

What the Public Really Thinks About Chemistry

The Royal Society of Chemistry's research has some surprising and reassuring findings—and a clear message for chemists communicating with the public

by Jon Edwards, Chiara Ceci, and Elisabeth Ratcliffe

Chemists are passionate people. We are passionate about chemistry, about our identity as chemists, and about the potential of chemistry and chemicals to make positive change in the world. When we hear people talking negatively about chemistry, we feel under attack, and we worry that the public don't understand us.

Many members of the Royal Society of Chemistry felt that, in the UK, the general public had a poor opinion of chemists and chemistry—a feeling often reinforced by alarmist tabloid headlines on topics such as food additives, pesticides and fracking. Our members wanted us to help change that.

But, even though we all felt like this, we lacked evidence. Despite a large body of evidence on public attitudes to science, there was very little data relating specifically to chemistry. Without data, any action we took would be based on guesswork. As our past president, Professor David Phillips, said: “chemistry is our profession, our passion, and we care about it so much that we are possibly a little biased. Perhaps we have become defensive due to poor press over the decades. But we should challenge this view and instead start thinking about public opinion in a more evidence-based way.”

So we commissioned an extensive piece of research to find out how the UK public really think and feel about chemistry. What is the true picture? Does chemistry really have an image problem? And what influence, if any, can we realistically expect to have on public perceptions?

Researching public attitudes to chemistry

Our research, *Public attitudes to chemistry*, [1] took over a year to complete, and comprised quantitative and qualitative phases. We commissioned this work from a leading social research company, TNS BMRB, whose team has extensive expertise in complex, multi-method research on public needs and attitudes around scientific and technical issues. In the qualitative phase, they carried out a literature review and conducted telephone interviews and a series of public focus groups. In the quantitative phase they held 2104 face-to-face interviews with members of the UK

public, using a random location methodology to maximise statistical accuracy. The data was rim-weighted to account for factors such as age, gender, and social grade. Throughout the process, we compared our results to the 2014 UK Public Attitudes to Science survey. [2] In addition to asking the public for their views, we also conducted an online survey of 450 chemists and RSC members to measure chemists' views of public attitudes to chemistry.

The results surprised us—and the news is good. Contrary to chemists' expectations, the majority of the public is generally positive towards chemistry, chemists, and chemicals. Most people believe that chemistry is important in daily life and contributes directly to economic growth. They also know that everything is made up of chemicals, that everything, including water and oxygen, is toxic at a certain dose, and that not all chemicals are man-made. This is in striking contrast to how chemists thought the public would respond. Only 12% of the chemists we surveyed thought that people would agree that chemists make a valuable contribution to society. In reality 84% of the UK public said so.

The most striking result, in fact, was not people's negativity towards chemistry, but their neutrality. When asked “How do you feel about chemistry?” half replied that they felt neutral. Only a fifth said they felt confused or bored and only 3% reported negative emotions such as being shocked, sad or angry. Almost one in three felt happy or excited. This might not seem to resonate with our personal experience, but it's important to remember how our perceptions can be distorted by a few negative incidents: a tweet or a blog post, or a frustrating conversation about chemicals. As scientists, it's important to step back from our emotions and look at the data. The very vocal minority does not reflect the view of the vast majority who in general, it turns out, don't have much opinion at all.

In the words of one of our focus group participants, “I don't really feel anything about chemistry... I don't know the sort of things that they do...” This was a common theme, and many people struggled to identify where a chemist might work, or what chemistry might be useful for. This represents a great opportunity for us. Instead of a negative attitude that we feel we need to combat, we instead have a void that we are free to fill with positive examples.

We asked people for their thoughts and feelings on chemistry, chemists, and chemicals and found that, unlike for us in the chemistry community, for the

general public these are three distinct concepts, with people having different emotions and associations for each one. This makes a big difference: someone who is anxious about, for example, 'chemical' additives in their food won't necessarily think that chemists are bad people or that chemistry is inherently dangerous. When we wrongly assume this, we become defensive, and this poisons our communications.

The public on: chemistry

Most people's first association when we mentioned chemistry was school memories, with many describing chemistry as 'one of the three sciences studied at school'. For some this meant a subject that was academic and difficult to understand, and made them feel inferior and insecure. "The only feeling that springs to mind is panic because I didn't really enjoy it at school", said one participant. Many were lacking in confidence, with 58% of women and 45% of men agreeing with the statement "I don't feel confident enough to talk about chemistry".

