentially interdisciplinary—bridging methodologies and philosophical constraints from the humanities with those from psychology and computer science. Language was and will stay a good domain to compare and contrast findings from music. Both domains struggle with modeling their symbolic and sub-symbolic aspects and both are uniquely human phenomena worthy of serious research effort. The main difference is that music research is still lagging behind in terms of research effort.

Leigh M. Smith: I've found the ILLC to have a very refreshing and encouraging approach to music research. As collaborators, the people working in music, including Aline Honingh, Olivia and Henkjan, bring a wonderful diversity of experience and skills which really help broaden and improve the research.

A focused atmosphere can be inspiring even if there is not direct collaboration between the research projects. At a more general level, problem-solving approaches, programming languages and computational modeling methods can be held in common. A key issue which arises in music cognition modeling is representation—particularly evaluating the adequacy of a representation with respect to empirical results and the expressiveness of a representation in then synthesizing predicted outcomes. This issue is something that most modeling endeavors face and therefore working in an institute with people facing such problems and solving them with a wide variety of methods provides inspiration, metaphors and in some cases potentially directly applicable ideas.

Olivia Ladinig: A great benefit for my research is the flexibility for new ideas in the ILLC. Since the institute is located within the humanities as well as the faculty of science, one is not forced to principally decide between computational, theoretical or empirical accounts. You are required to find your own way through different, yet equally legitimate, viewpoints to consider issues in your research.

Olivia Ladinig:

As a music lover you could probably not think of a greater job.

My goal in this research is to combine psychological and formal thinking. Since my academic background is in cognitive and general psychology (as opposed to clinical or personality psychology which has its focus on differences between humans), my main focus lies in commonalities and regularities which most of us humans share. For these kinds of generalisations, it is very useful to use a certain degree of formalized abstraction in psychological theories.

Imagine What a Listening Machine Would Be Like...

LS: Music is a universal, non-verbal form of communication as prevalent and varied as language. It shares aspects with human spoken languages and at the same time has its own unique qualities as a form of communication. Unlike spoken language, there is no direct semantic relationship to other objects, so meaning in music instead develops by reference between musical events. I'm interested and challenged by this self-reference which spans musical elements across the dimensions of time, pitch, timbre or dynamics.

OL: I think few question the excitement and pleasure due to research in music, since this strange auditory phenomenon is an important entity and companion in many people's lives. As a music lover you could probably not think of a greater job. One nice thing for me is that, although music in general seems to be something you cannot describe easily with words (which is maybe the reason why some associate something paranormal or esoteric with music research), it seems always possible to communicate with people from various different backgrounds about this kind of research. You can scale the level down to communicate with people who were never in touch with any scientific activity, but you can also discuss methods and details with experts in completely different scientific domains.

HH: When I explain to a more general audience that one of the foreseen applications of our European research project is to be able to make a *listening machine*, i.e., a machine that can listen and react in a human and musical way, people often react with saying, "Oh, so you actually want to replace a musician by a computer?" However, we are actually interested in what the machine cannot do: that is, what we cannot put in formal terms is not yet really understood. And this is what makes cognition such an intriguing domain.

Reut Tsarfaty