Vol. 7, Issue 1, March 2017

Journal of Unsolved Questions

JUnQ

Science and Art in Modern Times

Interview: Science on Stage
with Dr. Sascha Ott

Essay: Dance against Dementia
by Dr. Eckhart von Hirschhausen

NEW: JUnQ Photo Contest

Table of Contents

Preface

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Editorial Note

Dear Reader,

It is a pleasure for me to write the editorial of my first issue as editor-in-chief.
Right now, JUnQ is experiencing a very exciting and challenging time. A lot of our current members will be leaving the editorial board for job-related or family reasons, finishing this issue as their final work in the field of scientific journalism. Luckily their gap will be filled by new motivated members bringing a lot of fresh ideas with them. Bright minds of all scientific backgrounds are always welcome so don't hesitate to contact our team if you are willing to contribute.
The focus of our first issue this year lies on the relation between science and arts. Is there a connection at all between rational and emotional processes and methods?
We are absolutely convinced! Human kind would have never come so far if there hasn't always been a huge amount of creativity combined with an understanding of complex processes. In short essays on our part we will illuminate the people and works that shaped our modern picture of the world (page X and XIV).
Dr. med. Eckart von Hirschhausen, famous German physician, comedian and author, kindly allowed us to reprint one of his articles from www.spektrum.de about how dancing can prevent dementia (page III).
The interview with Sascha Ott will give us insights into the work of a science journalist who is combining the fascination of physical phenomena with an entertainment show. Is it an art to convey science on stage? You will get to know it on page IV.
The images of creations made by Tyler Thrasher you will see on page VI will make a minerals lover's heart leap for joy. He grows crystals on very exotic substrates and creates creatures that do not seem to be of this world.
If you are working in an old concrete facility like the CEA Saclay that needs some renovation you understand how depressing such an environment can be. The stencil artist C215 made it his business to decorate the buildings and labs of the Alternative Energies and Atomic Energy Commission in France. Learn more about him on page XVIII.

A yet new feature for JUnQ is our Photo Contest. All readers are encouraged to be creative and send in pictures of any kind from their work that are somehow arts and science related. The best picture will be drawn by lot and published in our next issue.

Since there were no submissions for articles, unfortunately this section must be left empty.
So at this juncture comes a call on our readers: please help to raise the attention on JUnQ. Tell your friends and colleagues about the Journal of Unsolved Questions. There is no shame in null or negative results. As I heard some friends lately "we all make beautiful failures so that we can learn". Share yours with the world and help your colleagues to learn.
With this in mind keep digging through the JUnQ to find the hidden treasures in Arts and Sciences!

–Tatjana Dänzer

From Head to Leg and Back – a Doctor's view on Dancing.

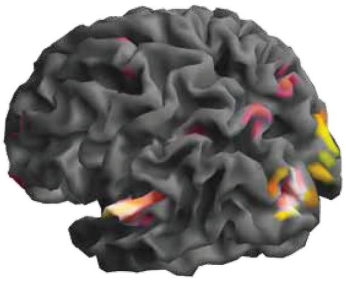
by Dr. Eckart von Hirschhausen

Dr. Eckart von Hirschhausen[1] is a German Doctor, comedian, author, cabaret artist, and show host and currently tours with his stage performance "Wunderheiler". He was born in 1967 in Frankfurt/Main and studied medicine at the Free University of Berlin, the University of Heidelberg and the University of London. After graduation, he started working in the field of journalism, mainly writing for news magazines and newspapers. Within only a few years, Hirschhausen began to host television shows and eventually started to perform as a stand-up comedian and cabaret artist. Nowadays, he is one of the best known comedians in Germany – and as we will learn now – he is also interested in dancing, at least the West Coast Swing, to train his brain.

[1] web: www.hirschhausen.com

(©Paul Ripke)

Nothing preserves our brain cells as well as a diverse and agile life: Dance against dementia.
A sample size of N=1 usually rankles the science journalist. However, here N is not N.N., that is *nomen nescio* which means "still to be named", instead I know the subject very well since it is me. Today, I report my little self-experiment in a brain scanner in which I have had two scans – one before and one after the summer. In between, I took dancing lessons. The question was: How malleable is my brain?
For more than 30 years, I did not set a single foot inside a dancing school and it was correspondingly tedious for me to memorize the moves. What drove me on was the legendary Einstein Aging Study, a long term study, which monitored people over the course of decades. It showed that our hobbies influence how fast our brain degenerates. My grandma always solved crossword puzzles, thus I knew very early on that – a tropical bird with five letters = MACAW! In the Einstein Study, the risk of dementia-related diseases is reduced by 41% if the participants solved crossword puzzles several times a week. Sports, like swimming, reduced it by 29%. However, a radical reduction of a thrilling 76% was reached by dancing!
Dancing challenges and delights us on many levels. We move our bodies and someone else's, we learn new patterns of motion, and the social interaction and the music make us happy. Solving crossword puzzles has only two levels, vertical and horizontal. So far, no medication, no game of chess, no nutritional supplement has ever reached a better medical effect against dementia than a frequent few steps on the dance floor. Thus, it helps to get one's butt in gear from time to time and even better, moving it left and right with the rhythm when doing so! At first, I always wanted to check on the location of my feet. Fortunately, they are directly wired to the brain and after some time, I could step on the toes of my dance instructor with my head held high. When I had the second scan in the MRI, the training revealed its effects. When, now, imagining dancing to swing music, the visual cortex was less active than before while the motor centers of my brain light up all the more. Thus, I did not only visualize the dance, but also automatically translated the music into motion patterns. It twitched and flashed from tongue to toe!
Professor Christian Elger who led the examination was surprised himself. Although, there are already comparisons of the brains of dancers and non-dancers, I could demonstrate my neuroplasticity in a direct before-after manner.



Inside the brain: These regions were active while only thinking of dancing Swing. Yellow shows the regions before, red after the dancing lessons, respectively.

When the first signs of Alzheimer's appear, it is already at least two years too late for drugs to be effective. Apparently, nothing preserves our brain cells as well as a diverse and agile life: Dance against dementia! Every child automatically wiggles and wobbles to music. Thus, we, as adults, would not need to learn dancing in such a tedious manner if we would not have broken loose from it in the first place. Dancing helps us now and later – "Man, learn to dance" said church father Augustinus, "otherwise the angels in heaven don't know what to do with you."

Read more:

Verghese, J. *et al.*: Leisure Activities and the risk of Dementia in the elderly. In: The New England Journal of Medicine 348, S. 2508–2516, 2003

This article was originally published here:
http://www.spektrum.de/magazin/dance-gegen-demenz-musik-erhaelt-die-grauen-zellen/1368425

By courtesy of Dr. Eckart von Hirschhausen and Spektrum. Translation by Kai Litzius.

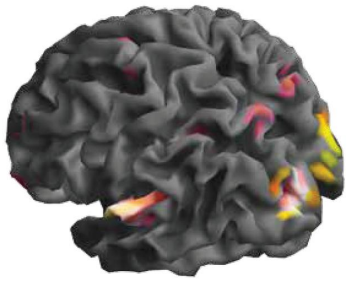
Vom Kopf in die Beine und zurück

Von Dr. Eckart von Hirschhausen.

Dies ist die Originalversion des Artikels, die zuerst erschien in Gehirn&Geist 11/2015. Auf Bitte des Autors wurde sie im Original hier aufgenommen.
Dr. Eckart von Hirschhausen ist Mediziner, Moderator und derzeit mit seinem Bühnenprogramm »Wunderheiler« auf Tour.
Um seine grauen Zellen zu trainieren, lernte er, den West Coast Swing zu tanzen.

(©Paul Ripke)

Eine Stichprobengröße von N = 1, da sträubt sich der Wissenschaftsjournalist. Aber da das N in diesem Fall nicht N. N., also noch zu benennen ist, sondern mir bekannt, weil ich es selbst bin, berichte ich heute über einen kleinen Selbstversuch im Hirnscanner. Ich habe mich zweimal in die Röhre gelegt, vor und nach dem Sommer. Dazwischen habe ich Tanzstunden genommen. Ich wollte wissen: Wie plastisch ist mein Gehirn?
Über 30 Jahre lang hatte ich keinen Fuß mehr in eine Tanzschule gesetzt. Entsprechend mühsam war es für mich, die Moves zu memorieren. Was mich antrieb, war die legendäre Einstein Aging Study, eine Langzeitstudie, die Menschen über Jahrzehnte begleitet. Sie zeigt: Unsere Hobbys beeinflussen, wie schnell unser Hirn abbaut. Meine Oma machte immer Kreuzworträtsel, daher wusste ich schon früh: tropischer Vogel mit drei Buchstaben – ARA! In der Einstein-Studie reduzierte sich das Risiko für Demenzerkrankungen um 41 Prozent, wenn die Teilnehmer mehrmals pro Woche Kreuzworträtsel lösten. Sportarten wie Schwimmen verringerten es um 29 Prozent. Eine Risikoreduktion von sensationellen 76 Prozent aber brachte nur das Tanzen!
Tanzen fordert und erfreut uns auf vielen Ebenen. Wir bewegen unseren Körper und den eines anderen, wir lernen neue Bewegungsmuster, der soziale Kontakt und die Musik machen uns glücklich. Im Kreuzworträtsel gibt es nur zwei Ebenen, senkrecht und waagerecht. Kein Medikament, kein Schachspiel, keine Nahrungsergänzung hat bislang eine bessere Wirkung gegen Demenz gezeigt, als regelmäßig ein paar Schritte aufs Parkett zu legen. Gut also, wenn man ab und zu den Arsch hochkriegt. Noch besser, wenn man ihn dann rhythmisch nach rechts und links bewegt!
Zuerst wollte ich immer nachsehen, wo meine Füße sind. Aber glücklicherweise sind die ja direkt mit dem Hirn verdrahtet, mit der Zeit konnte ich daher meiner Tanzlehrerin erhobenen Hauptes auf die Zehen treten. Als ich das zweite Mal im MRT lag, hatte das Training Wirkung gezeigt. Wenn ich mir nun vorstellte, zu Swing-Musik zu tanzen, war der visuelle Kortex weniger aktiv als vorher, dafür aber umso stärker die motorischen Zentren meines Gehirns. Ich stellte mir den Tanz also nicht mehr nur bildlich vor, sondern setzte die Musik automatisch in Bewegungsmuster um. Es zuckte und leuchtete von der Birne bis in die Beine und zurück!
Professor Christian Elger, der die Untersuchung leitete, war selbst überrascht. Zwar gibt es bereits Vergleiche zwischen Tänzerhirnen und denen von Nichttänzern. Ich aber durfte meine neuronale Plastizität erstmals im Vorher-nachher-Design demonstrieren.



