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ETHICS IN SCIENCE

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Preface

Editorial Note

Dear Reader,

Most of us know the ethical boundaries of social life in our respective cultures. “Be honest”, “Don’t steal”, “Don’t hurt or kill anyone” are just a few ethical codes that have been deeply imbedded in our minds ever since we were little children.

But what about moral codes in scientific life? Surely there must be some. But still simple rules like “Don’t kill” do not seem to keep scientists from injuring and destroying animals in pharmaceutical tests. And apart from the aspect of killing a living and sentient being: is it responsible to run trials on animals that have no or only minimal resemblance in their physiology compared to us? “Humans just aren’t mice” is the statement from Dr Corinna Gericke. Read more in her comment on “Why animal experiments are not necessary” on page 9.

Not only researchers but also authors and editors of scientific journals must stay inside an ethical framework to not generate a platform for fraud or enhancement but for honest and reproducible research. This applies also to negative and “null”- results. Are there any consequences for unethical behaviour in sciences? Find out what Brian Earp has to say in the interview on page 1.

As promised in our last issue we will also introduce you to the concept of Cradle to Cradle in an interview with Tim Janßen on page 5.

Of course, there is much more to explore about ethics in science and we already do have more in petto for our coming issues. Stay curious and dig through the JUnQ to find the hidden treasures!

— Tatjana Daenzer

Interviews

Ethics in Science and Publication

Brian D. Earp[1] is Associate Director of the Yale-Hastings Program in Ethics and Health Policy at Yale University and Research Fellow in the Uehiro Centre for Practical Ethics at the University of Oxford. His work is cross-disciplinary, following training in philosophy, cognitive science, psychology, history and sociology of science and medicine, and ethics.

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(Photo by Rob Judges)

JUnQ: The concept of ethics is really broad. Could you first help us to define it more accurately?

Brian D. Earp: Ethics is the branch of knowledge concerned with moral principles—it asks how we should behave, which might be very different to how we actually do behave. An ethicist is someone who studies the different theories about what is moral, or right, to do, and tries to come up with justified ways of identifying and applying the appropriate theory to particular cases or sets of cases.[1]

JUnQ: Are there different concepts of ethics in different cultures across the world? If so, are they perceptible in research depending on the cultural background of the scientist?

Brian D. Earp: Speaking descriptively, it is clearly the case that different cultures have different ideas about what is right, or ethical, to do in a given situation. Although, there is also quite a lot of overlap between various cultures in terms of what is believed to be morally appropriate, and probably some "core" moral principles that are more or less the same all around the world. A slightly different question is whether—objectively speaking—there is one "correct" set of ethical principles that applies everywhere in the world regardless of one's cultural background (or particular beliefs), such that, if someone in a particular culture doesn't agree with those ethical principles, they would simply be wrong. But there is no consensus about this. It is an ongoing debate among philosophers and it will probably never be completely resolved. My own view is that people are often much too quick to judge the behavior of other groups without (a) taking the time to fully understand the other group in terms of its own perspective and values, and (b) holding themselves to the same standard.[2–4] This doesn't mean that people should not criticize the practices of other cultures. It just means they should "do their homework" first and be equally rigorous in criticizing the practices of their own cultures.

All of that said, when it comes to the ethics of scientific practice in particular, I think there is much less room for wide cultural variation in standards and norms than there might be with respect to other issues (e.g., certain political arrangements or expectations for family life). There is a sense in which science by its very nature strives to be universal. Accordingly, there are some basic principles that should be respected no matter where you are in the world, or who you work for. I won't try to list them out, but they all center around controlling biases, avoiding conflicts of interest, and so on, so that the studies that come out of various labs—no matter which country those labs are based in—are as valid and reliable (and interpretable by other experts) as possible.

JUnQ: Would you make a distinction between ethics in laboratory work, data analysis and publishing?

Brian D. Earp: Here, I think there is a single underlying principle, which is that scientists should strive in every area of their conduct, to behave in such a way that they ac-

curately represent what they have done, how they have done it, and what can reasonably be inferred from it, all toward the goal of getting at the truth. So, in laboratory work, they should keep clear records of every step of the experiment, for instance. In data analysis, they should not try to "fish around" looking for a result that will be publishable, but rather, they should pre-register the data-analysis plan they intend to pursue and then follow this exactly.[5] They can then perform "exploratory analyses" if they wish, but these must be explicitly labeled as such so that other researchers can know how much weight to give to any particular statistical analysis in terms of what kind of conclusion can be drawn from it. Finally, in publishing, I and many others have argued that researchers (and journal editors) need to be much more open to reporting negative or null findings from well-designed experiments, so that the scientific record is not skewed toward studies that apparently "worked" (but might only be false alarms).[6–8]

JUnQ: What defines a result as negative? Is the non-publication of negative results a non-ethical behavior since we only publish a part of the acquired data?

