Science AMA Series: I’m Aleix Martinez, a Professor of Cognitive Science and Machine Learning at The Ohio State University. My main areas of expertise are face perception, emotion, and language. I’m available today to answer your questions. AMA!

ALEIX_MARTINEZ R/SCIENCE

Hi Reddit!
As a cognitive scientist, my main goal is to understand how the human brain works. That is, how our brain yields the set of observable human behaviors we see in ourself and others. I take a computational view. This means, I assume the brain performs a series of computations, similar to those executed by a computer, to decide how to interpret and respond to some input or situation. You can think about my work as identifying the algorithm the brain uses to solve a problem.

Some journal articles:
http://www.pnas.org/content/111/15/E1454.abstract
http://jov.arvojournals.org/article.aspx?articleid=2122685

News releases:
https://news.osu.edu/news/2016/03/28/notface/
http://researchnews.osu.edu/archive/21emotions.htm

Proof!
Hi everyone, Thank you for all the great questions. We received about 500 questions today. I have done my best to answer as many as possible, but I could not get to all of them. I will try to get some time off my schedule next week to answer a few more, but, in the meantime, I hope you can get the gist by reading my replies to the questions I was able to answer. This was fun and very instructive. Hope to see you all very soon. You can read more about my research on my website or follow me on google+.

How important do you think machine learning will be to our future understanding of cognitive psychology?

confessrazia

Machine learning is only one piece of the puzzle but an important one. I think it’s a must to analyze large amounts of data and, hence, very important to understand human cognition.
How closely related are the problems of recognizing emotions and recognizing individual faces? Is one problem more computationally complex than the other? Is the accuracy rate better for one of the problems?

Callisthenes

In short, we do not know. Not yet. We believe the computations are quite different and we seem to have specialized brain areas for each (FFA vs pSTS). See our recent work: https://news.osu.edu/news/2016/04/19/researchers-pinpoint-part-of-the-brain-that-recognizes-facial-expressions/

What level of abstraction do you think will end up being best for mimicking human cognition? Behavioral level, neuron level or something in between?

Can we do well enough with serial programming or will it will be important to develop much more parallelized hardware and languages to use for replicating human cognition?

PrettyIceCube

Great question! It depends on what you mean by “mimicking." Self-driving cars, for example, mimic human driving quite well and, pretty soon, they will be better than people behind the wheel. Now, that does not mean that the algorithm used by us and these computers is the same. One can indeed mimic at a behavioral level, that is, the output behavior is very similar to that of a human; this is generally called “computational” level. One can mimic at the algorithmic level — computers and people use a very similar (or equivalent) algorithm. But one can also mimic at the cellular level (called “implementation” level). All are important to solve scientific and engineering problems. For example, the self-driving car at the computational level and a model of Autism at the implementation level.

As for serial vs parallel, it is indeed true that the brain is massively parallel. But this does not mean we cannot achieve cognition in serial machines. The real question is computational power. What’s the comp power of the human brain and when will computer reach it? At present, we can only speculate on this. Another important point is that while a human brain only needs to ingest a few thousand calories a day, current technology requires access to large amounts of power to achieve anything close to what the brain can do. This is a true limiting problem.

Hi and thanks for the AMA.

A bit of a weird question, but is there some emotion that humans generally feel and portray the same way? Experiences are individual, but on a neurological level are there some emotions that create more varying reactions between different people?

Zigga-Zagga

We believe there are at least 23 facial expression of emotion that are universally used across cultures and many others that have grammatical function, like the “not face.” Link to our papers on this above.

What are your thoughts on the debate over the fusiform face area? (Here's a link for anyone curious) Do you think it’s an area solely devoted to recognizing faces and people who use it for fine distinction are in essence "anthropomorphizing" the things they are trying to distinguish? Or do you think it’s really just for fine distinctions and we have jumped to conclusions?
Also, what is your favorite way to simulate the brain? What neural network model do you use? (Do you use a neural network model?) What software? (Theano?)

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I'm currently doing my senior thesis for Computer Science (bachelors) and I'm trying to implement an open source library for face recognition based on convolutional neural networks (definition for the lazy) and sparse data representation (link for the curious). I'm also using OpenCV to pre-process the images (winnowing out areas of interest using haar cascades and aligning the potential faces by the eyes). I was going to try a java-based library for the CNN, but someone told me the python based libraries are actually optimized for this task?