Im Gehirn des Kolumnisten: Diese Regionen wurden bei der bloßen Vorstellung, Swing zu tanzen, vor dem Tanzunterricht (gelb markiert) und danach (rot) aktiv.

Wenn sich erste Anzeichen von Alzheimer zeigen, kommen Medikamente mindestens zwei Jahrzehnte zu spät. Offenbar erhält nichts unsere grauen Zellen so gut wie ein buntes und bewegtes Leben: Dance gegen Demenz! Jedes Kind wackelt ganz automatisch zur Musik. Wir müssten als Erwachsene das Tanzen also nicht mühsam lernen, wenn wir es uns nicht vorher abgewöhnt hätten. Tanzen bringt etwas für jetzt und für später – »Mensch, lerne tanzen«, sagte schon Kirchenlehrer Augustinus, »sonst wissen die Engel im Himmel nichts mit dir anzufangen.«

Quellen:

Verghese, J. et al.: Leisure Activities and the risk of Dementia in the elderly. In: The New England Journal of Medicine 348, S. 2508–2516, 2003

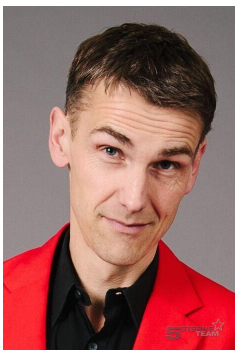
Dieser Artikel wurde ursprüglich publiziert in: Gehirn&Geist 11/2015
http://www.spektrum.de/magazin/dance-gegen-demenz-musik-erhaelt-die-grauen-zellen/1368425

Mit freundlicher Genehmigung von Dr. Eckart von Hirschhausen und Spektrum.

On Air and on Stage: Is it Art to Communicate Science?

Interview with Dr. Sascha Ott, Science Journalist, Physicist, Presenter, Actor

Physicist or Comedian? Action or science? Science journalist Dr. Sascha Ott[1] provides during his talks and shows impressive evidence that knowledge and humor do not necessarily have to be contrasts.
Dr. Ott started studying physics in 1991, but soon figured out that journalism appeared to be more attractive to him. Eventually, he became a profound science journalist and started to perform his own science talks and shows.[2]



[1] web: http://www.saschaott.de/
[2] photo: https://www.5-sterne-redner.de/referenten/dr-sascha-ott/

JUnQ: Dear Dr. Ott, you first studied physics but very soon realized that this was not your passion. Yet, you still completed your diploma and after your PhD in science journalism, you established your career with science shows on radio and on stage. When did you have the idea to combine science with an entertainment show?

Dr. Ott: I always liked to act but since I started to study physics, I wanted to finish it even though I knew I wasn't born for it. It took until my pre-diploma in physics to see an alternative and not much later, I had the idea of combining science with theatre in such an intense way. Journalism then helped me to combine natural sciences with language.

JUnQ: One surely needs a lot of talent!

Dr. Ott: There is a very important differentiation I should make: I don't see myself as an artist. I see myself as a craftsman. Together with the Physikanten, I'm working with real actors and I'm learning a lot from them by simply watching, training and copying. But sometimes, it can be sufficient to take an established method and alter it just a little bit to create something new and appealing. And this demands a lot of creativity.

JUnQ: Has there been a point at which you were wondering if your work is profitable enough?

Dr. Ott: I never had the existential fear that the overall concept will not work. Certainly, you have to calculate how much effort you must put into the shows and the development of the experiments in relation to the income. Therefore, it is simply not possible to do only perfectly tailored experiments for every single show. But you can improvise and adapt existing content, which is usually perfectly fine to give the audience something to hook on to.
In fact, I'm always positively surprised after doing my account settlements at the end of the year.

JUnQ: Do you see a need in communicating science via a show? Could this be a way to make natural sciences more popular especially for pupils?

Dr. Ott: In the last 10 to 15 years, the amount of popular scientific shows was continually increasing. Earlier, TV shows were rather didactic and almost entirely technical. Now, more people and even more primary-school pupils are interested in science. Considering most teachers are not trained to teach knowledge that way, I see a strong need and trend in communicating natural science in an entertaining manner and being authentic at the same time.
But, an amusing show on stage is of course not a replacement for teaching the theoretical and mathematical basis. The question is, what amount of knowledge is necessary in the present society. In our technological world, it is more and more common to be able to just handle machines by specifically designed interfaces. The need for the knowledge of the physical and mathematical context fades into the background evermore and many are not motivated or interested to learn about it.
The affection to a subject, although, is motivated by character. This applies to natural sciences as well as to humanities.

JUnQ: You were working as an author for a radio station. The lack of visualization reduces the reports only to acoustic descriptions of processes. This requires a lot of imagination from the audience. How difficult is it to mediate scientific content vividly via radio?

Dr. Ott: Of course, it is hard to emphasize the attraction of radio to a passionate TV viewer. But, I am convinced that nearly everything can be done acoustically. It is even easier to focus on a short narration than giving colour to it in an elaborately produced film. On TV, you are always in distress to find the right pictures. They only underline

the spoken words but do not display them precisely. It works well on technical processes like "how does a dustcart work". But, real modern science is not visual, it's microscopic.

JUnQ: How is the feedback to your shows? Do you have a lot of competition?

Dr. Ott: The *Physikanten* are performing shows in South Africa, Kazakhstan, Abu Dhabi, Dublin and Tokyo – that indicates a worldwide interest. There is no other company like the *Physikanten* that offers this kind of science show. This is clearly a unique feature in the physics sector. But, I think the potential is not yet fully explored. Other good shows can still find excited audience.

JUnQ: Thank you very much for this interview!

— Tatjana Dänzer and Kai Litzius

Insect Alchemy

Interview with Tyler Thrasher

Tyler Thrasher[1] is an artist using many different techniques to express himself. He is a musician, a painter, an illustrator, a photographer and, not least, to some extent a scientist. For one of his current projects, he grows crystal clusters on collected, inanimate objects, like dead insects and skulls. By transforming deceased creatures into something beautiful, often mystical, he attempts to follow the approach of alchemists. Nevertheless, his art builds on "hard science" and follows the physical rules of crystallization. His results offer a different, inspiring view on a well-known method and teach not only science but also the inherent beauty of their studied objects.

[1] web: http://www.tylerthrasher.com

(©Tyler Thrasher)

JUnQ: You are combining science and art to create something new by growing crystals on objects like skulls, dead moths and flowers. What inspired you to do so? How did you come up with this idea?

Tyler Thrasher: For as long as I could remember, I've always been a science enthusiast and had an affinity towards creating. I'm always looking for new ways to create and the way I see it, science is just a different medium. When I see the periodic table of elements, I see a list of potential mediums and resources for making. I've spent a lot of time studying chemistry and training myself as a chemist. During my time in college, I spent a lot of time hiking and using nature as references for my work and senior thesis project.
One thing led to another and I had the idea to use the principles of chemistry alongside the bits and pieces of nature I was collecting and using in my artwork. I obtained some chemicals and lab supplies and began experimenting. Probably one of the best feelings in my life was pulling out my first crystallized cicada shell.

JUnQ: Are you a trained or a self-taught chemist? Are you collaborating with chemists or based on what background/experiences are you performing your experiments?

Tyler Thrasher: I am a self-trained chemist. I took a lot of advanced chemistry classes in school and carried on that curiosity and passion through college. I spend a lot of time reading through my chemistry text books and resources and making sure I have every provision necessary to responsibly and safely execute my experiments. Every now and then, I will reach out to professional and more experienced chemists for advice, but for the most part, I'm self-trained.

JUnQ: Could you elaborate on the process how you grow the crystals? What were the challenges you were facing while developing your procedure? What chemicals are you using?

Tyler Thrasher: The process is simple. It's just a matter of preparing super saturated solutions using salt compounds. You create conditions necessary to break the ionic bond between the two ions or polyatomic ions, usually through heat. When the bond is broken and the ions are suspended

(©Tyler Thrasher)

in the solution, the magic begins. Once the solution begins to cool down or enough water evaporates from the container, the ions begin to "re-bind" and form crystals. The crystals are the pure and geometric samples of the respective compounds, growing crystals is even a method of purification within chemistry.
I use a lot of different compounds, so far I've grown over 20 different types of crystals, I won't elaborate on all of them because that's boring and I don't want non-chemists reading this and taking it upon themselves to buy some chemicals and "experiment". (laughing) But some of my favorite compounds are Tutton's salts and similar reactions, such as the crystals that come from a reaction between a crystal of Chromium Potassium Sulphate and a concentrated solution of Iron Ammonium Sulfate. The tetragonal crystals of Mono Potassium Phosphate are also amongst my favorites.

JUnQ: On first glimpse, science and art seem to be opposites. What are your thoughts on the similarities and differences of science and art? Do you think of yourself more as a scientist or as an artist?

Tyler Thrasher: Interestingly enough, I don't think they're opposites at all! I think there are a lot of overlapping elements between the two. Both have always been fueled by curiosity. Taking raw materials and observations and using those to create, quantify, and fabricate something new.
There are approaches to art that can be reckless in science however. Science has obviously always worked on a system of organization and categorization. The spontaneous and almost possessed-like state some artists come in to while creating wouldn't work in science. That's how laboratories exploded and old alchemists ended up killing themselves.
But art can be meticulous and precise and clean, and that's where the overlap can be. I also think a lot of science can be inspired by an artist's mindset, and I think it's a very useful tool to be a scientist with an artist's mindset. I mean, there was a small group of video game designers and animators that used 3D modeling to recreate the human immunodeficiency virus (HIV), and we got to see it in a whole new way. Or the team of brilliant animators that helped make the film "Interstellar" what it was. We learned so much about black holes and quantum physics just through the equations the animators used and plugged into their animating programs. But all in all, I think I'm 60% artist and 40% scientist. Art is definitely my goal and aim. Science is just my hobby, curiosity and medium. I'm not looking for new discoveries necessarily to document or expand upon, I'm looking for new work to create.

JUnQ: Is there anything science can learn from art?

