Science AMA Series: I'm Professor Yulia Kovas, Director of The Accessible Genetics Consortium in conjunction with Goldsmiths, University of London. I'm interesting in finding out what people know, think and feel in this post genomic era. AMA!

YULIA_KOVAS R/SCIENCE

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Should laypeople worry about the security, privacy, and future uses of genetic material they submit to academic genomics studies or private companies like 23andMe?

The_Circular_Ruins

This is an excellent question and I think societies should definitely get ready for the 'genomic era'. There will be more and more genetic testing done in the future. I personally do not think our greatest worry is access to our genetic material or information. Not right now anyway. Just simple questions about family history and behavioural data that people provide on social media - give more information than genetic testing today. The first thing that "lay" people (I prefer the term, non-experts) need to worry about is how little we know and understand about genetics. This is because right now most people would not know how to interpret the probabilistic information they are getting from their 'genes'. This may affect them psychologically.

If you'd like to know more about efforts to formulate an international ethical frame work for genetics research I'd recommend this paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3897849/

What do you think will be future implications of using CRISPR technology will be (good and/ bad)?

tialeah

I can see people already provided some excellent responses to the CRISPR (Clustered regularly interspaced short palindromic repeats) technique. I think this and other new methods of gene-editing will be widely used in some areas of medicine. However, we will need to learn much more about DNA before this can happen. For example, the same gene can affect many different traits (a concept called pleiotropy). There are some examples where a gene may have have a positive effect on one trait and a negative - on another. This obviously calls for much caution for any gene editing. Having said this, there is much research that is going on right now to use genetics to understand how we can target

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specific cells, for example, so that we can deliver drugs directly to where they need to go.

If you'd like to know more, this might be of interest (as recommended by one of my students) https://www.youtube.com/watch?v=jAhjPd4uNFY&feature=youtu.be

Hi Dr. Kovas,

If you had a genome in front of you, would you be able to tell what a person's strengths/weaknesses, or overall behavioral characteristics are? With what percentage would you expect to be correct? Are there any people involved with creating genetic profiles (gene A and gene B mean something separately, but together mean a different behavioral component)?

What are the current restrictions on sharing genetic data (with patient or without)? Are there any policy changes we should know about related to this?

Do you like the movie Gattaca?

Thanks!

LookinLikeCroMagnon

Great bunch of questions!
According to some solid predictions, all newborn babies' DNA will be sequenced soon after birth. This means that no more genotyping will ever need to be done on their DNA. The big question is what will we be able to do with this information. Currently, there is very very little that we can tell about psychological characteristics of an individual just by examining their DNA. This is because all psychological traits are influenced by many many genetic markers of very very small effects (the concept called 'polygenicity'). This means that it is very difficult to identify these markers. However, recently this work has begun. For example, here you can find a paper that reports on predicting educational achievement from DNA, where 9% of variability in achievement is explained by multiple DNA markers (polymorphisms): http://www.nature.com/mp/journal/vaop/ncurrent/full/mp2016107a.html. To hear the author talk about her work please see here: https://www.youtube.com/watch?v=9vq9WEIx0PI

My family is currently undergoing genetic testing because of my child's autism diagnosis, with no family history. We already did the microarray, now we're doing single-gene tests (over 2,000!).

My question is, what about traits that are a result of interplay between multiple genes? For example, perhaps my child only has autism because she inherited gene A from me and gene B from daddy, neither one alone would cause the disorder. Or it could be you need a certain set of 10+ genes, and without any one of them autism never develops, etc.

My understanding is, current genetic testing can't detect genetic causes of this kind. Is that true? Is anything being done about that? How likely is it that important traits are a result of multiple-gene interactions as I described?

slowlyslipping

As you probably know, our view of autism and autistic spectrum disorder (ASD) has changed dramatically, from viewing it as an entirely environmental condition (parents were often blamed for it) to viewing it as a 'genetic' disorder. Neither view is correct. Like most other traits, it seems to be a product of genetic and environmental influences. The environmental side of it is very poorly understood, it is really not clear what aspects of the environment contribute to the development of the condition. At the genetic level, a lot has been learned from family studies, and in particular - twins. Monozygotic twins

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who share 100% of their DNA show a remarkably high concordance for autism (if one twin has ASD, the other one is highly likely to also be diagnosed with it). Interestingly, Dizygotic twins (who share only 50% of the variable DNA) are less similar than can be expected from their genetic similarity. This indicates, that it is possible that some of the genetic effects on ASD are of an interactive type - when one gene depends on another gene (epistasis). What is also clear is that many many genetic markers (polymorphisms) seem to be involved in ASD, and currently only some of them have been identified. So, still a lot of research to do...