Most people were broadly positive, however, when prompted to think about 'the science of chemistry', with three-quarters stating that they felt chemistry had a positive impact on well-being. But they lacked real-life examples of the effects of chemistry, and thought of chemistry as serious, methodical, theoretical, and microscopic. This contrasted with their feelings about science, which they were more likely to see as fun, accessible, applicable, and a means of exploration and discovery.

The public on: chemists

When we asked people specifically about chemists, we encountered a problem peculiar to the UK: the word 'chemist' also means 'pharmacist' or 'druggist'. The association was even stronger than we had anticipated, with three quarters of people mentioning a pharmacy when answering "where do you think chemists work?", and a quarter being unable to think of any examples other than a pharmacy. This contributed to the disconnect people felt between the concepts of chemists and



72%

agree that **chemistry** research and developments make a direct contribution to economic growth in the UK



59%

of the public believe the benefits of **chemistry** are greater than any harmful effects

76%

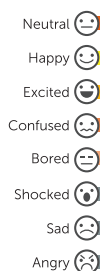
for **science***

55%

for **science***

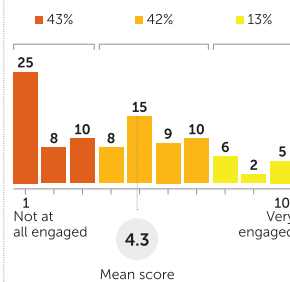
Public perceptions of chemistry are more positive than chemists expected

How do you feel about chemistry? (%)**



People don't have an emotional connection with chemistry

How engaged or interested are you with chemistry? (%)



Overall engagement is fairly low

60%

of the public agreed that "everything is made of chemicals"



70%

of the public agreed that "everything including water and oxygen can be toxic at a certain dose"



67%

of the public disagreed that "all chemicals are man-made"



88% of the UK public said chemists are approachable
But only

20% of the chemists we interviewed thought the public would have said so



84% of the UK public agreed that chemists make a valuable contribution to society
But only

12% of the chemists we interviewed thought the public would have said so

Public attitudes to chemistry is a study conducted by TNS BMRB on behalf of the Royal Society of Chemistry.

TNS BMRB conducted qualitative research followed by 2,104 face-to-face interviews with UK adults aged 16+. Interviews were conducted between 13 and 25 February 2015 on the TNS omnibus. For more details on the methodology and data visit rsc.li/pac

*Ipsos MORI Public Attitudes to Science 2014

**Multi-coded questions represent % of respondents who select each category, but respondents can be in more than one category.

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chemistry. “Chemists and chemistry are two separate things,” said one interviewee, “‘chemists’ takes people to pharmacist, but ‘chemistry’ takes you to the lab”.

After we reframed the concept of a chemist as a ‘scientist who works in chemistry’, however, the results were once again surprisingly positive, with 95% saying they thought chemists made a difference in the world, 93% saying they were honest, and 88% that they were approachable. Once again the chemists themselves were wide of the mark, with only 20% thinking that the public would view chemists as approachable.

Where chemical accidents and medical disasters were concerned, the public saw ‘corporations’ as the ones to blame, and very few people made a connection to chemists at all. They saw chemists as doing research behind the scenes and serving the interests of science, with the businessmen unscrupulously chasing profit. “Chemists don’t make these decisions,” said one participant, “It’s all about money, chemists are the pawns”.

The public on: chemicals

As with chemistry, the main feeling towards chemicals was one of indifference, with 55% feeling neutral towards chemicals, and one in five feeling happy or excited. The negativity anticipated by the chemists we surveyed did not manifest on anywhere near the expected scale. Less than 20% of the UK public believed that “all chemicals are dangerous and harmful” and over half of this sub-group still agreed that the benefits of chemistry are greater than any harmful effects. This reinforces our earlier conclusion: most people do not directly connect ‘chemicals’ with the discipline of chemistry. And so attempting to change attitudes towards one is not going to have any impact on how people feel about the other.

We need to accept that in everyday language people use ‘chemicals’ as shorthand for a synthetic and potentially dangerous substance. Most people do know that everything is made of chemicals, but they don’t use the word ‘chemicals’ in that sense. Their understanding of chemicals is nuanced and sophisticated, and they are capable of holding multiple and context-dependent definitions in their heads. To quibble about the precise definition of ‘chemical’ as we understand it is at best patronising and at worst it makes people suspicious and distrustful of our agenda.