Tyler Thrasher: Hell yes! Even the artistic concept of viewing the same thing from different angles. I sometimes feel as if science can be very rigid and structured, and that can lead to a staleness in scientific approaches, but an artist has to learn that simply changing the point of view about an object will yield an entirely different image. I sometimes wonder, how this approach and mindset could be applied to the sciences. Sort of like stepping out of the structures that we use in science, but not too much. Just enough to yield a different result. But I also think artists can learn a lot from scientists too. Like being more organized. (laughing)

JUnQ: Although scientists are familiar with financial uncertainty due to short-term contracts, this can be even more precarious for artists. What are the challenges in promoting your work? What roles are social media playing nowadays for artists?

Tyler Thrasher: Social media is everything. I say this to any working artist I talk to. Most of the work I sell is through Instagram. It also helps to be a photographer and visual stylist because I know how to document, shoot, and present my work in a very pleasing way.

The challenge with any artist promoting their work is finding your demographic. I would say it's almost near impossible to just know your demographic too. It takes some experimenting and analyzing to know who likes your work and WHY. After a handful of shows, pop up shops, and using some programs to learn my demographic, mostly women like and purchase my work. Mostly women attend my shows. This was a very surprising bit of info, as I would assume it would be for anyone realizing who buys their work and why.
This is by no means me categorizing genders and their respective interests, but I think I know why mostly women find interest in my work. My work has always been more on the natural side, incorporating elements of nature, both cyclical and incredibly self-sufficient. I think many women have more of an affinity towards natural elements for those reasons. My work has always been about the admiration and preservation of nature and I think this speaks to a more community-based mindset. This is of course me speculating and trying to figure out how to tastefully understand why 90% of the people that purchase my work or follow me are women. I think the more interesting part about understanding your demographic is also understanding what that says about you. What is in your work that inspires a certain type of person to engage with it, and what part of that comes directly from you through your work? What would it say about me if 90% of the people that engaged with and liked my work were white supremacists? (laughing) I know that's an extreme example, but an example none the less.
Social media is such an incredible tool for artists, so much so that it's killing the need for galleries which is an interesting consequence. It's awful for gallery owners, but in a sense gives artists a larger and more easily accessible audience. It will be interesting to see how galleries combat this side-effect in the next few years as social media persists and continues to enhance the capabilities of the artist and their work.

JUnQ: Have you already considered using galvanization to apply metal coatings to your objects? Do you have other plans to incorporate science in your artwork?

Tyler Thrasher: I have a little bit. The only thing is, there's so many metal skulls and insect replicas floating around that it would be tricky to make something a little more original in that department. I have A LOT of cool experiments lined up that incorporate science and art; it is just a matter of finding the time for the experiments. I will not give away too much, but there is something involving large terrariums, some opal, and emeralds.

JUnQ: Crystallization is only utilized in one of your current projects. What other media are you using and can the different techniques benefit from each other? Are you working on them simultaneously and how do you balance them?

Tyler Thrasher: I don't know how to just do one thing. (laughing) I paint, illustrate, make electronic music, and I'm also a photographer. They totally benefit from one another as well. They all pertain to the same themes of nature and the importance of staying curious. It's tricky making time for everything, but I usually use them interchangeably and sporadically. I'll usually go through all of those different mediums in a day, making stuff any moment I can.

JUnQ: Is there anything else you want us to know?

Tyler Thrasher: The only other thing I can think of is my art book I'm working on, titled "The Wisdom of the Furnace". The book will showcase a lot of my crystallized and chemistry-based work and a handful of illustrations all in an esoteric alchemical context.

JUnQ: Thank you very much for this interview!

All photos ©Tyler Thrasher.
Further reading:
Patreon: https://www.patreon.com/user?u=1016403
Instagram: https://www.instagram.com/tylerthrasherart/
Store: http://tylerthrasher.storenvy.com/
c&en: http://cen.acs.org/articles/93/i47/Meet-Artist-Tyler-Thrasher-Makes.html

— Eva Jaumann

JUnQ Photo Contest

Have you ever regretted not to have your camera to immortalize a beautiful, dreamlike or poetic scene in the lab?
Is there a funny, challenging or even profound situation in your lab, office, studio… that combines Science and Art?

Don't miss it!

Conditions of participation:

- All submissions should be sent via email to *junq@uni-mainz.de*.
- The participant may submit photos until **31.07.2017**.
- The participants may submit only one photo per person. The text should not be much longer than 500 characters.
- The participants transmit to JUnQ the right to use of the image and text along with the participant's name in the context of the contest.
- The participants guarantee JUnQ that they have all rights on the images. They ensure that all people pictured in the images agree on being published in the journal. They ensure furthermore that the pictures contain no immoral or illegal content.
- Each photo can only be submitted once. Multiple submissions will be sorted out.
- The participant is not entitled to compensation.
- The wining photo will be drawn from a lot by members of the editorial board of JUnQ after validation of suitability in the scope of the contest. Any recourse to courts of law is excluded.
- The participant must not be a member of the editorial board of JUnQ.

A Tale of Art and Science

Science fair demonstrations are something that I always look forward to. I was there this other day at one such fair for gifted youngsters. I was demonstrating an experiment on densities. The experiment was quite a familiar one. The one where liquids with different densities do not mix. And where liquids with a lower value of density stay on top of liquids with larger densities, as distinct layers. To make it more vivid and interesting for the kids, I added a different color to each layer. A young boy came up to me after the demonstration and said..."It would be so boring if we did not invent colors to begin with". His observation struck me and got me thinking. With our academic training in Science, we take a lot of stuff for granted. We rarely stop to wonder at the beauty and artistry inherent in the everyday experiments that we do and in the things that are around us.

To the common demographic, scientists and artists will appear to be poles apart. The scientist being an objective individual driven by data. The artist, a subjective eccentric, swayed by waves of emotions. But this stereotype is quite artificial. The altars of Art and Science - the studio and the laboratory - still remain the only places without prejudice. The places where success and failure are treated as they should be, as lessons in figuring out answers to the perti-

nent questions of life. "What is true? Why does it matter? How can we move society forward? Why are we here? Where are we going?"

The artist and the scientist act as co-pilots when society takes the leap into the new and unknown. Any good story becomes great because of the storyteller. How much a scientist can enjoy a collaboration with an artist becomes apparent when there is a new scientific discovery. The natural propensity of an artist at communicating emotions makes him the perfect narrator. Even da Vinci acknowledged this when he said, "Art is the queen of all sciences communicating knowledge to all the generations of the world."

So, Art and Science are nothing but two sides of the same currency that drive the engine of social progress. Carl Jung alluded to the synergistic expression of Art and Science in his 'artist-scientist'.[1] In fact, research has found Nobel Laureates in science to be 17 times more likely to be a painter, 12 times to be a poet and 4 times a musician compared to an average scientist.[2] Funding agencies, like the Wellcome Trust,[3] have long tried to make artists and scientists collaborate.

The latest Nobel Prize in Chemistry highlights molecular machines.[4] These molecules reflect the artistic bent of mind of the scientists. And this relationship is not one-sided. Artists have contributed as much to science as well. The American painter, Abbot Thayer was behind the camouflage, now so ubiquitous in combat.[5] The art of Origami has provided inspiration for designing stents used in medicine as well as airbags in cars.[6]

Even though, we can find so many manifestations of the 'artist-scientist' in real life, still modern education seems to be treating Art and Science as two distinct and disparate disciplines. Such a perspective forebodes a future where the prophecy of Prof. Feynmann - "Scientific creativity is imagination in a straitjacket." could well become the norm. To prevent such a grim future, the key of the arts is the only viable release.

Thus, I decided to go back and look through the archives of Art and Science to revisit the times when they complemented each other. A journey through history as old as humanity itself. From the paintings on ancient rocks in caves, to the pyramids and the magnificent temples of the far east, to the Renaissance, Art and Science have shared a long and evolving relationship.

The Greeks had a word for art - *Techne*.[7] The very same word which is at the root of modern interpretations of technology. An idea which, in this century, is very close to the ideal of science and research. And the literal antithesis of art, to begin with.

Now, any story of Art and Science will be incomplete the Renaissance. A time when society was gearing up towards an intellectual upheaval after the regressive Dark Ages. A time when one of the greatest minds, Leonardo da Vinci, was making such accurate physiological and anatomical drawings of human form that it forever changed the landscape of visual art. One such example among his myriad drawings of the human form was *Sketch of Uterus with Foetus* (*c.* 1511-13).[8] The sketch is a reminder that Art and Science are two different paths to the same higher spiritual truth. A seminal contributor, also during this period, was Robert Hooke (1665), who through his passion to see the microscopic world, brought forth the idea of the 'cell'.[9] The smallest functioning unit of 'life' and a representation of the mastery of Nature.

How an artist has manipulated the sense of motion and time can be found in Degas' *Dancer* (*Large Arabesque*) (*c.*1882-95).[10] A bronze ballerina suspended in an eternal arabesque with its suggestion of motion and dynamism intriguing everyone for more than a century. It is only in this decade that science, like experimental psychology, has evolved which clearly reveals that the human mind and body get primed when it looks at such depictions of fluid movement.[11−12] The electrical conductivity of the skin and the heart rate generate a map of someone who is actually dancing.

Not only sculptures, the invention of synthetic colors paved a way forward for 19th century French artists. Up to then, colors like ultramarine blue were derived from *lapis lazuli*, a natural source. An expensive practice. Thus its use was restricted to divine representations or commissioned pieces from the nobility.[13] But now the colors were in the public domain. A fortunate accident which allowed artists, like Seurat, to develop techniques like Pointillism.[14] Seurat, like Degas in his sculptures, tried to play around with the perception of vision and color. A way where, when you zoomed in, you saw distinct points of color. But when viewed through the telescopic end, a sense of dynamic perception created through deft brushwork by clumping of complementary colors, afforded you the entire masterpiece. A brilliant example that combined the optical and color theories of his century and the century after was the piece *A Sunday Afternoon on the Island of La Grande Jatte* (1884).[15] The way how the masters of Pointillism seemed to trigger the sensation of a shimmering artwork, depending on where you looked at the painting and under what light, is still open to scientific speculation.[16] What is not beyond doubt, though, is the unanimous "Aha!" moment felt by all when they see the composition.

