

Chapter 9

Reasoning and the brain

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A Contribution to the Liber Amicorum for Michiel van Lambalgen

My contact and interactions with Michiel go back to 2003, when a young, brilliant student of Michiel at ILLC approached me for an internship in my research group at the Donders Centre for Cognitive Neuroimaging. His name is Giosuè Baggio, currently professor of psycholinguistics at the Norwegian University of Science and Technology, in Trondheim. At ILLC Giosuè had received a solid training in philosophy and logic, which he wanted to apply to the study of semantic phenomena in language processing and their neural basis. In the meantime Michiel had spent a sabbatical with Keith Stenning at the University of Edinburgh where he studied the psychology of reasoning. From my side, I had a keen interest to put the empirical investigations of language processing on firmer formal grounds. This created a middle ground for Michiel and myself, where we felt some fruitful collaboration could be established.

At about the same time NWO had launched a thematic program for foundational research in cognitive science. Johan van Benthem was the chair of this committee and I was a member. My interactions with Johan and Michiel led to a, by now, long term connection to the ILLC, which has been continued and bears fruit until this very day. When the NWO Cognition Program launched a call Michiel and I teamed up with two other colleagues and submitted a proposal on “Reasoning and the Brain”. The central theme of the proposed project focused on defeasible inference. According to deductive logic, reasoning is non-defeasible. That is, if a conclusion follows deductively from a set of premisses P , it cannot become invalid if additional information is obtained. However, this does not characterise our reasoning and inference making in everyday life. Van Lambalgen and Hamm had published their important formal theory on tense and aspect (The proper treatment of events, 2005) in which they treated the lin-

guistic processing of temporal information as a defeasible process. This processing involved a mechanism of computing and re-computing so-called minimal models. Such (re)computations are, among other cases, assumed to take place when a reader/listener processes the default implications of the English progressive, as in the following examples:

- (a) Michiel was building a barn, when a neighbour dropped by for a chat.
- (b) Michiel was building a barn, when he was struck by lightning.

In the absence of information to the contrary, it is assumed that the barn will be finished, as in (a), but this inference is defeasible, as in (b). In our grant proposal we specified experimental procedures to study the neural substrates of defeasible inference with the help of recording electrical and magnetic brain activity (EEG, MEG). The idea was that if the formal model of Van Lambalgen and Hamm is correct, we should see differential traces in the brain signals if we compare cases as in (a) to those in (b). The second part of the project focused on possible deviation in defeasible inferences in people with an Autistic Spectrum Disorder (ASD). The project proposal convinced the referees and the NWO Program committee. On this basis we could offer our joint master student Giosuè Baggio a PhD position and we attracted another gifted student, Judith Pijnacker, for the ASD part of the project.

I don't have space here to summarise the outcomes of these projects, apart from saying that the results were in line with our predictions from the model. Our NWO-funded project resulted in two PhD theses, *Semantics and the electrophysiology of meaning: Tense, aspect, event structure* (Baggio, 2009), and *Defeasible inference in autism: a behavioural and electrophysiological approach* (Pijnacker, 2010). In addition, it resulted in 7 co-authored publications with Michiel in international journals and as handbook chapters. Certainly, both in quality and quantity a sizeable outcome that we should be proud of.

When writing this piece for Michiel, I just realised that there was a common characteristic between Michiel and our two PhD students. Here is a quote from my laudatio at the doctoral ceremony of Giosuè Baggio: "You are not one of those who enter the room with a lot of decibels. Modesty and integrity are two of your most salient characteristics. You are a deep thinker, and always listen carefully to other people's arguments. You will not say easily 'I think that is nonsense', even if you might think it every now and then. Given your qualities, a little less modesty in your interactions with the rest of mankind would not be unjustified. Of course, the ambition to develop a neurobiology of meaning is far from modest." Mutatis mutandis the same applied to Judith and Michiel. Michiel clearly had his views and ideas, but never presented them in an imposing way. That was also clear in our supervision meetings with the students, where he listened carefully to what the students had to say and gave his advice in a gentle manner. Our meetings with the students took place mostly in Nijmegen, but also sometimes in Amsterdam.

Michiel didn't have his office in the buzzing ILLC headquarters, but in a quiet room close to the Oude Manhuispoort, secluded from the student traffic and the networking scientists. Sometimes he had to cancel our meeting for external reasons, such as shown in the following email exchange from June 2005. Michiel: "Dear all, to my great regret I will not be able to make it tomorrow due to the strike, and, no, I don't have a driver's license". My reply: "We will prepare a court case against ProRail for their obstruction to the progress of science, and thus of mankind."

In the same year I received an email from Michiel that characterizes him well (it is in Dutch): "Beste Peter, Martin Stokhof heeft me gevraagd een hoofdstuk te leveren voor een nieuw handboek, nu voor Philosophy of Linguistics. Mijn stuk dient te gaan over taal en cognitie. Ik heb onmiddellijk ja gezegd. Mijn vraag is: wil jij op enigerlei wijze meeschrijven? Het lijkt me dat dit een gestructureerd wijze kan geven om over onze modellen en ideeën van gedachten te wisselen. Ik realiseer me ten volle dat je het vreselijk druk hebt, en dat ik mogelijk het leeuwendeel van het werk zal moeten doen. Om werkverlichting gaat het me ook niet – het lijkt me gewoon erg interessant". As is clear from this email, Michiel is interested in the intellectual challenge, the exchange of ideas. He wasn't interested in taking center stage or in offloading his part on other shoulders. One could say that Michiel is a true intellectual in the classic sense of the word. All the paraphernalia of modern life in academia might not have been seductive for him.

My interactions with Michiel have been very fruitful. In later years they became less frequent, mainly due to health-related issues. The interactions also led to connections with Michiel's own network. As a result, on and off I had the possibility to discuss ideas with Keith Stenning, Fritz Hamm, Oliver Bott. I am grateful for our collaboration. It not only resulted in a very productive project on Reasoning and the Brain, but also, and even more importantly, it has enriched my own thinking, especially on issues to do with the compositionality of meaning.