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Dear Sir or Madam,

I am Martin Miguel and I am applying for the DeepMind Research Science Internship for 2020. I am very interested in taking part on the current developments in AI and Neuroscience.

I am currently enrolled and three years into my PhD. I graduated with a combined Bachelor + Master's degree in Computer Science at Universidad de Buenos Aires in 2015 and continued into the Doctorate. My research topic is developing models of cognition in time for exploring affect in music, particularly rhythms. Theoretical frameworks posit that part of musical affect comes from violation of expectations. Since music is highly structured and regular, it is easy for it to generate strong expectations. My focus is on having computational models of music cognition that integrate stimuli over time and provide a certainty metric. Certainty on the expectations is key as only violations of strong predictions generate affect.

During my PhD I have worked in modeling beat expectation, the most basic rhythmic expectation. We took from previous work and produced an agent-based model that had the previously mentioned features. Later, we set to evaluate whether the model's certainty measure related to cognition. We performed an experiment where participants were asked to tap to the beat while listening to rhythms of varying complexity. With the results, we could assert that our model's certainty related to how strongly participants felt the beat and how precisely they followed it. The details and evaluation of the model are currently under review in a music research journal. The preliminary results of the experiment were presented in the meeting of the Society for Music Perception and Cognition in August 2019.

The next step is expanding the modeling to capture hierarchical expectations in music, maintaining the focus on continuous evaluation and certainty. The first candidate are Hierarchical Bayesian Models. Their two-level inference mechanic where a top-level grammar structures the inference from the observable data allows describing the groups and repetitions seen in music. Bayesian models have been used to continuously integrate information and inherently allow calculating certainty. Another venue of exploration comes from transformer deep neural networks. Transformers have successfully been used to capture structure and long-time dependencies in sequential data, including text and music.

My approach to research has been question-centered and has turned me to incorporate knowledge from areas outside computer science, such as experimental psychology and neuroscience. I believe this makes my profile appealing to DeepMind as I posses the technical background for AI and the hands-on experience for research that involves thinking about cognition and the design of experiments.

Thank you in advance for reviewing my application.

Yours faithfully,

Martin Miguel