As one moves forward in the exploration of the intimate relationship between Art and Science into the 20th century, two epochal events prop up along the landscape. Two reclusive and eccentric characters, who would shape the earth of Art and Science for years to come. Pablo Picasso and Albert Einstein. In the first decade of the century, 1905 to be exact, Einstein engaged the scientific community with the Theory of Relativity.[17] A discovery that changed the

perceptions of the day. A theory that precluded and questioned the nature of reality and how one perceives it. Fast forward five years to 1910, and the world was challenged to rethink their perceptions yet again - this time, it was Cubism.[18] Picasso, in his masterpiece *Portrait of Daniel-Henry Kahnweiler*,[19] created an image replete with distinct elements, each with their many perspectives. Both Cubism and Relativity thrived as it played on the critical and sedulous analysis of the audience. They rewarded the enthralled with a sense of comprehension and realization.

The middle of the 19th century saw the invention of the photographic camera. A brilliant scientific and technological achievement. The culmination of years and even centuries of effort in capturing images permanently. An evolution of the *camera obscura*.[20] The exposing of light-sensitive metal plate or paper to fix the images revolutionized the way people began to think of paintings and of painters. Even though photography posed a challenge to the painters of the day, but with time, photography has evolved into an art form. A medium of painting with light. One of it's great exponents was Ansel Adams. He played around with the juxtaposition of nature, art and technology to deliver timeless compositions of epic landscapes. The technical prowess and the creative brushstrokes is evident in his *The Tetons and the Snake River, Grand Teton National Park, Wyoming* (1942).[21] Photography has done away with the need for elaborate canvases to portray and capture our memories for posterity. And thus the words of Dorothea Lange truly resonate today, when everyone has access to a digital brush and canvas, "Photography takes an instant out of time, altering life by holding it still."

The ability to record and capture images with such ease and convenience has been instrumental to the advancement and understanding of science as well. The Princeton University Art of Science Exhibition is one such initiative.[22] The exhibition displays images conceived as part of scientific research. And it has opened the doorway to the artist to appreciate the aesthetics of science as well. (More about the exhibit in our feature in this issue.)

Science has not only provided inspiration through light, but through sound and chemical alchemy as well. Even music, so long thought to have no connections with science cannot be farther from the truth. Music, itself, is nothing but a creative juxtaposition of a multitude of sound waves. Not only that, music also has a healing power, undiscovered before the last century. Indeed, Art and Science does amaze us all.[23] In the 21st century, artists have visualized the geometry in sound through the art of Cymatics.[24] To take it even a step further, scientists from Japan have succeeded in making three dimensional artwork with sound by overcoming the force of gravity itself.[25] Through careful manipulation of the process of crystallization, artist and scientist Tyler Thrasher (hear more about his passions when he spoke with us) has created works of art from seemingly 'lifeless' subjects.[26]

From creating Martian landscapes in the Atacama desert and fueling citizen science projects for next age space travels,[27−28] Art and Science seem to be more and more intertwined in the new century. It is also heartening to see the effect of creative arts on life sciences. Animation has given biologists the opportunity to visualize and design future experiments to understand proteins.[29] Such a union between Art and Science is not new though. It is old–as old as communication itself. Of a time before the discovery of any form of written language. Before there was any script, there were the cave paintings, with their myriad lines and marks. New research on cave paintings has revealed something quite extraordinary.[30] A form of graphical communication that has survived both space and time. From the western European caves in Spain and France to the holes in the ground in Australia and Indonesia separated by more than 30 millennia, these sites exhibit a drastic and eerie similarity in their symbols. These paintings could hold the key to the origins of communication out of Africa. The wonderful co-habitation of scientist and artist will surely deliver many more dividends.

During my long and rewarding exploration for this article, I have come to realise that Art and Science will always share a strong and at the same time strained relationship. A relationship where one complements and reinforces the other, a relationship that will endure through time and space again and always...

— Soham Roy

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Scholars Then and Now

From Allrounders to Specialists, A Journey Through The Ages

Is it possible to know everything in every discipline? Surely not, especially not in modern times in which it is increasingly important to have experts of an explicit field of knowledge. We all remember some real whiz kids from our school years but only a very few of us can be outstanding experts in widely varied fields. Just imagine the time you would need to learn all of it.

The old all-round talented scholars from ancient Europe seem to personify knowledge itself, since they did not restrict themselves to a specific science. They engaged in philosophical and moral matters as well as in fundamentally science-oriented issues.

Let's take Aristotle as an example. He lived about $c.$ 400 BC in ancient Greece and was in similar ranks of Plato and Socrates. He set standards in logic, metaphysics, philosophy of nature, ethics, politics and physics. Aristotle surely did not consider himself satisfied with only one issue - his curiosity seems universal.[1]

The Middle Ages, mainly shaped by the ideology of the roman-catholic church is always said to be a hostile time for science and rational knowledge. But even here, we find outstanding minds. Just look at Hildegard of Bingen, the Benedictine abbess (1098–1179). Of course, she surrounded herself with Christian mysticism but at the same time, she composed songs and wrote essays about cosmology and the art of healing that are still of some relevance today.[2] She was not necessarily a scholar but she had influence and intellect. Quite an achievement for a woman of that time!

Somebody on whom we absolutely must shine a bright light, when talking about universal geniuses. is Leonardo da Vinci (1452–1519). He was clearly the champion in combining arts and sciences. Just think of all his anatomical studies, the sketches of aircrafts, weapons and military equipment of all sorts. And of his numerous paintings with the Mona Lisa and The Last Supper leading the way. da Vinci studied the flight of birds, dissected bodies and wrote treatises about perspective and shade in paintings.[3–4] The keynote of his complete work - the unity in arts and sciences - still inspires and mesmerizes people all over the world. In the year 2000, Adrian Nicholas built a parachute based on da Vinci's sketches that had never been realised until then. In spite of severe warnings by experts, he tested the device from an altitude of about 2000 m - and it worked![5] What a great mastermind and pioneer Leonardo da Vinci was.

Comparably remarkable is the work of Johann Wolfgang von Goethe (1749–1832), who probably was the most impressive poet of Germany.[6] He began his career as a law student in Leipzig and later held different offices in civil service. At that time, he already wrote poetry, influenced by the ancient writers, Shakespeare and of course, his numerous love affairs. Later, his famous works like "Die Leiden des jungen Werthers" ("The Sorrows of Young Werther") and "Faust I and II" followed. His complete works reflect all the literary movements of the late 18th and early 19th century. Next to his poetry and dramas, he also showed huge interest in natural sciences, ranging from research about granite over human and vegetal anatomy to optics and Newton's theory of colours. Even the mineral FeO(OH) was named Goethite to honour his commitment to geology.[7]

Last on the list is Alexander von Humboldt (1769–1859) who explored the world frequently at the risk of his life. In contrast to his early passion for science, he studied public economy in Hamburg, Germany. After he earned enough money by developing tools for miners. he started to circumnavigate the world. On his journeys, he discovered and studied a plethora of places, plants and animals. A lot of them now carry his name, making him immortal.[8]

When I was a child, I did not differentiate between the natural sciences. I loved watching documentaries on TV, no matter the topic, be it astrophysics or plant life (although, it was sometimes hard for me to follow the details). The question about my desired career I always naively answered with "nature researcher", meaning that I wanted to examine everything I could get hold of. Later, I realized that Natural Science is too complex to be studied altogether so I ended up with Chemistry. For researchers in the past, it must have been similar. There was no straight division between the disciplines and the material and financial conditions must have been different. Historically, the knowledge was not as advanced as it is today and the engagement in different disciplines was not such an intellectual challenge. Today, we have so much more specialized scientists, merged in intercultural and sometimes interdisciplinary research fields following the old scholars' footsteps. The secrets of the world are slowly unravelled only by the works of all these experts.

— Tatjana Dänzer

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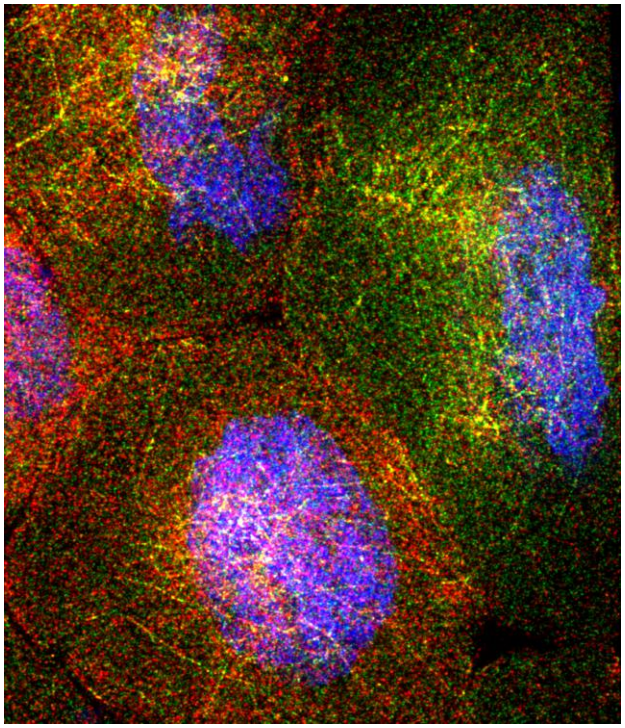
Capturing the fleeting beauty in Science – The Princeton Art of Science Exhibition

The pursuit of the unobserved and the unfathomable in scientific research often affords the scientist glimpses of unrivaled visual experiences. The Princeton University Art of Science exhibition provides an avenue where scientists have the opportunity to present their images obtained during their research. The exhibition helps to spread awareness of the scientific technique and the artistic brilliance that research is replete with, to artists as well as to the common demographic. The exhibition attempts to forge a strong connection between Art and Science. The exchange with artists reveals a different way for scientists to visualize and contemplate their own research.

The Princeton Art of Science exhibit will be in its seventh iteration in 2017. From starting its journey in 2005, with presenting the works created by the Princeton community, the exhibition has grown not only in its size but also appeal. A quirky feature of the exhibition are the awards of the top three submissions decided on by an expert jury. The prizes reflect the golden ratio in their amounts, a nod to the historical aesthetic sense.

We, at JUnQ, express our gratitude to the Princeton Art of Science exhibit, who have been kind and generous to share few of the submissions from past galleries. We wish them success for the 2017 exhibition which opens May 5, 2017 and for future exhibits.