I'm wondering what your thoughts are on sticking with Java vs switching to Theano or another python-based library. I'm aiming for usability to the layperson, so Java seems like a good choice because it's currently the most popular programming language and tends to be faster than python, but if it's going to be significantly slower.... but if I'm aiming for usability to a broad base (including lay people), then I can't get too specific architecture-wise, which kind of rules out hardware specific optimizations anyway, so ....

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Also, YAY!!!! Thank you for doing this AMA!!! I've always been fascinated by the intersection of technology and neurology, so I really want to work in the cognitive sciences. Do you have any advice for someone trying to break into the field?

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And lastly (here's the fun stuff) what do you think about the ethical issues of simulating the human brain? Where do you think the line between human and computer should be drawn (if at all)?

When do you (personally) think we should consider these simulations "conscious"?

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ArsenicAndRoses

FFA is well established as a face area, especially for identity. That doesn't mean it does not serve other purposes. See also the pSTS area we have recently identified to decode facial expression: https://news.osu.edu/news/2016/04/19/researchers-pinpoint-part-of-the-brain-that-recognizes-facial-expressions/

I'd certainty suggest using Python (see: http://scikit-learn.org/stable/) and Matlab (if you have a license).

This is a great area to work on so, yes, you should pursue this if you are interested. Find the best Professors to work with (those that match your interests) and apply to those schools. Your search should be based on who you want to work with rather than a specific location or school.

To break into the filed, think outside the box. It is a cliché, but it’s the only way.

I loved your article about facial expression as a part of grammar for negation. Do you know if this effect is spread across other facial expressions and connotations of words? I am a language teacher and am very interested in the effect of teacher expression in the comprehension of new vocabulary for students. Would you say it is reasonable to think that more expressive teachers will be a benefit to
student's understanding of vocabulary in the first introduction and the consecutive recall of that vocabulary? Thank you for answering our questions! You definitely seem very busy, I appreciate it.

Elements18

Great question! We scientists do not like to speculate and, unfortunately, I am not aware of any research that has tested your hypothesis. Seems a reasonable hypothesis, especially when it comes to teaching children, but without well-designed scientific experiments it remains unproven. In general though, people are better at understanding others when they can see them (e.g., video chatting vs phone; most of us prefer the former). Also, research has shown that teaching children face-to-face yields better results than using online systems, even when there's a human at the other end. On the other hand, too much expressiveness could serve as a distractor. I guess my hypothesis is that there must be a balance and that quality of expression (i.e., how well it matches the intended meaning) is more important than quantity.

What do you think is the biggest problem you faced when getting a AI to recognize different emotions?

lulzmort

Understanding how humans solve the problem. Researchers tried to solve this problem at the computational level (see my comments above), but were not very successful. My group spent years decoding the algorithm humans use. When we had this, we were able to implement an AI system at the algorithmic level that surpassed all our expectations. Our algorithm is even better than the average human now.

Are there any patterns of thinking that are hardwired into our brains and can never be altered? It seems we humans are always prone to make the same mistakes very much like how history always repeats itself.

kenjitheshibainu

Well, all we do is wired in the brain. I guess your question is how much influence does education and culture have. I believe the answer is very significant. Increasing educations, improves acceptance of others and openness to alternative viewpoints as well as better dialogs. I believe access to high-quality education needs to be a cornerstone of every society.

Do you personally think we have free will or do you hold to the idea that our decisions would be the same if all factors were the same?

I have had some problems trying to understand free will from thinking on how i would do if i relived a day twice, if i had no memories what so ever from the first time i can see no reason what so ever for me choosing different actions the second time, if i were in the same mental state.

baronmad

Great question. Wish I had an answer. This is one of the major debates in the cognitive sciences right now. You will find defenders of both right now, although most of the researchers I know are on the negative side – there's no such thing as free will. But, again, it is too early to say.

Do you think the Geneva convention needs to be updated to consider robots/ai in warfare? If so, what
sort of regulation would you choose?

professy

The concern is that the promise of humanless wars could increase the number of armed conflicts, machine vs machine. This is an area of concern that the research community and innovators are taking very seriously.

At my University we are building a game which will be used by Logopedists and their patient with a speech deficient. The game will be used by Logopedists to monitor progress and be a motivator for patients to practice their speech. Pictures of the patients their faces will be taken during the game and analysed by a Neural Network to see if the patient can or correctly uses their facial muscles during speech. Sound analysis is currently out of the scope of our project, but is something the Project owner wants to implement in the future. We are currently trying to understand Deep Neural Networks and the TensorFlow framework.