Brian D. Earp: Broadly speaking, a negative result is just any result you were not predicting or didn't expect. Another way of thinking about negative results is that they are those results that do not appear to support your hypothesis. Finally, if you are using null hypothesis significance testing (NHST) in particular, a negative result is normally understood in a more narrow sense as a pattern of data yielding a p-value that does not allow you to reject the null hypothesis according to the alpha level you have set (usually 0.05, the conventional criterion for "statistical significance," although my colleagues and I have recently argued that the alpha level you should use for a particular experiment depends on numerous factors. So, there should not be one single, automatic alpha level for every research question).[9–11]

Here is the problem with systematically failing to publish negative results. Imagine that you run an experiment 20 different times (or perhaps you run 20 different versions of an experiment, and call the first 19 versions "pilot studies" when they don't turn out the way you anticipated). Now suppose that only one of those times you get a "positive" finding, i.e., a result that appears to support your hypothesis or which allows you to reject the null hypothesis if you are using NHST. Obviously, chances are very high that this "finding" is really a Type 1 error—a false alarm. Yet if you only write up that one version of the experiment, you are essentially guaranteeing that whatever you publish will be non-replicable nonsense that others may try to build upon and therefore waste time and resources. In real life, it is not usually quite as simple as this dummy example I have given. But it shows why selective publishing of only positive findings can make it more likely that those "findings" are really just statistical noise.

Another reason why it is important to publish negative results—as long as they come from a well-designed and well-executed study—is that often, they can be informative. Sometimes, knowing that something doesn't work (even though you really expected it to, based on your theory) is just as informative as learning that something does work. In fact, it may be more informative in the long run, because you didn't expect it—so now you have to ask yourself deeper questions to get at what is really the case.[12]

JUnQ: Do you think editors and reviewers apply the appropriate politics toward publication of negative results?

Brian D. Earp: Some editors do, but, overwhelmingly, no. In my view, it should be just as easy to publish a paper reporting negative results as a paper reporting positive results, assuming that the experiment was equally well-designed and carried out in both cases. Therefore, I am sympathetic to proposals for "results-blind" publishing, where editors essentially make a decision about whether to publish a paper based on the introduction and methods section alone, before they see any results.[13–15] That way, they are making a judgment about the quality of the experiment, and using that as the criterion for publication, knowing that—whatever way the data come out—we will have learned something valuable, and we will be reducing publication bias as well. There is also a growing movement among some journals now to accept "Registered Reports," which follow a similar logic.

An example of a new journal that actually does have the right idea in terms of the politics and policies of publication is Meta-Psychology[1]. I really encourage readers to check out their "About" section online or their inaugural editorial, which lays out convincingly why they have adopted various "Open Science" policies—including open peer review—and explains other nice features, such as a willingness to publish negative results and otherwise help researchers empty out their "file drawers."

JUnQ: The main metric to evaluate the work of a scientist is based on the impact factor. Since high-impact factor journals ask for novelty, it is not likely that scientists can publish their negative results there. Do you think an alternative system is possible, where the impact factor is erased, all scientists communicate and collaborate more, without competing to gain the most coveted result?

Brian D. Earp: It is a great shame that impact factors are used to evaluate the work of scientists. Impact factors are notoriously unreliable indicators of quality, easy to "game" or "hack" and so on. They really should not be used, pretty much for anything. But as long as impact factors exist, it will be necessary for the editors of high-impact journals to "stick their necks out" and be brave and start making

[1] https://open.lnu.se/index.php/metapsychology/about

room in their journals for negative results derived from well-designed and conducted studies that are appropriately suited to answer an interesting research question. If the high-impact journals start to do this, then they will change the norms of what counts as "prestigious." Again, there are already some encouraging signs in the "Registered Report" movement that some of the big players are indeed willing to do this.[16−18] As for whether an alternative, more collaborative system is possible … in theory, yes. And in practice, too, at least a little bit, with new journals and initiatives like Meta-Psychology. But I don't know how likely that kind of system is going to be on a wider scale unless the reward structure of science changes radically to encourage such a thing.[19] And that would mean that governments and funders, and hiring committees at universities, and so on, would need to be educated about the problems with the current way of doing things, whereby chasing after impact factors with "sexy" findings is so alluring.

JUnQ: What are the consequences for unethical behavior or misconduct in science and publishing? Is there any form of moral, social or legal penalty?

Brian D. Earp: Certainly fraudulent behavior—falsifying data, deliberately misreporting results, and so on—is completely unacceptable and most universities have systems in place to impose very harsh consequences (including loss of employment) on anyone shown to have committed fraud. Such a person would also likely lose their reputation in the court of public opinion, not just among their fellow scientists, but also sometimes in the wider society.[20] But I think it's important to hold ourselves as scientists to a high ethical standard: not just say "don't commit fraud." That means reporting our results in a humble way, and not exaggerating what we found.[21] It means being honest about mistakes we made in the research process, not covering them up and hoping the reviewer doesn't notice. It means taking criticisms from others seriously, and not just trying to press an agenda.[22] It means making our data, when possible and appropriate, publicly available so that other researchers can replicate our analyses and our findings. It means rooting out sources of bias in our workflow, and so on.[23] I am now starting to see that simply failing to pre-register your study may have adverse effects on your reputation: other scientists are learning that studies that were not pre-registered are not necessarily as trustworthy as ones that were, and so they don't take findings from such studies as seriously.