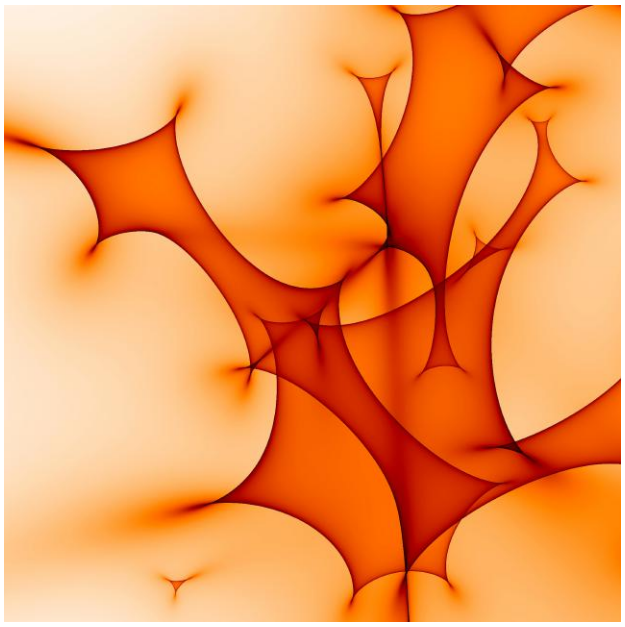
— Soham Roy



MESSENGER MESHWORK (2013)
People's First Place
Shawn C. Little, Kristina S. Sinsimer, Elizabeth R. Gavis and Eric F. Wieschaus
Department of Molecular Biology

The fruit fly ovary consists of about 100 egg chambers. Each chamber contains 15 "nurse cells." These surround the oocyte, or egg cell, which ultimately will develop into a baby fruit fly. The nurse cells synthesize RNA molecules that are ultimately deposited into the oocyte.
Here we see four nurse cells. Each red or green dot is an individual RNA molecule, which is produced from DNA (shown in blue). The RNA molecules intermingle on a threadlike network that allows them to move from one nurse cell to another and then into the developing egg (which we don't see in this image).

Image and Caption : Shawn C. Little, Kristina S. Sinsimer, Elizabeth R. Gavis, Eric F. Wieschaus, Princeton Art of Science



LIGHT DEFLECTION 2b (2009)
Joachim Wambsganss
Department of Astrophysical Sciences

According to Einstein's Theory of Gravity, a ray of light is attracted by a clump of matter. As a consequence of "gravitational lensing", the light ray changes its direction from a straight line by a minute amount when it passes close to a cosmic object. Stars and planets in our Milky Way or in other galaxies can act as "microlenses": They focus the light of a background source in a very characteristic way. The main effect is a time-variable magnification of the background source due to relative motion. In our research, we simulate the effects of light deflection by tracing light rays backward through a field of lensing objects and calculating their deflection. The colors in the resulting two-dimensional maps in the "source plane" reflect the density of light rays, they indicate the magnification of the background source as a function of its position. The sharp "caustic lines" are locations of very high magnification. When a background star moves across such a pattern, we can measure its variable brightness with our telescopes and deduce properties of dark matter or discover extrasolar planets. Figure 2b: This microlensing pattern indicates the magnification of a distant "quasar" as a function of its position; it is produced by the light deflection of many stars in an intervening galaxy. (Zoom of "Light Deflection 1")

Image and Caption : Joachim Wambsganss, Princeton Art of Science

C215 – A Parisian Street Artist Focused on Stencil Graffiti

"I try to interact with context, so I place in the streets elements and characters that belong especially to the streets. I like to show things and people that society aims at keeping hidden: homeless people, smokers, street kids, bench lovers for example"
- C215

Christian Guémy, who goes by the moniker of C215, was born in 1973, in Bondy in France. He started spray painting in 2005 and his street art spread like wildfire. What makes him so special is the use of spray paint and stencil to draw faces of the famous and the not so well-known persons in eclectic places such as streets, public buildings (like town halls or jails) and even in an abbey. He notably painted on the walls of a research center, the CEA Saclay (Alternative Energies and Atomic Energy Commission, Gif-sur-Yvette, France). Since I worked at CEA for a bit more than three years, it brought me to appreciate and recognize his art. C215 kindly accepted to answer many of our questions and has generously allowed us to publish some of his work.

C215 mixed art and science in transforming junk objects into pieces of art (Fig. 1, 2), and bland and whitewashed walls - a giant canvas for his exhibition (Figs. 4, 5, 7, 8). His work represents characters that made history such as, Le general de Gaulle, who was instrumental in setting up the CEA in 1945, Marie and Pierre Curie and their contributions in identifying and isolating radioactive elements (Fig. 1) notably Polonium, a metal that they discovered together in 1898,[1] or Schrodinger and his famous cat (Fig. 4). Apart from iconic figures, individuals whose achievements are not highlighted in standard texts also find pride of place in the art of C215. For instance, Lise Meitner (Fig. 7), a Jewish Austrian physicist, who escaped the authoritarian Nazi regime and settled in Sweden. She played a major role in the discovery of nuclear fission, but somehow was left behind and did not share the Nobel prize with Otto Hahn.[2] In one his graffiti, C215 has paid tribute to Rosalind Franklin (Fig. 8), who took the "Photograph 51" in 1951, which was an X-ray diffraction image of DNA. It is widely known now that Watson, Crick, and Wilkins, without Franklin's knowledge, used this photograph to build the chemical model of the DNA molecule. The Nobel prize for revealing the structure of DNA was awarded in 1962 to these researchers but not Franklin, who died four years earlier.[3]

Popular fiction, like a R2-D2 close to a similar robot-looking liquid nitrogen tank (Fig. 5) or crazy Homer Simpson losing control (Fig. 2) and poetry (Fig. 6) are often used by C215 to portray the lighter side of science. It is important for him "to paint the soul and history of places, so they are the soul of CEA". His art somehow reminds scientists that "they belong to a chain of stars, that they belong to a mythology by themselves".
Painting in the CEA Saclay was not straightforward since it is a highly-secure place to which the access is tightly controlled. C215 acknowledges that "it has been very special to paint in such an unexpected place where art is not supposed to pop up". There, "science [was] an inspiration for sure, even if there is science inside art". Beyond science as a factual concept, relying on evidence, it is also an imaginary field. Thus, C215 visited this peculiar research center and picked several locations. He worked together with a CEA scientist to decide what could be the subject of each spot. He also worked on several objects provided by the scientists, like posters (Fig. 1) or measuring devices (Figs. 2 and 3).

C215 did not stop at just the walls of the CEA either. He recently (2016) painted faces on the walls of the Marie Curie Museum in Paris.[4]

— Adrien Thurotte

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Figure 1: *Marie Curie on the periodic table of elements ©C215*

Figure 2: *Homer Simpson ©C215*

Figure 3: *Measuring device ©C215*

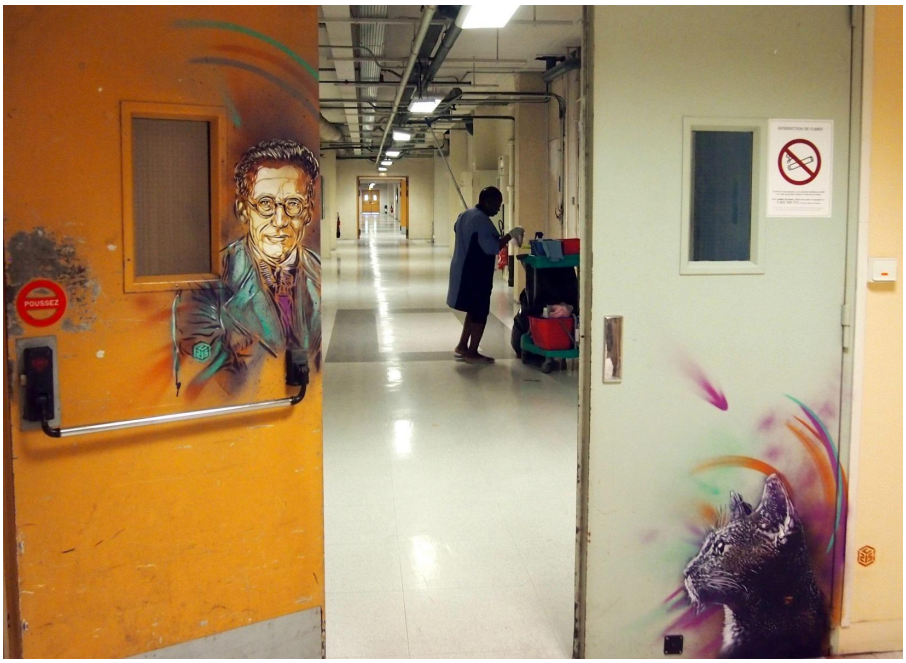

Figure 4: *Schrödinger and his cat ©C215*

Figure 5: *R2-D2 close to a similar robot-looking liquid nitrogen tank ©C215*

Figure 6: *A close-up of a bird landing on a liquid nitrogen tap ©C215*

Figure 7: *Lise Meitner, an Austrian physicist who played a major role in the discovery of nuclear fission ©C215*

Figure 8: *Rosalind Franklin took the first X-ray diffraction image of DNA in 1951 ©C215*

Questions of the Week

The Journal of Unsolved Questions presents a "Question of the Week" on its homepage every week. Set up and formulated by the members of the editorial board, or guest writers, the main purpose of the "Question of the Week" consists in intriguing the reader by presenting topics of ongoing research. "Questions of the Week" published so far cover a wide variety of scientific fields, but share the feature to be of certain interest to several disciplines.
In the following, we present selected "Questions of the Week" from the last six months.

What Causes the Formation of Fairy Circles?

Tatjana Dänzer

If you ever wander about the barren lands of southern Africa, like the scarcely vegetated Namib desert in Namibia, you will most certainly stumble across a fascinating malformation of the soil called fairy circles. They are circle shaped bare patches of dry ground with a diameter of several meters enclosed by taller grass at the edge, compared to the steppe landscape of the surroundings.

Fairy circles in the Namib Naukluft Park, Namibia. (©Heike Dänzer).