For more about the twin method I'd recommend this video:https://www.youtube.com/watch?v=BTYCv1ObZrI

Hi there, thanks for doing the ama!

I'm studying Sociology/Criminology and it's still a debated topic as to whether people's attraction to other people is somewhat genetic or whether it is learnt either subliminally or not.
So my question is, to what extent do you believe that sexual orientation is an influenceable choice over a genetic fact. Sorry if this out of your field but I'm interested to get a little outside perspective.

Ajaiixx

You are right, I am not an expert in this particular area of research. My focus is on individual differences in learning abilities, motivation, cognitive abilities and other human characteristics relevant to education. However, what I can say is that whichever area is addressed with behavioural genetics - we are finding at least moderate genetic effects. This suggests that it is highly likely that sexual attraction and orientation is influenced by many genes (DNA variants) of small effects, that interact with environments - to produce individual differences. There is an excellent summary of behavioural genetics findings in this paper: http://pps.sagepub.com/content/11/1/3.full

For someone like me who suffers from depression and mental health issues(schizophrenia) do you think it is immoral to reproduce?

schizophrenicman123

Every individual should be able to and should be allowed to make decisions about reproduction themselves. Even if we discover all the genetic variants (polymorphisms) that are involved in complex traits, such as depression, the prediction of whether someone may develop depression will be only probabilistic. This is because genes will interact with environments, and the same genes may express differently in different environments. By the time we will be able to make solid predictions of traits from DNA alone, we may also develop better understanding of how to prevent or treat conditions, for example from targeting specific cells with drugs, or by providing specific environmental conditions early in development. In any case, the value of Life can not be evaluated or predicted in a mathematical way and will always remain a mystery. However, we can equip ourselves with the best current information when making any such decisions; be this through academic papers or medical consultation.

Hello Dr.Kovas

I don't really understand what it is you do, could you explain it as if I were a five-year-old?

Sykrias

OK. Probably not a five-year-old, but I will try my best. I am fascinated by individual differences, and would like to understand why people differ in psychological traits, such as learning ability, motivation,

empathy etc. The most basic answer is: we differ because we have differences in our DNA sequence and we differ because we develop in different environments. My research programme is dedicated to understanding these processes at all possible levels: molecular genetics, brain, cognitive etc.

What are the potential implications for the public if large companies attempt to patent genetic modifications for humans in the same respect that companies such as Monsanto have done for crops? If a company were able to develop a genetic modification to prevent a degenerative condition such as ALS and patent it, would an individual be infringing upon said patent by passing that genetic sequence on to their offspring through natural reproduction?

[XxSolomonxX](#)

This is a real concern and I am very glad you are asking this question. I will leave it to our legal expert at TAGC to respond to this (we will post answers on tagc.world), but briefly, we need to do all we can to sustain funding for genetic research and not to leave it to commercial companies only. Indeed, current law allows patenting in genetics and this may disadvantage us in the future. The Human Genome Project is a tremendous example of scientific collaboration - scientists all over the world worked together round the clock to sequence the human genome and to make it publicly available - rather than allow commercial companies to patent it. I hope that future genetic discoveries will benefit everyone equally.

I'm curious to hear your take on the exposome. How do we best quantify it to measure it's impact on the individual? Do we treat it like the weather, and address it in more of a public health arena, or should we keep it focused on individuals? Also, how do you see it fitting into the emerging field of precision medicine? Thanks for doing this AMA!

[DiscursiveMind](#)

OK, for those who don't know this term, exposome refers to all of the environmental exposures that an individual encounters throughout life, complementing the genome - the entire DNA sequence of an individual. When genome meets exposome - transcriptome, epigenome, proteome, neurome and phenome (the collection of all your expressed traits/behaviours) of an individual are created. This is an extremely exciting time - our ability to anlayse huge datasets (big data), containing millions and billions data points - is developing at an astronomical pace. I have no doubts that big data analyses will lead to discoveries of new patterns in the exposome and genome and their interplay - and will lead to new discoveries. We will without a doubt know more about ourselves in the future. What will we do with this knowledge - remains a total mystery.

Hello! I am curious your take on "gifted" programs at schools. Placement in these is usually determined by the achievements of a student, do you forsee a future where this is instead determined by ones potential? What are the implications on students without the best genetics if that were to be the case?

[Frank_Steine](#)

This is a fantastic question. Potential is an extremely difficult thing to measure. Genes do not act in isolation and in fact interact with environments. For example, a student may have genetic potential to become a great musician, but this will only be actualised if they are exposed to or are able to seek a musically rich environment.

Achievement itself, and factors such as SES are themselves genetically influenced to some extent. Whilst there is the potential to use genetic information directly to identify those students who are more

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likely to do well at school, the important question is whether we direct resources to help those most in need, or those who are most able. It is a misconception that for societies to flourish we just need to foster talent. It is important to direct resources to tailor educational curricular to an individuals needs.