Seeing that you worked with face perception, emotion and language, do you maybe have prior research, datasets or something else you can point us at?

If you want more information, you can always contact me trough pm or a reply to this post. Thanks in advance!

M1ch13l

You might want to use our system, see: http://cbcsl.ece.ohio-state.edu/cvpr16.pdf The system will be available for non-commercial uses later this year (most likely late summer or early fall). You may contact me (email) in July or August or check out our website: http://cbcsl.ece.ohio-state.edu. You can also follow me on google+

Salutacions des de Barcelona :)

• We tend to talk a lot about how can we improve our AI and technology in general to behave as a human would. My question here has to do with the opposite, which would you say are the biggest changes humans are experiencing at a cognitive level (also when interacting with new techs) and if there is a tendency expected for the upcoming generations? I am curious on any reads you can recommend on this topic.

• Additionally, feel free to recommend any reads thought for the general public on Cognitive Science in general. All my contact with this science was through "Cognitive Science: An Introduction to Mind and Brain" and I enjoyed it pretty much :)

• Finally, just a short question out of curiosity. Are there any events/meeting/presentations on the topic ever happening in Barcelona that you could endorse?

sennacheribbo

Our technology shapes our brains. When books were invented, people did not have to memorize as many things, which resulted in cognitive changes. With GPS, we free ourselves from getting lost but also from having to memorize maps and directions in advanced. AI will have similar effects.

Eye, Brain, and Vision (Scientific American Library Series), by David Huble is an easy, enjoyable read. Also, books by Steven Pinker. I’d recommend the language instinct. If you want to get into the philosophical side, one of my favorites is Fromm’s the anatomy of human destructiveness.
NIPS will be in Barcelona this December.

why do you think there is to an own gender bias in facial recognition for females but not so much males? I've read some studies about OGB being found in infant girls from 3-6 upwards just weird how males don't seem to get it.

mrhominidae

Some people are better at reading faces than others. In general women are slightly better at reading facial expressions, but the difference is very small. There are much larger differences between individuals.

Hi Aleix (or should that be Professor Martinez) & thanks for the opportunity. My question is about face perception & language. I'm great with faces, but awful with names. Why can't my brain just connect the dots? And how can I help it learn to? When introduced to a new work site last month I was given the "this is Bob, he does policy, this is John, he does Project X" 20 minute tour. I would see these guys in the break room & recognise them (remember earlier interactions & maintain a conversation), but couldn't remember their names. On paper, I know Bob is in policy and John is in Project X. But it's like "never the twain shall meet". I'd go looking for John to answer a question & have to ask which one he is. It's taken me about 8 weeks to get these people straight in my mind - this is an recurring experience in both work and social settings to greater or lesser degree. What's going on in my head?

minimarcus

This is quite natural. The parts of the brain that process names and faces are believed to be dissociated. You need to cerate a link between the two and not everyone is great at this. In fact, many people have this exact same problem.

The Human Brain Project is struggling in Europe. Do you think its goals are too lofty given its 10 year timeline (map the human brain roughly 1:1 into code in order to simulate the brain as a computer program)?

Wootsat

This is an amazing, lofty project with great potential. If successful this could be extremely important. I guess your question is whether we would be better of dividing that large sum of money onto smaller projects. In an ideal world there'd be more money devoted to basic and applied research, but resources are limited.

I would be interested in any comments you can make regarding prosopagnosia and aphantasia. I believe I have both of these conditions.

TychaBrahe

I do not work on this directly, but if you contact me personally (email), I can put you in contact with colleague who might be able to test you.

What are your thoughts on IBM Watson and HPE Haven OnDemand, which offer cognitive computing
and machine learning as a service for businesses?

129381729841

AI systems are surely going to help us solve many problems in the future. These are some early examples.

Why are facial expressions more pronounced in certain individuals than others?

ridethelightning98

Although we all have the same major facial muscles, their flexibility and our bone structures differ. This yields apparent differences in muscle activation (production). In our research, what we measure is the % of change from rest (neutral expression) to maximum extension of the muscle (100%). This normalizes production differences across people.

Some animals have instinctive behaviors that are passed genetically from the parent. For example, some hunting dogs have built-in algorithms for hunting.

Humans have a long maturation period and have to learn a lot.

Do humans appear to exhibit any cognitive algorithms from birth?

I remember studying Piaget in school. I recall that some cognitive functions (algorithms) were not instantiated -- as it were -- until certain ages. Does that mean they were learned? Or did they just become manifest at a certain stage of development?