Their origin has long been a cause of intense discussions. The earliest interpretation of their appearance may come from the Himba people, who share the legend that the circles are the footprints left behind by their ancestor Mukuru. Other stories tell of aliens, dragons or fairies.[1] On the other hand though, science suggests toxic gases or residues from already dead plants, radioactive elements or insects to be the origin of the features.[2] Lots of investigation have been made in the last decades to prove each theory but no one could come to a substantial and indisputable conclusion. Since no toxic or radioactive substances were found in the soil of the fairy circles, they must arise from something else.[2]

Supported by satellite images, Dr W. Tschinkel, from the Florida State University, was able to offer proof that the circles are not permanent. They grow and develop and after a lifespan of 41 years on average, they "die".[3]

Cramer *et al.* used an empirical model considering various biological, chemical and weather factors to predict the appearance of fairy circles. They conclude that circle formation must be the result of plant organization and competition for nutrients since the plants at the periphery of the circles are more lush than the plants farther away.[4]

A very vivid explanation comes from N. Juergens who examined the termite population of fairy circles. The sand termite Psammotermes allocerus, their nest and tunnels were the only similarity found in 100 % of the investigated circles and even in young circles. Apparently they feed on plant roots and keep large areas free of water accumulating vegetation which causes also a higher water content in the ground centered beneath the circle.[5]

Only a few years ago, fairy circles were found in Pilbara, Australia similar to those in Africa. Getzin *et al.* doubt the dependence of the pattern formation from termites or ants since many circles didn't host any of these insects. They blame pattern-creating plants in water-limited environments, such as in a desert, to be responsible.[6]

Read more:

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[5] N. Juergens, *Science* **2013**,*339* 1618–1622.
[6] S. Getzin *et al.*, *PNAS* **2016**,*113* 3551–3556.

How Does an Airplane Brake After Landing?

Kai Litzius

Modern aviation is one of the most important and possibly, also the safest when it comes to transportation and travel. As a result of the increasing need for fast and reliable transfer of resources, airplanes have become increasingly complex and nowadays, only a relatively small number of people know how they are operated.

In this "Question of the Week", we want to focus on one particular detail of aviation: The landing. A typical airplane approaches the airstrip with a speed of around 270 km/h and has to decelerate within a very short time to guarantee a safe landing. So how do you brake an airplane?

Figure 1: Landing of a modern aircraft. (downloaded from https://upload.wikimedia.org)

To answer this question, we first have to think about how braking works in the case of any wheel-based vehicle. In a nutshell, the braking process always exerts a torque upon the wheels which then use friction with the ground to lose kinetic energy. Friction, however, is massively dependent on the weight that rests on the wheels. In case of landing an airplane, the aerodynamic lift basically nullifies the weight of the plane and therefore makes braking while using the wheels extremely inefficient. As a result, the plane needs other ways to slow down until the aerodynamic lift and speed is sufficiently reduced. In modern aviation, this is done by two different braking systems: the Spoilers and the Reversers, that both are usually operated by a computer, which tries to reach a constant deceleration of convenient magnitude (about 0.17 – 0.30 g).

Figure 2: Spoilers on an aircraft. (downloaded from https://upload.wikimedia.org)

As soon as the wheels get in contact with the ground, the Spoilers (Figure 2) are fully activated. These are flaps located on the back-end of the wings and can significantly reduce the aerodynamic lift as well as increase the drag. These flaps are extremely important for the braking process because without them the friction of the wheels is not sufficient for efficient braking. Basically, wheel brakes and Spoilers together can already be sufficient for slowing down an airplane.

However, to reduce the amount of stress the wheel brakes have to withstand, there is an additional system: the Reversers (Figure 3). These are mechanisms located at the engines that can be activated to redirect the engine's exhaust forward, rather than backwards (commonly referred to as thrust reversal). All three systems together can be used by a computer to reach an extremely smooth braking process without putting too much stress on the single components.

Figure 3: Reversers on an aircraft. (downloaded from https://upload.wikimedia.org).

As a result, the landing process by itself is extremely complex and depends on many factors. Most of them can be controlled by a computer, however, in case of any unforeseen circumstances, the pilots have to be prepared to take over and land the airplane manually. This (and many other factors) makes the training of pilots one of the most demanding educational processes of our time.

Read more:

[1] http://walter.bislins.ch/blog/index.asp?page=Wie+bremst+ein+Verkehrsflugzeug+nach+der+Landung%3F (last access 08.03.2017)

[2] http://www.smartcockpit.com/aircraft-ressources/A320_Flight_Deck_and_Systems_Briefing_For_Pilots.html (last access 08.03.2017)

[3] http://www.airspacemag.com/flight-today/how-things-work-stopping-the-a380-27549065/?no-ist (last access 08.03.2017)

Why Haven't We Met Aliens Yet?

Jennifer Heidrich

Lying on the grass and looking into a sparkling star-filled summer sky. Can there possibly be anything more beautiful? But it also makes me think about how small we really are and are we truly alone in the universe. This question has bothered humans since the beginning of our existence.

In the observable universe, there are at least 100 billion galaxies containing 100–1000 billion stars each. Not to

mention the gigantic number of existing planets surrounding those stars including trillions of habitable ones. Consequently, there must be plenty of opportunities for alien life to develop.

But is the contact with extra-terrestrial life really that likely? It has to be mentioned, that a huge number of existing galaxies are completely out of reach because of the expansion of the universe. Only the ones being part of our local group come into consideration for a theoretical alien contact. Anyways, if life had developed only on 1 % of all planets in habitable zones in the Milky Way, there would be millions of planets inhabited by aliens. Since life on earth emerged rather late compared to the age of the Milky Way, potential super-intelligent and technologically advanced aliens would have had much time to build powerful space ships and to make a trip to our blue planet. In fact, if those guys would have been able to build generation space ships, they could colonize the Milky Way in a few million years. And that is not a long time when we think that life on earth exists since 4 billion years and the fact that other planets might have had developed life long before earth did. So if only one of those theoretical alien races would have developed into a super-technological civilization, shouldn't we know by now?

So where are all the aliens? Why did they not contact or – in a bad scenario – attack us so far? This lack of proof for aliens despite its apparently high probability is called the Fermi Paradox, named after the physicist Enrico Fermi.

There are different scenarios which can resolve the Fermi Paradox and some of them are quite amusing and imaginative. Here is a small selection:
1. In spite of the apparent high probability, we are alone in the universe. We might always have been and always will be. The condition for the emergence of life could be much harder and complicated than we assume.
2. There were intelligent aliens long before humans came into existence. They could have gone extinct before someone on earth ever thought about extraterrestrial life at all. Indeed, we do not know everything concerning different thresholds life has to overcome in order to survive. We might just be lucky that we do not yet have encountered one really tough barrier, like the dinosaurs obviously did. Or maybe at some point, every sophisticated culture will destroy itself by inventing a highly destructive super-weapon.
3. Our extraterrestrial friends want to observe us in order to do psychological studies or maybe we are just part of some "galactic zoo" for aliens. They also might just wait until we are a threat to them and then kill us. This has also been a topic in various science fiction books.
4. Life forms from outer space are already among us and we do not notice.
5. The aliens are simply not interested in having communication or imperialistic wars with anyone else and stay peacefully and happy on their home planet.
6. The universe is full of extraterrestrial signals but we are not advanced enough to detect them.

Maybe there will be a day in the future when we get a more definite answer to the Fermi Paradox. Let's just hope it will be a salubrious one!

Read more:

[1] M. H. Hart, *Quarterly Journal of the Royal Astronomical Society* **1975**,*16* 128.
[2] A. Frank, W. T. Sullivan, *Astrobiology* **2016**,*16* 359.
[3] YouTube. "The Fermi Paradox — Where Are All The Aliens? (1/2)"*YouTube*. 06.05.2015. Web. 08.03.2017.(https://www.youtube.com/watch?v=sNhhvQGsMEc)
[4] YouTube. "Drake's Equation - A Deep Dive | Answers With Joe"*YouTube*. 01.12.2015. Web. 08.03.2017. (https://www.youtube.com/watch?v=ggdIlzn2y44)

How Music Influences The Brain?

Soham Roy

The story of music and human cognition is intricate and intertwined from the beginning. Since close to fifty millennia, music has remained an integral part of being human.[1]

Music has always aroused feelings of rapture and desire, even though it is intangible. And now science has unlocked the mechanism. As the reward center in the brain gets primed with the anticipation of listening to familiar music, there is a flood of dopamine, the "happiness" neurotransmitter.[2] Things can get discordant too. If one listens to unpleasant music, there is a reduced production of serotonin, our mood-regulator.[3]

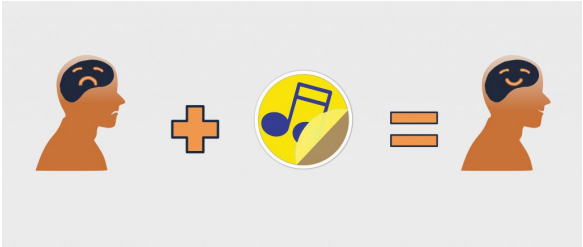
It is quite natural to ask, if the audience is experiencing euphoria, what is the artist feeling ? Well, scientists have looked into that aspect as well.

The brains of musicians light up like a celebration of fireworks when they play.[4] The left and right hemispheres enter in a harmonious exercise when an artist performs on their musical instrument.

But can music improve how we interact with life ? And the answer is a resounding "YES".

Learning an instrument with structured and disciplined practice, has an array of benefits.[5] It can enable us to find more creative solutions to problems in social as well as academic settings. Playing music makes for a greater neural plasticity in the brain which can better help with retrieving and indexing information – in short, a better functioning

memory.



Music for peace of mind.

Even though we know what neurotransmitters are responsible and the neural pathways they seem to take in the brain when we hear music, still there is so much more that we do not know. For instance, the auditory cortex is still quite unknown to us in its organization and functions. Only recently, there was a discovery of two separate populations of neurons, sensitive to how we process music and human speech, different from ambient sound in the environment.[6] Though, it is still a question of speculation – are we born with it or is it developed through experience.

Four hundred years have passed since William Congreve remarked, "Musick has Charms to sooth a savage Breast". Music, has indeed, displayed the ability to heal. It has shown promise to improve the lives of those affected with schizophrenia.[7] As music also helps in better connecting our episodic memory, it can have a positive influence in individuals suffering from Alzheimer's or PTSD.

So let's tune in to some nectar for the brain and turn those frowns upside down.

Read more:

[1] https://en.wikipedia.org/wiki/Music#History (last access 08.03.2017)

[2] V. N. Salimpoor *et al. Nature Neuroscience*, **2011** *14*, 257–262

[3] S. Evers *et al. Eur Arch Psychiatry Clin Neurosci.*, **2000** *250*, 144–147.

[4] http://ed.ted.com/lessons/how-playing-an-instrument-benefits-your-brain-anita-collins (last access 08.03.2017)

[5] E. A. Miendlarzewska *et al.*, *Front Neurosci.*, **2013** *7*, 1–18.

[6] S. Norman-Haignere *et al.*, *Neuron*, **2015** *88*, 1281–1296.

[7] N. Talwar *et al.*, *BJP*, **2006**, *189*, 405–409.