JUnQ: According to you, are people sufficiently aware of the ethic challenges? If yes, are they willing to change their behavior to be more ethical?

Brian D. Earp: Because of the "replication crisis" that I (and many others) have been researching and writing about these past several years,[24−29] I think there is more general awareness now that some of the old research habits and publication practices from decades past are not good enough to produce a robust and reliable scientific literature that we can properly be proud of.[30,31] Many scientists fully understand the need for reform. Especially in the younger generation, there seems to be an eagerness for "going back to basics" and really checking to make sure that our design and methodologies, data analysis strategies, and reporting and publication standards are helping us get closer to the truth—not just another publication.[32]

JUnQ: Thank you very much for the interview!

— Adrien Thurotte

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Cradle to Cradle: Interview with Tim Janßen

Tim Janßen is a member of the executive board and co-founder of the Cradle to Cradle (C2C)[1] association.[1] C2C pursues the idea of reusing every product causing a non-existence of waste. Humankind should not be nature's destroyer but a useful creature which leaves a "positive footprint". Together with volunteers they talk with politicians, economists and even pupils to get everyone enthused about their ideals.[2] Tim Janßen as responsible person for the management inside the C2C association develops strategies for an increasing impact of the association.[1]

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JUnQ: Where does your interest in sustainability come from?

Tim Janßen: I think it comes from what I believe in, but the turning point happened during my studies: I studied business sciences for six years and came to a point where business did not give me answers to the bigger social questions. The answers simply did not meet my expectations anymore. You can look at certain things under economic perspectives like how companies, economy and economic data work and how they can be managed. But social and ecological questions have not been addressed at all. I graduated my Master at the university of Lüneburg, Germany with the focus on economy and a little bit of philosophy. During this time, I was open for other concepts and so I also came across the topic "Cradle to Cradle". I liked the concept of practical, social and ecological answers to economic issues.

I really liked the idea to bring up "my own economic sciences" and connect it with Cradle to Cradle. Urgent questions about social justice, responsibility and the way and manner how we produce are dear to me. For example, how can products be created to be healthy? How to deal with the lack of raw materials? Equity is also an important factor. If you go through the world with open eyes, you reach a lot of different topics which have a higher social relevance.

JUnQ: How long have you been involved in the Cradle to Cradle concept?

Tim Janßen: My colleague Nora Sophie Griefahn and I founded the organization in 2012 as a matter of the heart. Also, within the scope of science there are chairs working on this issue. We really missed the groundswell public dialogue about the idea behind Cradle to Cradle. It simply didn't happen. A lot of discussions today are about classic sustainability mostly about efficiency and optimization of established systems. That means only to be a little better, a little more efficient. In other words: to act "a little less worse".

To us this was insufficient. We wanted to spread the idea and to invite people to join the discussion. That's when we started to build up regional groups. Now we have reached more than 50 initiatives with more than 700 volunteers who act Germany-wide to discuss all questions about Cradle to Cradle in the society. We talk to other environmental associations, political parties, local communities, consumers, students, pupils, teachers etc. from all fields.

I have been working on it for five years now as founder and manager. But over the years we recognized that besides of the volunteer work we need a professional administration to support the volunteers. After our first C2C conference, in 2014 we established our first office in Berlin. Right now, we have eight team members led by Nora and me. From there we supervise our more than 50 initiatives, manage Public relations and organize a large conference in Lüneburg. More than 700-1000 people are joining us in Lüneburg each year. We also do a lot of other events throughout the year like workshops and political events.

JUnQ: The idea for the association was, so to speak, mainly to create more interdisciplinary transparency and sustainability for the topic of Cradle to Cradle?

Tim Janßen: That was not mainly why we started the organization. To be successful you need an interdisciplinary discussion. It's crucial to involve many people to make a societal change. In our opinion, the topic of C2C was too little discussed, especially in Germany. We wanted to change that and provoke this discussion by giving people the opportunity to ask themselves questions in the area of Cradle to Cradle at our events and website. We than would like to answer these questions and work together to transfer this educational work into the centre of society. The intent is that the ideas of Cradle to Cradle are just self-evident in our minds.

It is quite stupid to produce a product that produces waste. Products must be healthy for the user and they must run in cycles. They must be designed for that purpose from the very beginning and that is what this basic thinking is all about. For this to be normal, we have founded the Cradle

to Cradle association to propose what we call the Cradle to Cradle School of Thinking. Behind this idea stands a special image of humans. Cradle to Cradle is not just about transforming individual products so they go into cycles and are healthy in use. This image of humans creates a different view of the human being and his "footprint". And the footprint discussion today, in the context of CO_2 and all the other footprints is always a reducing, avoiding debate. The goal of consequently reducing the harmful footprint means, it would be better humans left no footprints. That means in conclusion: humans should not be here at all?