It is common in schools around the world to stream students into different abilities groups already, but this is done in quite a crude manner. Genetics has helped identify that we are much more different than these streams can accommodate.

For more about genetics in education I'd particularly recommend:

http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1118482786.html
http://www.palgrave.com/br/book/9781137437310

I was given a 23andme kit when they were starting up years ago. It was incredibly fascinating to see how much information about myself was readable from my genetic code, such as hair colour and straightness to the consistency of my earwax.

Do you think that gene sequencing is something everyone should have done in the future? Perhaps for the purpose of garnering useful medical information such as blood type and rh factor, sensitivity to certain drugs, and potential disease risks.

Do you think the existence of this information would be exploited by insurance companies to inflate prices for higher risk customers? Or even by potential employers who would choose not to hire a candidate based on genetic traits?

Do the pros outweigh the potential cons?

Also as a final note, how accurate would you consider the current state of understanding when using genetic sequencing to treat patients? For example giving a patient smaller doses of a painkiller that they are genetically predisposed to be more sensitive too.

GentlemenScience

Excellent questions. At TAGC (The accessible genetics consortium) we are working on these issues together with lawyers, policy makers, and other relevant experts. I will provide a brief response here, but we will post a more extensive response on the TAGC website shortly. As I mentioned already in another response - currently prediction for complex psychological traits is very crude. Family history and behavioural (phenotypic) information has more value than genetic testing. In the future, this is likely to change and the predictive power of DNA will become more precise (but will always remain probabilistic). This raises important questions about who will have access to genetic information and who will be allowed to use it. For example, if a newborn's DNA is sequenced at birth, will this data be waiting for them When they turn 16 or 18 before they can act on it? Or will their parents be making decisions about any possibilities of genetic engineering, choices of educational programmes etc. What if the parents disagree on these decisions? Will doctors be able to use this information? Will people need to disclose information about their DNA to insurance companies? All of these issues will need to be thought through and policies will need to be put in place. I can see that as some jobs become obsolete, a new host of jobs will appear - genetic counselling for complex diseases and disorders, 'genetic advice' - like 'mortgage' advice, etc. With regards to your 'painkiller' question, already today genetic testing helps to guide some treatments, in particular in cancer. And genetic research in 'response to treatment' is flourishing. This is definitely where I see huge benefits of genetic research.

Thanks for doing this AMA professor! My question is more philosophical than anything, how do you think genomics will impact the way humans conceive of themselves? I know we tend to think of

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ourselves as core "souls" encased by a shell of "body", so how does understanding genetic variants
that relate to, say, intelligence, addiction, tendency to commit crimes/suicide etc change that? Also
what does it imply in terms of our conception of free will to think that there is underlying, molecularly
determined causality behind our actions and personalities?

OnQuh

I do think that knowledge changes the way we think - fundamentally. Therefore, I do think that genetic
discoveries will change (to some extent) the way we think about ourselves and about others. Like with
any knowledge, there may be positive and negative sides of this knowledge. On a positive side, we will
recognise that genetically everyone is special, individual and unique. We will also recognise that
everyone carries risks for many traits - good and bad. That in many ways, genetics is a lottery - some
people are more lucky than others - and we should recognise this. It is harder for some people to loose
weight, to stay motivated, to be conscientious, not to get angry... It is easier for some people to do
things. These are not excuses or achievements - they are explanations. I think genetic message is one
of tolerance, of compassion, of equality despite differences.
On the negative side is that knowing may be a burden. People may try to run away from their
'probabilistic' fate, or worry about things that may (or may not) come, and this may affect them
negatively... This is not a question about genetics only, it is more about any prediction.

Can ones intelligence be considered a genetically inherited trait or is ones intelligence the result of
ones upbringing? If both statements are true, then which plays a bigger role?

the505

Indeed, both statements are true. Intelligence, like most human traits, is a product of genetic and
environmental influences. They interplay with each other, in most interesting ways. For example, it has
been shown in several populations that heritability of intelligence increases with age. That is, individual
differences in intelligence in children are largely explained by environmental differences, but as we
grow older, genetic differences among us explain more and more differences in intelligence. It is not
entirely clear why this is the case. One explanation is that, as we go through life, we make decisions
that are partly driven by our genetic propensities. So, we choose environments that are suitable to our
genetic propensities or react or respond to environments and events - in ways that reflect our genetic
predispositions. This way genes influence intelligence more. I highly recommend this paper on genetic
findings about intelligence:
https://kclpure.kcl.ac.uk/portal/files/35094548/Plomin_Deary_2015_Mol_Psychiatry.pdf

What happened to the 'c' in your surname?

kisordog

It never had it!