BobHHowell

Both. Language is a good example. Although it takes time to develop, we believe it’s part of a universal grammar, an algorithm that is common to us all. However, you still need to learn the peculiarities of your language (say English) which are different from those of others, e.g., SVO vs SOV.

What has been the most useful algorithm for artificial intelligence invented in the last say 10 years?

What techniques are you still missing?

alphacharly

One of them is face detection, which you can find in many electronics now. Also, speech recognition and spam detection. Other face recognition technologies are around the corner and object recognition will probably be available soon. We are also designing an online AI system that will teach you American Sign Language. The possibilities are endless. Driverless cars are probably less than 5 years away.

What a coincidence! Just last night I read your paper "PCA versus LDA". I feel compelled to think up a great question, but mostly I just want to dive into your current research and learn more.

When asked about teaching AI to interpret emotions you replied:

My group spent years decoding the algorithm humans use. When we had this, we were able to implement an AI system at the algorithmic level that surpassed all our expectations. Our algorithm is
even better than the average human now.

My questions are:

1. As algorithms outperform humans, does that or should influence how humans learn about emotions?

2. Have there ever been any observations of how humans interpret other faces that completely surprised you?

thefakepicholo

1. I don’t think so. Our cognitive system solves most of these problems outside of conscious awareness and will continue to do so.

2. Perhaps the most surprising finding to me was to realize how bad we are at recognizing fear from facial expressions. We are actually really good at recognizing fearfully surprised, but not very good at fear.

Hope you enjoyed the pca versus lda.

What are some overall negative trends in your field, and what do you wish could be done better?

argolossantos

Let me address a related question. Many outside the field think that AI systems will take our jobs. This is not true. In general, technology facilitates our work and AI systems are no exception. We will be able to solve more problems faster.

To what extent are these ‘algorithms’ endogenous? Can they be formed, or indeed altered, by things like formative life experiences (positive or negative), education, culture?

petkoalas

The ones I focus on are of a biological origin (meaning you are born with them or they develop over the first years of life), but they can indeed be modified based on life experiences; think of psychopathologies such as PTSD, you may need to be prone to them, but you also need an environmental trigger. Another example: people that have been abused as children detect anger and fear from faces more readily than others.

Hi! How differently do people view your computational vs experimental studies? Working in cognitive science, I guess most of your colleagues have no idea about what you are doing when presenting your computational work, so how do they react? Are they trusting results from computational studies? Also, do you feel like most people in your field from the cognitive side have the knowledge to tell apart good from bad studies in modelisation? I ask because I often read studies with trivial computational simulations with predictable conclusions, or sometime just plainly bad studies with a bunch of free parameters that look like they have been carefully selected to give a good fit between the model and the data. Those studies are often published in specialized journals, and I feel like it must be because the reviewers had no expertise whatsoever in modelisation and only in the related field of study in cognitive science. Do you feel like that’s an issue?

viggar
Cognitive science is a multidisciplinary area. We have people doing behavioral work, others doing imaging (e.g., fMRI), neurophysiologists, and people like me who do computational work. All of them are complementary and necessary -- what you can achieve with one, may not be attainable with the other approaches. Computational work is taken very seriously by my colleagues who use other approaches. I take their work very seriously too. In fact I typically collaborate with people in all of these areas when designing my experiments and models.

What use do you expect out of "human like" robots in the future? (Short and long term)

Izenzeven

Short term (not a complete list, but will give you an idea): self-driving cars (also planes, buses, trucks, trains, etc.), better passwords (e.g., face recognition), better speech recognition (by adding facial expression analysis), automatic annotations of images and videos, AI tutors and teaching materials (my lab is designing an online AI tutor that will teach you American Sign Language), AI tools to aid in medical diagnosis (we are designing tools to diagnose Autism, PTSD and other psychopathologies).

Long term: AI will be quite ubiquitous. We will have tools to help us perform our jobs better, faster, safer. This will help us solve problems that were unattainable before, for example, design systems to diagnose patients faster and more safely, understand diseases that we currently find too complicated to study (and treat them), travel faster and safer, find better ways to live our lives (safer environments, housing, etc.).

What are your thoughts on the singularity concept? Does this concern you at all?

cyberpsych

No, it does not concern me at all.