From our point of view, this is a very inhumane image. By the perspective of how we are discussing, we take a role in which we say people belong to the Cradle to Cradle School of Thinking. We want to encourage people to leave a positive footprint on Earth to indemnify and get encouraged to do good things for people and planet today. We can be useful and not only less harmful!

JUnQ: Why should it be a new assembly to support this thought? Would not the idea alone have been able to apply to something already established? Why did it have to be something new?

Tim Janßen: The issue is whether to start with something new or introduce the ideas into existing systems. As an organization we require people who contribute with their ideas and the association helps to bundle up all these ideas. Since in this area there are a lot of people who are interested in it, I advise people who want to start their own organization to join us instead and to meet quite a lot of other co-workers.

But for the founding of the Cradle to Cradle association, there were more reasons. The German sustainability debate is very elaborate, and this is something which unfortunately still teaches us the reality of the last years. In our small business, we have already been able to bring about a change in working life. We are also organizing a large conference on this subject. There are major conferences in the field of sustainability but even there, questions about material health remain mostly unanswered. The only feedback we ever received was about the safety of certain materials. This was at a resource forum in Berlin something odd since most of the debate was about licensing measures. From our point of view, this approach is wrong. We can only improve a system that already works. If the system does not work, you cannot improve it. And that is exactly what we witness these days. It does not help to join existing organizations, which for 30 years have discussed conventional sustainability. That is a bite on granite. At that point, to drive a different perspective and to discuss the same problems with others, but with different solutions, we urgently needed a new organization. Up to this day, there is no other environmental protection or organization, no other economic association, no political party. Only a few politicians are already committed to this idea. But it is slowly working now. We have great success with the fact that people recognize they can count on our feedback. Healthy products from the very beginning are designed to go into cycles and that still characterizes us to this day. We are one of the very few organizations to get up and go for it!

JUnQ: What are your personal wishes and goals for the future of the association and the concept?

Tim Janßen: The concept is a simple approach to design products and choose only materials that are useful and match the needs for certain applications for the customer. But we notice that many things around us are toxic and useless after their consumption. Our society lives with a certain luxury and huge global problems.

Since we need other solutions, we must act differently in the future. I believe we have been on a very good path over the past few years and would like to continue this way. We have many, many ideas but sometimes we are restricted by our capacities. One step further would be the expansion of the association. We are a donation-financed organization, and if we had more money at our disposal – which probably all the environmental associations would say – then we could realize even more. Now, we can certainly improve our work in the field of policy position papers, even scientific publishing itself would certainly be great.

Another goal is to develop our educational work to raise awareness of this topic in schools. It is incredibly difficult to finance this since only a few people spend money to support such concepts in schools and we are still in the initial phase for 3 years now. We meet many people who have not even thought about this concept. They are so influenced by their habits that they do not recognize progressive currents as Cradle to Cradle. To reach these people, we must become much stronger. There is still a lot to do to get the whole human society to say: "All the products I buy should not be going to be garbage anymore and I want healthy products." This can be a claim from customers to the companies. Nowadays there are companies which think in advance. They tell us that it is important that we present our products differently. There are already many examples today, but it is not enough! The major part of our production still works with the principle Cradle to Grave. If we do not change that soon, we will run out of time. This has not only to do with climate protection goals, but also with poverty, economic refugees and wars. These topics are all closely related.

JUnQ: Companies tend to be very economically interested without thinking about tomorrow. Do you see that some companies accept green thought-provoking ideas like the Cradle to Cradle concept and then use this as a marketing strategy? Is this just a feeling or is it sometimes a bit played on?

Tim Janßen: Cradle to Cradle is a concept for innovation on the one hand, on the other C2C certified is one of the most recognized environmental labels on the market. There are several types of companies, but you could divide them into three areas roughly:

1. Companies that are still not interested in the topic
2. Companies that start with it
3. Companies that are completely convinced and direct their entire entrepreneurial activity in this direction.

There are great examples of companies that also act holistically and for which it is an important concern to manufacture Cradle to Cradle products from conviction. They adjust their whole product range and thus bring out products which work with healthy materials in cycles. However, we have also discovered company examples, where only individual product lines or few products in the entire range meet the quality requirements. There is a comprehensible certification for Cradle to Cradle products established by a non-profit institute in the USA, which has developed a five-stage certification. This enables the consumer to check the quality of the product, depending on how it is classified.

The question is of course how the company then continues. No one claims that such a complex and sometimes difficult change in production works overnight. But the company takes this opportunity and changes bit by bit. Since the products appear as positive examples on the market, the end-user can be understood as a "change agent". If you support these companies, they notice it as wanted and then make the turn to more of such products. Finally, they listen to what the customer wants. But that is still not clear enough.