Can Blind People See What They Feel?

Andreas Neidlinger

You certainly know the game little kids play where they have a cube, a sphere and a pyramid, and they have to put them through holes of the corresponding shape. In the beginning, this might be difficult, but it becomes quite easy and dull after some time. Now, it is simple for most people, but how difficult is the same task for blind people? i.e., Can people who have been blind for their entire life and are familiar with different shapes by their tactile sense, recognize the same shapes when they gain the ability to "see"?

This question, referred to as the Molyneux Problem, was first asked by William Molyneux, an Irish philosopher and politician, in 1688.[1] Of course, answers that could verify this question were not easy to find in the 17th century due to the impossibility of highly complex surgeries at that time. Nevertheless, a lot of discussions arose about the co-operation between our senses. For instance: Is the eye able to understand the geometry of objects or is the visual recognition just possible by a learned collaboration with the tactile sense?[2] Or the other way around: How do blind people understand shape; how do they "look" for them?

Just recently, in 2011, five children, who were born blind, became able to see after surgery at the ages between 8 and 17. They were familiar with several shapes by examining them with their hands. Interestingly, they were not able to relate this tactile information with the visual input from these objects, but they learned to connect both senses quite fast.[3] However, discussions are still not at an end, to unequivocally explain the outcomes.

The Molyneux Problem once again shows that even simple questions can result in long-lasting discussions and unexpected outcomes. Never stop asking questions and dig through the JUnQ to find the hidden treasures!

Read more:

[1] W. Molyneux: Letter to John Locke, 7 July 1688, in: *The Correspondence of John Locke* (9 vols.), E.S. de Beer (ed.), Oxford: Clarendon Press, **1978**, vol. 3, no. 1064.

[2] A. Frank, W. T. Sullivan, *Astrobiology* **2016**,*16* 359.

[3] R. Held *et al*, *Nat. Neurosci.* **2011**, *14*, 551–553.

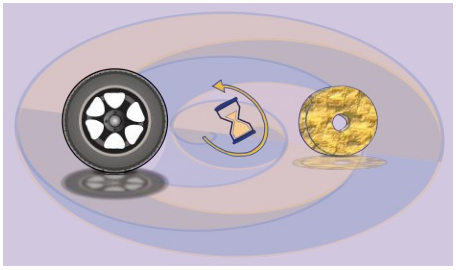
Who Invented The Wheel?

Tatjana Dänzer

What is the most useful invention of humans? Sure, most people will answer this question with "The Wheel!" Indeed, today almost any machine runs with some kind of wheel. But do we know whom to thank for this gift? Let's take a little journey back through time.

Of course there was a time before the wheel, around 5000 BC. People used slides and logs of timber to transport goods. During the Bronze Age (*ca.* 3500 BC), wheels of clay and of wood were being attached to carts. Records of those first wheels are found in different cultures of the same

age. For a long time, it was believed that the Sumerians from Mesopotamia were the inventors of the wheel. But new findings prove that other cultures from Western and Eastern Europe of the same age built something similar. The main difference of those earliest constructions were in the suspension – some were rotating with the axis, some were rotating around it.



Rewind to our greatest invention.

Over the ages, this technology spread all over the world. The wheels became lighter and more stable. The development of trade, technology and (even) warfare, is due to the wheel. The wheel has made it possible for us to wonder at all the modern engineering marvels.

Still it is unlikely to identify a group of people – not to mention a single person – as the inventors of the wheel. To imagine what fortune one would amass today from such an invention...

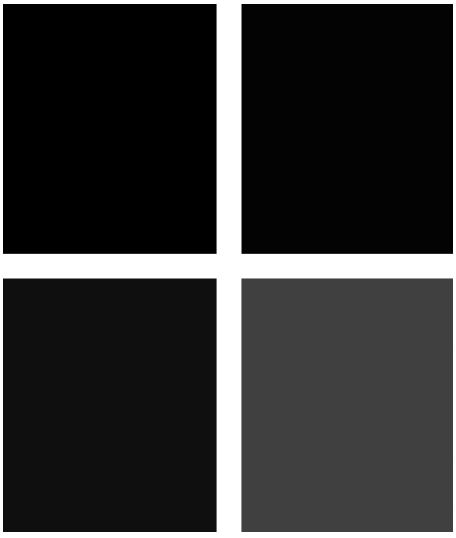
Read more:

[1] https://www.ke-next.de/panorama/die-groessten-erfindungen-das-rad-116.html (last access 16.03.2017)
[2] http://www.ancient-origins.net/ancient-technology/revolutionary-invention-wheel-001713 (last access 16.03.2017)

What Is The Blackest 'Black'?

Soham Roy

We all know what the color 'black' is. If I ask anyone, I will get different responses. From the familiar blackboard in the classroom to the ubiquitous asphalt of the roads. Some might recall, with fondness, it as the color of the little dress on their high-school prom date. Others might be more correct, and remind me that "true" black is the absence of any reflected light. And point me towards the nearest black hole (at the center of the milky way or on the Sagittarius arm of it, depending on what one believes.[1])



Is it Black or is it Gray?

Even then, when I show the above graphic, all (including me) will be unequivocal in declaring the colors to be shades of black. Although those are hues of gray. Such befuddlement ails us all. As Dr. Stephen Westland, professor of color science and technology at Leeds University, is right in saying, "Unless you are looking at a black hole, nobody has actually seen something which has no light." [2]

Given our feeble attempts at defining and rendering 'Black', it becomes quite a challenge to explain Vantablack – the blackest material known,[3–4] where Vanta is an acronym for Vertically Aligned Nano Tube Arrays. Although, NASA might argue that their super-black deserves that title.[5] It is easy to visualize Vantablack as a forest of carbon nano tubes. The tubes are stacked in a vertical orientation, with the length of the individual tubes being much much larger than their diameter.

Vantablack (downloaded from https://upload.wikimedia.org)

Yet, that still doesn't explain why it is the 'blackest' of blacks and could rewrite and replace all previous conceptions of black.[6] When light hits the Vantablack surface, it gets trapped in between the carbon nano tubes. The photons undergo a lot of collisions with the walls of these tubes. They lose their energies as heat to the walls and the tiniest amount is reflected back as light, all of 0.035 %.[2,7]

Such properties make it very exciting as future prospects. From manufacturing telescope coatings, where even the tiniest speck of scattered light can seriously affect its contrast and resolving power. To the defense and stealth sectors, who find the material extremely fascinating.[7]

Yet, it is still baffling to answer how does it feel to see the blackest material known. We understand a surface by its depth or its topological features. These features change reflectance. But for Vantablack, even when it is crumpled up, it defies perception. "You expect to see the hills and all you can see… it's like black, like a hole, like there's nothing there. It just looks so strange", as Surrey Nanosystems CTO Ben Jensen puts it.[2]

Vantablack is the darkest material we have that is as close to perceiving what a black hole would look like. This might be a bit disconcerting for us in the future, expecting to see textures but being greeted with an abyss. "And if you gaze long into an abyss, the abyss also gazes into you."

Read more:

[1] http://www.universetoday.com/75723/where-is-the-nearest-black-hole/ (last access 08.03.2017)

[2] http://www.independent.co.uk/news/science/blackest-is-the-new-black-scientists-have-developed-a-material-so-dark-that-you-cant-see-it-9602504.html (last access 08.03.2017)

[3] https://www.surreynanosystems.com/vantablack (last access 08.03.2017)

[4] E. Theocharous *et al.*, *Optics Express* **2014**, *22* 7290–7307.

[5] http://www.nasa-usa.de/topics/technology/features/super-black-material.html (last access 08.03.2017)

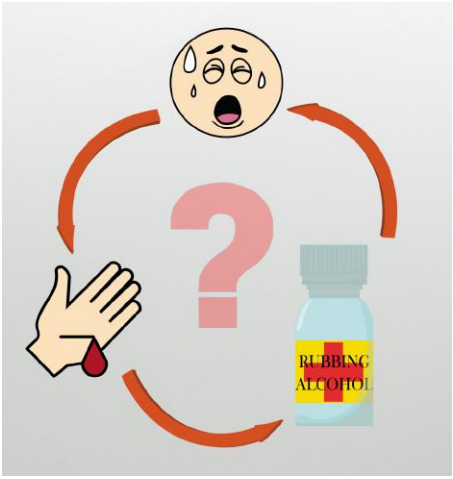
[6] https://www.theguardian.com/fashion/shortcuts/2014/jul/14/vantablack-nanofabric-new-black (last access 08.03.2017)

[7] http://www.extremetech.com/extreme/186229-its-like-staring-into-a-black-hole-worlds-darkest-material-will-be-used-to-make-very-stealthy-aircraft-better-telescopes (last access 08.03.2017)

Why Does Alcohol Burn in Wounds?

Andreas Neidlinger

Have you ever wondered why rubbing alcohol, i.e. isopropyl alcohol, which is used to disinfect cuts burns so much when applied to the wound? As my mother always said: "As long as it burns, it helps". This didn't help me much as a kid, anyway. But why does it burn in the first place? Do you feel the bacteria die? Do some of your cells get killed, too, and you feel that?



Feel the burn.

In fact, neither is true. Interestingly, the pain you feel is due to a heat reaction. But wait, doesn't alcohol usually give you a cool sensation when applied to the skin? True, but when the alcohol is able to penetrate your skin, e.g. when you have a cut, it gets in contact with your vanilloid receptors-1 (VR1). These are heat-gated receptors that normally get activated when the temperature rises above 42 °C, sending a painful sensation to prevent tissue damage by overheating. But why do your VR1 send a pain signal, even though the temperature does not rise above 42 °C? A study, a few years back, showed that alcohol has a similar effect on VR1 as capsaicin, the substance from chilies responsible for the hot taste.[1] Alcohol and capsaicin "trick" the VR1 by lowering the switch temperature from the above mentioned 42 °C to roughly 34 °C. Accordingly, your body temperature is high enough to induce an alert signal of VR1, giving you a burning (heat) pain even though your tissue isn't nearly hot enough.

Maybe it helps you in the future when disinfecting wounds (or eating hot food) when you think that the pain is not real but rather a trick by played due to your heat receptors.

Read more:

[1] M. Trevisani *et al.*, *Nat. Neurosci.*, **2002** *5*, 546–551.

