Review of the CBMM workshop on the Turing++ Question: 'who is there?'

By Ethan Meyers January 24, 2016

From the 3rd to the 5th of September 2015, the Center for Brains Minds and Machines hosted a workshop to addressed the first Turing++ Question: 'who is there?'. The workshop invited experts from the fields of computer vision, cognitive science and neuroscience to engage in a discussion about what are the neural algorithms and the underlying neural circuits that support the ability of humans and other primates to recognize faces. The goal of the workshop was to generate new ideas about how to make progress into understanding the neural algorithms that underlie face identification.

The workshop started on the afternoon of September 3rd with a session on the historical developments in these different fields. Takeo Kanade gave the first talk in which he spoke about the early development of computer vision systems in the 1960's and 1970's when computational constraints were a major bottleneck, and this talk was followed by a talk by Isabelle Bulthoff who spoke about the development of psychophysics of face processing which research started taking off in the 1970's. The third talk was given by Robert Desimone who described the electrophysiology work in macaque monkeys that occurred in the early 1980's. During that time it was thought that information was coded in highly distributed manner and so the initial reports that single neurons could be highly selective for only faces was initially met with skepticism; however with the ability to record repeatedly from the same animal, and the rise of computational data analyses, most researchers in the field become convinced of the findings. The fourth talk was given by Nancy Kanwisher in which she spoke about the first neuroimaging studies of faces in the early 1990's and the final session of the day was given by Anil Jain who described current developments in the face identification in computer vision and how the field has been making increasing progress through the years.

The second session was held in the morning of September 4th and was the first session to focus on current research topics in face processing. The session started with a talk by Thomas Vetter who discussed his work on 3D face animation, and also whether 3D information was needed for face identification or only for computer

graphics. This talk was followed by talks by Winrich Freiwald who spoke about his work identifying facial features that neurons in different macaque face patches responded to and by Lior Wolf who spoke about scaling machine learning methods to very large face data sets, which can dramatically increase the performance of these methods. The fourth talk was given by Cheston Tan who spoke about how faces are processed holistically, and how a computational system, based on the HMAX model, could account for this effect if one were to template with very large receptive fields. This session then concluded with a panel discussion led by Josh Tenenbaum and Amnon Shashua that discussed connections between the different talks, particularly with regard to whether 3D information was needed for face identification.

The third session of the workshop was held on the afternoon of the 4th and focused on two prosed computational models of face processing. The first model was presented by Qianli Liao and was based on a modified version of the HMAX model. This model was very compelling because not only was it biologically plausible, but also because it could achieve a high level of face identification accuracy on the Labeled Faces in the Wild data set without having to first align facial features in the images. The second model was presented by Ilker Yildirim and was based on a 3D analysis-by-synthesis approach where a convolutional neural network was used to efficiently fit the parameters of the 3D model. The advantage of this model was that it could perform well on unusual views of a face (e.g., the back of the head), although questions remain about whether this type of 3D model is biologically plausible.

The fourth session was also held on the afternoon of the 4th and focused on how to evaluate whether computational models were accurately capturing how neural systems are working. The first talk in this session was giving by Alice O'Toole and focused on a comparison of human and computer vision systems, and was followed by a talk from Pawan Sinha that focused on some strengths of the humans visual system to recognize faces under highly degraded conditions (such as very low resolution images) that currently far exceed the ability of computer vision systems. The final talk of the session was given by Jim DiCarlo in which he spoke about the relationship between face processing compared to the processing of non-face objects in neural systems. The session concluded with another panel discussion that focused on what data would be useful for constraining models and for moving the field forward.

The final session of the workshop was held on the morning of the 5th, and was the second session to focus on current research topics in face processing. The first talk was given by Arash Afraz who spoke about his work using muscimol and optogenetics to silence cells in face patches, and was followed by presentation by Ken Nakayama

who described how online experiments could be very effective to estimate a range of human recognition abilities (from prosopagnosics to super recognizers). The third talk in the session was given by Matt Peterson who spoke about using eye-tracking to understand face processing, and the last talk was given by Elias Issa who discussed how neurons in the face patches respond to images of inverted faces.

The workshop concluded with a session a panel discussion led by Gabriel Kreiman which consisted of a brainstorming sessions about what resources and knowledge would be useful for advancing our understanding of face identification. It was proposed that a website that would allow researchers to compare neural data, behavioral results and computational models would be very useful for moving the field forward. Based on this discussion, the CBMM is currently building such a system which should be available to researchers by the middle of 2016. Overall the workshop was incredibly valuable for sharing knowledge about how different disciplines study face processing, highlighting what are the key challenges for developing a computational understanding of the neural algorithms that underlie face identification, and for generating ideas about what would be the next best steps to pursue to make progress.