We have also experienced a movement in the bio marked in recent years. But the segment of consumers who demand bioproducts is rather small. Commercial agriculture still dominates. For us, it is very important that the company does not use it solely as a marketing tool. Right now, I am not concerned because there are enough people who have a closer look at the detail. This is what I think is crucial in such a big community as ours, which checks itself and what's happening in the background: Are their wages fair? Is renewable energy used? What happens to the water used in production? Are the materials healthy and suitable for cycle systems? Ask and see what the companies answer. But there are already a lot of credible examples. There is no greenwashing. On the contrary, there are many sustainable companies, only sustainability is very sparsely defined. Almost no company comes out without a sustainability report. There are small optimizations, but often at the status quo.

JUnQ: How is the feedback from the still quite young association of internal co-workers of the Cradle to Cradle society and from people who have already occupied themselves with the topic? How has the association developed in recent years?

Tim Janßen: We have more than 700 volunteers who are also supported by our office in Berlin. There is a lot of positive feedback about what we have received over the years until today. Many people ask us about their possibilities to discuss and engage with us. People like to come to the annual events, as our congress. We have a large internal network through which we swap ideas with all our participants. Once a month we have a conference with all our speakers from the regional working groups. The feedback is full of enthusiasm and mutual consent. We invite everyone to participate. This is also the strength of our organization!

There is a tremendous amount of strength and motivation coming from communality. Many years ago, we were still alone, but time has shown that it only needs a few procedures to get things up and running. Where there are many people with the desire to join, a movement is established. We have already succeeded over the last few years quite well and it goes on. We get a lot of feedback from very different directions. Teachers who tell us it was great that the Cradle to Cradle Regional Group made a lecture in their class. If you can join us now, you can visit us at our congress, on our website, follow us on Facebook,.... There are so many possibilities and the feedback has always been positive over the years because many people have missed something like that. Social aspects were simply a missing piece in the puzzle.

JUnQ: How is the feedback from outside (politicians etc.)?

Tim Janßen: The Cradle to Cradle concept itself has been discussed for some years. But things take time and our congress is under the patronage of the Federal Environment Minister. This also shows that politics are getting impulses. We also cooperate with various federal and state ministries in a very different way. We discuss topics such as procurement at federal and provincial level as well. We also ask very complex questions to the media. We have great media partners on our side, for example BrandEins (great economic magazine) and many others. It is a very colourful circle of supporters.

JUnQ: Do you have a favourite project right now?

Tim Janßen: The best answer probably is that there are so many projects that I could not want to make a project stand out. All the projects are. For us, it is important that something happens in many places and that we quickly discuss with many people how we can imagine the future together. So that it will not be too late and therefore all projects are welcome. No matter if small or big, we need them all!

JUnQ: Thank you very much for the interview!

— Dania Rose-Sperling

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Opinions

Opinions on Animal Testing – Why Animal Experiments are not Necessary

Doctors Against Animal Experiments Germany

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Whether animal testing for drug development is necessary and without alternative has always been a long and emotional debate. The german association Ärzte gegen Tierversuche e.V. (Doctors Against Animal Experiments Germany)[1] rigorously takes the view that animal testing is indeed the wrong way for the important medical advancement. Dr. med. vet. Corina Gericke (vice chair) explains in this essay why they think that animal experiments are not necessary.

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Scientists, politicians and citizens are now increasingly recognizing that animal experiments don't fulfill what they promise, and that their results are not directly applicable to humans. It is often claimed that animal testing is indispensable, because a „complete organism" is supposedly required for the development of pharmaceutical drugs. Animals may well be complete organisms, but they are the wrong ones. Animals and humans differ considerably with regard to anatomy, physiology and metabolism. Even animals of different species can react quite differently to chemicals and pharmaceutical drugs. It is not possible to predict whether a human will react identically or differently based on the results of experiments conducted on animals. One study conducted by the pharmaceutical company Pfizer came to the conclusion that „one would be better off tossing a coin than relying on animal experiments to answer the question of carcinogenic substances. Only 5 - 25% of the substances harmful to humans also have adverse effects on the experimental animals. Tossing a coin delivers better results".[1]

The numerous pharmaceutical drugs that were considered safe based on animal experiments, but caused serious or even lethal adverse effects in humans, are proof that the results of animal experiments cannot be transferred to humans with the necessary reliability. In Germany alone, as many as 58 000 deaths are estimated to be the result of medication errors.[2]
On the other hand, no one knows how many beneficial pharmaceutical drugs are never released because they are prematurely abandoned on the basis of misleading animal experiments. Many drugs that are highly beneficial nowadays, such as aspirin, ibuprofen, insulin, penicillin or phenobarbital, would not be available if one had relied on animal testing in earlier days, because these substances induce grave damage in certain animal species due to differing metabolic processes. They would have failed outright if subjected to the present-day procedures applied in the development of active ingredients.

Regardless of the numerous scientific reasons, there are many ethical reasons to reject animal experiments. Each year at least 115 million animals die in the laboratories of the chemical and pharmaceutical industry, in universities and other research institutes.[3] Animal experiments degrade animals as „model organisms" to disposable measuring instruments. Yet animals are sentient fellow creatures capable of suffering. Animal experimentation is not compatible with ethically justifiable medicine and science.