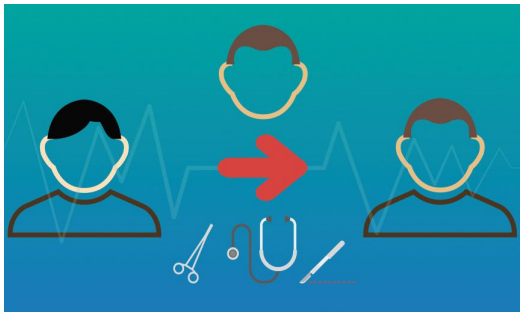
Will It Ever Be Possible To Successfully Transplant Heads?

Tatjana Dänzer

According to media reports, the Italian neurosurgeon Dr. Sergio Canavero will attempt the first transplant of a human head (cephalosomatic anastomosis) in the end of 2017.[1] Valery Spiridonow is volunteering for this project since he suffers from spinal muscular atrophy (SMA) and believes the surgery will offer a chance to escape from this fatal disease.[2]

Similar experiments have already been performed more or less successfully on animals. In some cases, the animals survived but they remained paraplegic and their cardiovascular and respiratory systems had to be supported. Also they did not survive quite long after the surgery.[3–4] In

fact, many experts are strongly doubting the success of this highly expensive transplant too.



Head Transplant : Fact or Fiction?

Even if it might become a 100 % success, there remain a lot of serious questions: – Will the patient (the head) be mentally and emotionally the same person as before? – Will the brain be able to cope with a completely strange body and vice-versa?

Of course, Spiridonow will first have to find a donor for the body. He needs the body of a physically healthy man suffering from cerebral death and the consent of his relatives. Spiridonow's new body will have the genome of the donor, so what are the legal consequences for any offspring regardless of whether they were conceived before or after the transplant?

So once again we are confronted with the problem of how far mankind can go to explore the possibilities of science and consider ethics at the same time. I think we should be excited and enthusiastic for the outcome of this dramatic surgery if it is going to happen anyway.

Read more:

[1] http://www.cbsnews.com/news/russian-man-volunteers-for-first-human-head-transplant/ (last access 16.03.2017)

[2] http://www.desireforlife.org/valery-spiridonov/ (last access 16.03.2017)

[3] S. Canavero, *Surg Neurol Int.*, **2013** *4*, 335–342.

[4] S. Canavero, *Surg Neurol Int.*, **2015** *6*, 18.

How Does a Touchscreen Work?

Kai Litzius

Touchscreens are getting more and more important for modern media. The most striking advantage of this technology is the combination of intuitive in- and out-put devices, which allow the user to directly interact with the system and vice-versa. But how does such a screen work, which types are available, and why do certain type of touchscreens react to fingers, but not to a normal pen? These questions we will answer in this week's featured question.

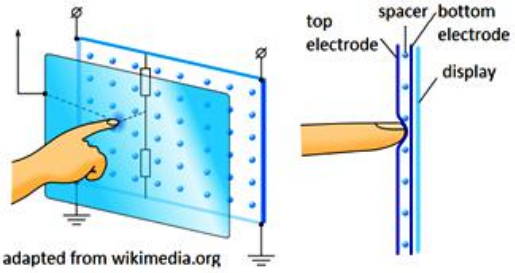


Figure 1: How a resistive screen works?

One of the first touchscreen technologies (that is still in use nowadays) is the so-called resistive screen. This specific screen type is composed of two conductive, relatively transparent layers (usually indium-tin-oxide (ITO)), which are held separated at a small distance by spacer dots. To the bottom layer, a small voltage is alternatingly applied in x- and y-direction, while the top layer connects to the second half of the circuit. They are capped by a stiff, but bendable layer and directly sit on the actual display. Touching the screen with a little bit of pressure bends the conductive layer on top and closes the circuit. The resulting currents along the x- and y-circuits can be measured and provide information about where the circuits are closed. The idea is that the longer the current path , the higher becomes the electrical resistance. This technology is still commonly found in cheaper devices and in devices meant to be operated with gloves and can yield high accuracy. However, due to the mechanical deformation the screen has a finite lifetime.

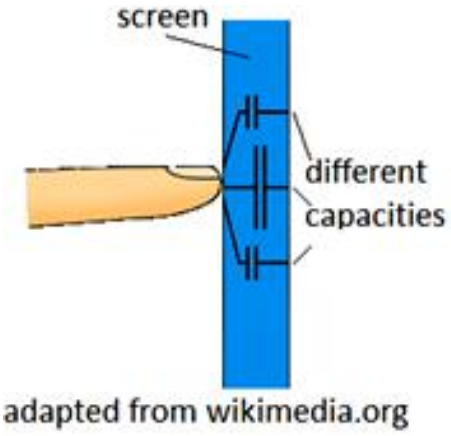


Figure 2: How a capacitive screen works?

The second, and probably most common, technology is used in "projected capacitive screens". Those screens are composed of two grids, rotated at 90° to each other, of very fine conductive wires (usually ITO deposited on glass) with spacers in between. In contrast to the resistive screens, they do not form a continuous layer. Instead, the ITO grids create a large amount of crossings, which act like little capacitors whose capacity changes whenever a conductive or dielectric object (like a finger) approaches the grid. A digital controller measures now the capacity of all grid

points one by one and if a certain deviation from the saved standard value is reached, a touch is registered. This technology allows multi-touch applications since all grid-points are measured separately and the image quality is enhanced due to the lower amount of ITO between the user's eye and the actual display. However, these touchscreens need specific materials to be able to detect a signal and barely work with thick gloves or normal pens due to the fact that the capacity does not change if a standard insulator (like plastic) is brought close to it.

There are far more types of touchscreens based on, e.g. infrared light, inductive coils, sound and the piezoelectric effect. However, the two types, mentioned here, are the most commonly found ones nowadays. In the future, there might exist even more sophisticated types of human-interface-devices (HIDs), but at the current time, touchscreens still are one of the most successful HIDs and were able to widely repress the simple push-buttons.

Read more:

[1] http://www.computerworld.com/article/2491831/computer-hardware/computer-hardware-how-it-works-the-technology-of-touch-screens.html (last access 16.03.2017)
[2] https://de.wikipedia.org/wiki/Touchscreen (last access 16.03.2017)

Are There Two Opposite Points On Earth's Surface With Identical Temperature and Air Pressure ?

Andreas Neidlinger

There have been already two Questions of the Week about the weather: "Can we control the weather?" (http://junq.info/?p=2783) by Nicola Reusch and "Is accurate weather forecast possible?" (http://junq.info/?p=1318) by myself. Today, I do not want to go into detail about the meteorological work, but demonstrate a mathematical theorem by the means of weather.

You certainly heard about antipodes, i.e. points that lie on diametrically opposite sides on the earth's surface. If you'd like to have a look where your antipode is at the moment, check refs. [1] and [2]. Now, these two parts of the earth are the farthest apart from each other as you can get, while staying on the ground; with the exemption that they are a little closer, when you are at sea level on both ends than they are when you are on top of Mount Everest on one side. Think about how different the climatic conditions must be between those two antipodal points. What if I told you that at any moment there are at least two antipodal points on earth's surface which share the same temperature and air pressure. Would you believe me?

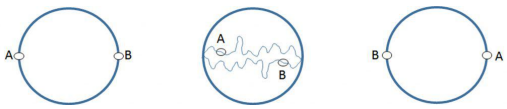


Figure 1. Two antipodal points A and B (left), antipodal paths from A to B (middle), and swapped points A and B (right).

No? So too what I thought at first. But let me reveal that it's true. Take a look at Fig. 1(left). There you see the two antipodes A and B. If we measure the temperature of both points and they are identical, fine, we did our job. But most likely this won't happen. If we move from the original point A to point B on any path while keeping A and B antipodal points (Fig. 1, middle), the temperatures of the two points will swap (Fig. 1, right). Therefore, there must be at least one set of antipodal points, where the temperature of A and B is identical, since swapping would be impossible otherwise.

Since swapping will occur on one set of points on a given antipodal path, you can imagine a line separating hemisphere A from hemisphere B on which any pair of antipodes will have equal temperature (Fig. 2). If we check air pressure on one set of antipodal points, we most likely won't find matching values. But we can also be certain that both values will swap, if we move from one point to the other, while staying on the equal temperature path from Fig. 2.

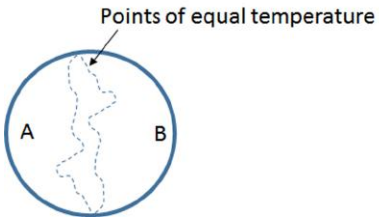


Figure 2. Antipodal points on earth's surface with equal temperature.

Therefore, we must find one pair of antipodes with equal temperature and equal air pressure on earth's surface at any given moment. Fascinating, isn't it? This is called the Borsuk-Ulam Theorem.[3] It is a mathematical theorem which remarkably illustrates that results which seem impossible can in fact be true, if you keep investigating in a scientific manner.

Read more:

[1] https://www.jasondavies.com/maps/antipodes/ (last access 16.03.2017)
[2] http://www.findlatitudeandlongitude.com/antipode-map/#.WMpjcfnys2x (last access 16.03.2017)
[3] http://www.und.edu/instruct/tprescott/papers/thesis/thesis.pdf (last access 16.03.2017)

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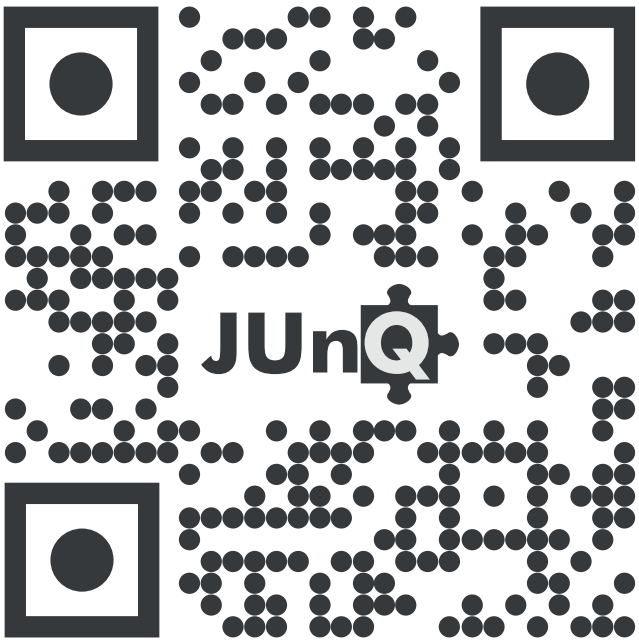

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