As of the end of this summer, I will have earned a masters in Psycho- and Neurolinguistics. I am very interested in continuing on to a PhD in some form of language science research, but I would like to work in research full time for a year or two before I commit to a PhD, given the time commitment. I want to be sure it is definitely what I want to do with my life. I have had difficulty finding academic research positions available to those without a doctorate. Have you got any suggestions as to how to find this kind of work? Thanks so much.

sesquipedalianlike

You might be able to get a lab assistant position, but other research positions are for MS, PhD students and graduates.

What role do you think neural networks / deep learning will play in AI? Are these machine learning algorithms sufficient for a computer to visually understand the world around it?

ClimbingClimbOn

These systems are great for companies that have access to large amounts of data. Where large numbers of samples are given, these systems perform really well. However, children learn from very few examples. My goal is to understand how.
What are some facial gestures that we may take for granted as universal (like the “not face” in the first link you posted) but actually are not? Has there been any research into the “etymology” of these kinds of evolved facial languages?

shaggorama

Absolutely, this is an active area of research.

Do you have a go-to resource to point ML beginners to that provides a good intro primer to ML concepts?

Bobbr23

There is no one single source, but a good introduction is Pattern Recognition and Machine Learning.

Hi there, do you do much interdisciplinary work? I teach English to adults (native and non-native speakers) and I have become very interested in researching the specific neurological process of reading in adults and teaching adults to read.

I am fascinated by our brains ability to learn how to read but most of the articles I read approach this subject from an andragogological (pedagogy for adult learners) perspective and therefore focus on observation and refinement of teaching methods. These studies look at the results, but I want to approach it from perspective that looks at the processes in our brain that happen when adults are reading or learning how to read.

So I guess my questions are, do you do any interdisciplinary research? Does your research ever overlap with education/ pedagogy or similar subjects?

Thank you and have a nice day!

epickneecap

We are designing an online AI system that will teach you American Sign Language, but I do not have experience on the other domains you mention.

How accurate is the show Lie to Me

lifeinvaders

Based on actual research results, but still fiction. I haven't watched it so I cannot comment in detail, but I'd guess nobody is as accurate at reading others as fictional characters like this one.

Hi Dr. Martinez, thanks for doing this AMA.

Does prosopagnosia affect perception of emotion? I know interpreting faces is pretty important for understanding others emotions, and was wondering if the inability to remember faces has any sort of effect on this perception.

pigonawing
There is some debate on this, but it seems some people are only impaired to recognizing identity (who you are) and other only to expression. We now know there are at least three brain regions dedicated to face processing, which potentially explains how this might happen.

I'm curious to know your thoughts about music/art therapy. Is there any scientific research out there that shows there might be a link between music therapy and helping a person's brain better create the 'computations' you have talked about? And if so, do you have any suggestions on reading materials? Thanks for taking the time to do this AMA!

David Huron, here at OSU, might be able to answer your question.

I took your computer vision class this year, just wanted to say I really enjoyed it!

Hi Aleix, thanks for the AMA.

We have seen that self driving cars make better decisions than Humans do. And there have been several instances of this superiority. This can be attributed to the complex way the human brain behaves. But do you think the human brain's algorithm is a bit flawed in comparison?

My second question is with regards to emotions. How long till we see machines that emote? Is it possible?

Human cognition is amazing and extremely robust. However, we usually do many things at once and can be easily distracted, which can cause an accident. Computer systems are designed not to be distracted. Humans are not flawed, we did not evolve to concentrate on just driving.

Emotion is essential to human cognition and will certainly be essential in systems that want to imitate human cognition.

I tend to understand peoples faces because when I mimic what I see, it causes an emotional response and through trial and error over the course of life, found it works.

Question: Do people who can't move their faces (paralysis) from birth have the same level of empathy/emotional recognition of facial expressions?

This has been hypothesized but results are mixed. Mobius syndrome (paralysis of the face) is associated with some mild impairment.

im fascinated by machine learning, currently pursuing a masters in data science/machine learning. Would you recommend I go into a phd program after?
That's a very personal decision. I can say that you will likely have lots of fun and that there's plenty of work for people with a doctorate in machine learning right now and for the foreseeable future. But I should also emphasize that a phd is a serious endeavor which will take most of your time for the next 4-5 years.

When evaluating facial expressions it is known there are multitudes of micro expressions going on. What is the sample/frame rate required necessary to catch all of the expressions being presented. I would expect subconsciously our brains automatically detect most of these, but I'm interested in what rate is necessary to count them all.

Good question. In other words, how fast can you contract and relax your muscles? For most of what you need to see, 30 frames/sec is sufficient, but if you want high quality analysis you should have 60 or more.