Animal "models" have nothing in common with human diseases

Since some diseases do not occur in animals, their symptoms are simulated using „model organisms". For instance, in order to induce Parkinson's disease, monkeys, rats or mice are injected with a neurotoxin that destroys brain cells. Cancer is induced in mice by means of genetic engineering or injecting cancer cells. Cerebral strokes are caused in mice by inserting a thread into a cerebral artery. Diabetes in rats is caused by injecting a toxin that destroys

the insulin-producing cells in the pancreas. Heart attacks are simulated in dogs by constricting a coronary artery with a noose.

The artificially induced symptoms have nothing in common with the human disorders they are supposed to simulate. Important aspects of the origins of the disorders, such as diet, lifestyle habits, drug consumption, harmful environmental influences, stress, and psychological and social factors, are not taken into consideration. The results of studies using animals are therefore misleading and irrelevant.
In fact, research based on animal experimentation repeatedly fails all along the line. 95% of potential pharmaceutical drugs that are shown by animal testing to be effective and safe do not pass clinical trials,[4,5] either because of insufficient effectiveness or undesired side effects. Of the 5% of substances that are approved, one third is later taken off the market because grave, often even lethal side effects in humans become evident or serious health warnings are added.[6]

For instance, the „invention“ of the cancer mouse was believed to be the long-sought key to combating malignant tumours. In the mid-eighties, researchers at the Harvard University succeeded in inserting a human cancer gene into the genome of mice, so that the rodents prematurely developed tumours. This genetically engineered mouse was even the first mammal to be patented, in the USA in 1988 and in Europe in 1992. Since then, hundred thousands of cancer mice have been „cured“, but all the treatments that were „successful“ in rodents failed in humans.

Animal experiments have led medicine into a dead-end street

Animal experimental research regularly announces breakthroughs with all kinds of disorders. Animal testing supposedly proved this or the other method of treatment to be successful in combating Alzheimer's disease, Parkinson's disease, multiple sclerosis, cancer, atherosclerosis, etc.. However, the hopes of the afflicted patients are almost always disappointed, and the celebrated miracle cures are never heard of again. Humans just aren't mice.
Scientific studies are increasingly casting doubt on the benefits of animal experiments. They prove that the results of animal tests often do not correlate to the insights gained from humans, and that animal experiments are often irrelevant to the clinical application for humans.
In an English meta-study the results of different treatment methods on experimental animals and patients based on the relevant scientific publications were compared. Only three of the six disorders investigated delivered correlations, the remaining half did not.[7]

In a further comparative study a British research team determined that the results of studies conducted on both animals and humans often differ quite considerably. According to the study, the inexact results of animal experiments can endanger patients and are also a waste of research funding.[8]
In a German study, 51 applications for animal experiments that were approved in Bavaria were analysed with regard to their clinical implementation. The research team discovered that even ten years later not one single project had been demonstrably implemented in human medicine.[9]
Animal experimentation is not only useless, it is even harmful. It implies security that does not exist, and the false results it delivers only impede medical progress.

Scientific research

Putting an end to animal experiments does not mean the end of medical research. On the contrary – switching to studies on humans, for instance in the areas of epidemiology, clinical research, occupational safety and health, and social medicine would lead to real medical progress. Testing methods without the use of animals, using human cells and tissues combined with special computer programs, deliver exact and conclusive results, as opposed to animal experiments.
Sophisticated computer models are capable of delivering information on structure, effect and toxicity of substances, such as new drugs or chemicals. Microchips combine computer and in-vitro methods; in a system of minute ducts and chambers, microchips are colonized with human cells from different organs. Thus it is possible to test the effect of an experimental substance on the individual organs, as well as how it is metabolized and whether any toxic waste products are formed.[10] Those who believe that animal experiments are conducted in order to develop new therapies for sick people are profoundly mistaken. Many animal experiments conducted as pure research don't even pretend to benefit medicine. Examples of animal experiments approved and conducted in Germany:
At the University of Leipzig it was discovered that hibernation protects hamsters' neural tissue and can thus for instance prevent Alzheimer's disease.[11]
In the Federal Research Institute of Nutrition and Food in Karlsruhe, carotinoids were mixed into calves' milk replacer, in order to find out why tomatoes and melons are so beneficial to humans' health.[12]
In order to investigate the consequences of acute acoustic shock on the inner ear of guinea pigs, the animals were subjected to the sound of rifle shots (156 +/- 4 dB), then killed.[13]
At the Institute of Avian Research in Wilhelmshaven, 22 herring gulls captured on a German North Sea island were not fed for six days. The aim was to find out how long gulls can starve.[14]
In Ulm, a research team has been investigating the effects of gravity on the development and bio-rhythms of different animal species for years. For instance, an apparatus was assembled, with which measurements can be conducted on living scorpions over a period of several months. The animal is affixed to and immobilised on a plate. Electrodes inserted into eyes, leg muscles, brain and body continu-

ously measure nerve currents.[15]

There is no need to search for animal-free testing methods to replace such research projects. These animal experiments can be eliminated without substitution, because human data have long been available, or because their results are completely irrelevant to human health.