The science of communication

As scientists, we should base our communication

strategies on evidence, rather than speculation. There is a science to communication. The more data we have, the more usefully we can tailor our approach. You may think you know how people feel about chemistry in your country. We thought we knew how people felt in the UK—but we were wrong. Fortunately, even though our survey is the first chemistry-specific one of its kind, there is already a huge body of evidence available globally on broad subjects, such as public attitudes to science, and specific topics, like animal research and climate change. This research is an essential starting point for any study of public attitudes and opinion.

The Eurobarometer [3] is a series of public opinion surveys conducted on behalf of the European Commission on a variety of topics, from unemployment to terrorism. This includes surveys on public attitudes to science and technology, where questions are asked about specific issues, such as chemicals, genetically modified crops, and the environment.

The Pew Global Attitudes project (US), the Korea Foundation for the Advancement of Science and Creativity, the British Council in Russia, and the China Research Institute for Science Popularization (CRISP) are only a few of the many organisations who have conducted national or international research into public opinion on issues around science and technology in recent years. A wealth of data is available. Unsurprisingly, variations and cultural differences abound.

And it’s not just surveys. The theory of public understanding and communication of science is a research topic dating back at least 30 years. [4] A number of different communication models have emerged. To reflect the different approaches, we tested out different chemistry engagement materials on audiences in our workshops. The materials that set out to tackle misconceptions about chemicals were the most controversial. In trying to unseat deeply-held views, we invited suspicion and aggravated people’s feelings of inferiority. “The chemists are trying to justify the man-made and destructive element of chemistry”, said one participant. “Why bother?—because I’m obviously wrong,” complained another.

This type of communication—in which we assume that someone will come round to our point of view if only we provide them with the right information—is known as the ‘deficit model’, [4] and has been widely discredited. This model says that, having been misinformed by the media, the public harbours irrational fears and make poor decisions. The supposed solution is to re-educate the public, improving their scientific knowledge and providing them with the correct information.

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It is easy to see why this approach persisted. In a 1988 a study of Public Attitudes to Science in the UK, over 80% of the public said that they were interested or very interested in science, but only 20% considered themselves to be well-informed. [5] This certainly indicates a deficit—between the information the public wanted, and the information that they were getting. But, in spite of a sustained campaign by the Committee on Public Understanding of Science disseminating popular science through the mass media, a follow-up study in 1996 indicated very little improvement in scientific literacy.

There will always be a gap in knowledge between scientific researchers at the top of their field and the lay public, as there is in every field. It would be strange if there wasn't. But improving scientific literacy can't be the only aim of science communication. Our efforts need to be less of a one-way lecture and more of a conversation. To communicate effectively we need to know our audience, their motivations, and their existing level of knowledge. We have to ask questions, find out where they are coming from and what they are worried about, and work out what they want to get out of the conversation. One-way 'engagement' is not engagement at all.

How to get the public to feel something about chemistry

For chemistry the biggest challenge is not suspicion and negativity; what we need to overcome is people's neutrality, disengagement and lack of confidence. This is due to a lack of positive images—or indeed any images—of chemistry and chemists reaching our audience. In the absence of alternatives, the public falls back on stereotypes. And they know they are stereotypes. They just don't have anywhere else to go.

So how can we provide more interesting images? Not necessarily through events such as science festivals, which can be self-selecting: they attract people who are already interested and who have some initial knowledge. In order to reach the neutral and the disengaged we need to go to the people, not ask them to come to us. In fact, science communication happens every day, in every conversation. Every time we introduce ourselves and what we do, we are communicating chemistry.

An easy place to start here in the UK is to address the confusion around chemists and pharmacists. Instead of saying "I am a chemist", we should try instead "I am a scientist, working in chemistry". We should also try and find out what the other person is interested

in and relate our work to that. For example, in our workshops we had a hugely positive response to engagement materials around the concept of everyday chemistry—things like cleaning and baking—and about key historical developments like the discovery of the contraceptive pill. After viewing our video that related chemistry to baking, one participant said, "It doesn't feel above me now... it feels parts of everything, not an academic subject". Our Communication Toolkit contains a summary of our research and tips for how to more easily communicate chemistry day-to-day, and is freely available on our website.⁶

Decades' worth of evidence shows that the public likes science and, because we chemists are scientists, they like us too. They just don't really know who we are. And now our research shows that we already have what we need to inspire people with chemistry: our passion for our subject. We should stop trying to teach chemistry to the public and instead show them how excited we are by its potential to improve our lives—which is why many of us became chemists to begin with. Enthusiasm is infectious, and chemists can be the most enthusiastic people I know. If we share the emotion of chemistry with the public, they will begin to feel emotional about chemistry. 🍷

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