Why are animal experiments still conducted?

Clinging to animal experiments does not have scientific reasons, but rather is based largely on tradition. More than 150 years ago, the French physiologist Claude Bernard (1813 – 1878) elevated animal experiments to the touchstone of all medical and scientific insight. Bernard's doctrine lives on in a contemporary scientific paradigm that only accepts results that are analytically explicable, as well as measurable and reproducible. Within the framework of this scientific system, sicknesses become technical defects and animals become measuring instruments.

Thus a researcher's quality is not measured by the number of people he or she has helped, but rather by the amount of scientific publication. True to the motto „Publish or perish", it is only possible to attain profile in the world of science by means of a long list of publications in renowned scientific journals, the amount of research funding available depending on the list of publications. This funding is invested in new animal experiments, which again result in a new publication. This absurd system is self-sustaining and devours incredible amounts of research funding, third-party funds or scholarships, without being of any benefit to sick people.

A further reason why animal testing is continued in some areas is the lack of financial support for animal-free research, as well as the protracted procedures for approving the implementation of in-vitro methods.

Finally, animal experiments serve the pharmaceutical industry as a means of hedging their liability. If something goes wrong with a drug, the manufacturer can point to the animal testing conducted without the side effects arising. Animal experiments are also very popular in the pharmaceutical industry, because they can be used to prove anything one wants. There is bound to be a species and a test setup that will deliver the desired results.

Animal experimentation not only stands for cruel and therefore unethical methods, but also unscientific methods that have no right to a place in modern 21st century medicine and science.

— Dr. Corina Gericke

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Views on Life, the Universe, and Everything

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.

Is Mycelium the Material of the Future?

Tatjana Daenzer

No, mycelium is not a recently discovered chemical element. It might be the solution to the question of how to replace petroleum-based materials!
Mycelium is the tenuous web of vegetative fungal cells called hyphae that grows in the soils shown in figure 1.[1] The parts of fungi that we usually see are just their body fruits (mushrooms, chanterelles, shiitake,...). But mycelium forms a much larger network below the surface that can even spread over several thousand square kilometers.[2] It is one of earth's most important organisms since it helps nature to "digest", meaning that it decomposes organic material and turns it into compost.[1]

Figure 1. Microscopic image of a mycelium network (1mm·1mm).[3]

But can this bio-based material save our planet? The answer to this question could be easier as you might think. Fungal material is renewable, compostable under certain conditions (moisture and the presence of other organisms), fire resistant, moldable, free from volatile organic compounds (VOCs), dyeable and vegan.[4] Companies like Ecovative and MycoWorks have already started to produce items from mycelium that can find access to our daily life.[4,5]
Ecovative was founded in 2007 and claims to produce more than 450,000 kg of mycelium material per year. They explain the production process on their webpage: Agricultural waste is seeded with mycelium from mushrooms like Ganoderma. After some time of incubation, the waste is cut into little particles that are filled into a mold with the desired shape. The mycelium grows a few days until it has filled the mold and can be removed. In a last step the solid material is dried to stop the mycelium from growing. From that process packing material and even decoration can be made.[6] Imagine how many things could be substituted that are still petroleum-based and not compostable.
MycoWorks, founded in 2013, is specializing on replacing leather by mycelium – a relieve for our vegan friends. They claim that "...it feels and performs like leather".[5] Indeed, recently I had the chance to touch a sample of "mycelium leather" and it does feel quite comfortable!
Mycelium as a full substitute for most of our plastic-based everyday products has still a long way to go. Sure, fugus as fancy packing material is not unusual anymore but customers still have to be convinced to wear clothes made from mushrooms. After all, some fungi are responsible for decay and mould. How will it react on the (moist) skin? Can it be washed without any damage to the fabric? How quickly does it decompose?
There must still be made a lot more research and explanatory work until consumers are convinced to take mycelium as an impeccable material. But maybe one day the world will be greener and we will be producing less eternal waste.

Read more:

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Two Minds, One Body and a Billion Questions.

Mariia Filianina

Conjoined twinning is one of the most fascinating and at the same time devastating human malformations. This is an extremely rare phenomenon. The occurrence is estimated to range from 1 in 50,000 births to 1 in 100,000 births,[1] when identical twins are born physically connected to each other. They can be joined anywhere – head, chest, abdomen, hips, and so on.[2] In fact, there is a whole spectrum of cases with different degrees of bodily overlapping: from being joined by a thin sliver of skin to being extensively fused. The "fusion" can be so extensive that in some cases, it is no longer correct to talk about "twins" because there is only one individual with some extra organs.[3]

Conjoined twins have been known to exist for centuries, yet there is very little understanding of this phenomenon. Common public questions are: How do conjoined twins live together? How do they eat, walk or manage any other daily routine activities? Do they share thoughts and can they read each other's mind?

The answers to these questions are indeed different for different pairs of conjoined twins. For example, 27-year old Abigail "Abby" and Brittany Hensel are joined at the torso. They have two hearts, two spines, two sets of lungs, two arms and two stomachs. Below the waist, they are more like one body. Each twin controls her half of their body – Brittany, the left twin, can't feel the right side of her body, and vice versa. Each twin manipulates one arm and one leg.

As infants, the initial learning of physical processes that required bodily coordination, such as clapping, crawling, and walking, required the cooperation of both twins, even standing up takes total coordination. Now as grown-ups they are incredibly well coordinated with this set-up, able to walk with a smooth gait, dribble a basketball, ride a bike, and even drive a car: both steer and Abigail controls the accelerator with her right foot. The really mesmerizing thing is watching them type on a computer, as both girls' hands fly over the keys, but there is no verbal discussion of what they are writing.[4]

For 98 percent of all sets of conjoined twins, each person has their own separate and distinct thoughts and feelings. But in the case of Tatjana and Krista Hogan,[5] which occurs in only one in 2.5 million births, they share neural activity because their skulls are connected.

The girls are still too young to investigate their neurological wiring, but from the MRI scans, doctors have determined that there is a "thalamic bridge" that links one sister's sensory input to the other, creating a conscious loop. Essentially, if one thinks a happy thought, the other can perceive it. When one sees an image through her eyes, the other receives the image milliseconds later.

With a few tens pairs of conjoined twins across the world today Abby and Brittany, Krista and Tatjana are defying the odds. And a fair answer to all the curious questions can be that they are able to do normal things, even though it takes a lot more effort for them than anyone can imagine.

Read more:

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When Will We Be Able to Hoover with a Dyson Sphere?

Tatjana Daenzer

Probably never, since a Dyson sphere is not a vacuum cleaner of the same-named famous brand. In fact, until now it is just a thought experiment:
In 1960 Freeman J. Dyson published his theory about "the long-scale conversion of starlight into far infrared radiation" in Science.[1] He states that aliens with further developed technology than ours must have found an advanced way like this to harvest solar energy.

Figure 1. Illustration of a dyson sphere.[3] ©Kevin Gill

One model of such a device is depicted as a shell around the system's sun at a distance of about two earth orbits with a thickness of 2 3 m and the approximate mass of Jupiter. All the energy emitted by the star could thus be absorbed and harnessed on the inner surface. Of course, one must first exploit an entire planet to obtain all the mass needed for this device - a huge technical trouble.
But with his hypothesis Dyson also proposed a way to trace intelligent existence in far-away solar systems that was new up to then. Until the 1960s the search for aliens based on the search for extra-terrestrial radio signals. However, a Dyson sphere would appear as a dark object emitting radiation in the far infrared (about 10 µm).[1] Now, instead of only listening to strange radio noise, scanning the sky for abnormalities in the infrared spectrum became also of importance.
Some years ago, mankind seemed to be one step closer to discovering a Dyson sphere (or something similar): the light of the star KIC 8462852 shows an immensely changing intensity as if a huge object was regularly passing by. An orbiting planet would be too small to cause such an eclipse. This evokes suspicions about space-factories or cities and even whole Dyson-like devices. But the shadow could probably also be cast by natural causes like the remains of a burst asteroid or an interstellar cloud.[2]
Until we are able to construct a Dyson sphere millions of years could pass. We first must develop advanced methods for space-travel and the technology to destruct a whole planet. Not to speak of the energy we will already have consumed on the way. But then, of course, we might be able to drive our hoovers (or anything else) with energy from a Dyson sphere ;)

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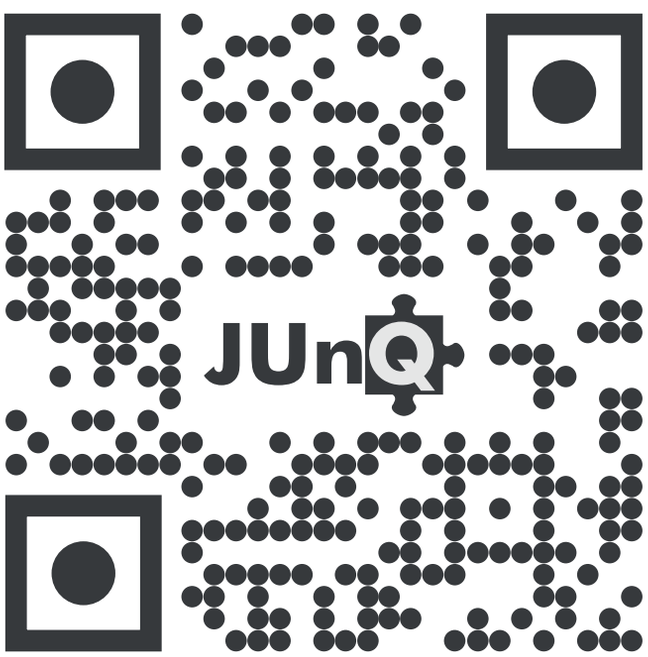

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