

I was standing in front of a Wellcome Trust committee, trying to convince them to fund my project. Fifteen important people stared at me in silence, as I talked about washing poo off nappies, what a nightmare babies are and how new parents are mostly completely terrified (and covered in sick)

I started talking faster and faster. I wittered about how much nonsense advice new parents are subjected to, and how hard it is for them to find evidence-based information, and how our project would help. A poised woman at the end of the table raised an eyebrow and leaned forward. I suddenly realize she is Professor Alice Roberts, medical doctor, paleoanthropologist and TV goddess. I have never felt more like I was having an anxiety dream while I was awake.

*"But what good is this going to do? If I want to know some evidence-based information about child-rearing, I'll go to the peer-reviewed literature," she said.*

I have no idea what Sophia Collins, person with imposter syndrome, replied. I remember saying something. But what I SHOULD have said, as I realized 5 minutes later, and have remembered on numerous sleepless nights since, was, *"But Alice, you're a university professor with a medical degree, OF COURSE YOUR INFORMATION-GATHERING STRATEGY IS NOT TYPICAL OF MOST NEW MUMS."*



# Nappy Science Gang



If you've ever had a baby, you know that it's an earthquake in your life. The National Childbirth Trust (NCT) did some research into the experiences of new parents, and EVERYONE felt that they were 'uniquely failing' in the first few months. If you've not had a baby, but you think you might one day, remember these words when the time comes. Everyone feels like this. It's OK.

I've talked to people who were paediatricians, nursery nurses, primary school teachers, people who you'd think would have a bit of a head start. And they still all felt overwhelmed with the sudden responsibility, drowning in advice, but not knowing what to do for the best. As someone with a science background, you at least have some skills in finding and evaluating evidence. But if you've ever tried to read papers outside your field, you'll know how hard it can be, when you don't know the jargon, the methods, etc. Imagine how much worse it is for people who don't know what peer-reviewed literature means, let alone how to find it?

You have so many questions as a new parent. How do I get my baby to sleep? Why are they crying? How do I keep them alive until they reach adulthood? Will they die of meningitis? How do I provide a stimulating and loving environment for the next 18 years and help them grow into a happy and successful adult? How do I get sick out of this dry-clean-only jacket? And why was I wearing a dry-clean-only jacket around a baby in the first place, am I an idiot?

These and many more questions whizzed round my head during mammoth breastfeeding sessions in the middle of the night. It all felt so overwhelming, I eventually started fixating on one small, circumscribed area that felt like a raft I could cling to. We were using reusable nappies for environmental reasons. I started researching the best ways to wash them. And what I found was all sorts of different advice, trenchantly given.

'These nappy-washing guides can't all be right,' I thought to myself, 'surely it would be possible to perform some experiments to work out the best way to

wash reusable nappies? But it's a pretty niche product. Scientists aren't going to get around to this. But here are thousands of parents in all these Facebook nappy groups who really want to know the answer. Someone should do a user-led citizen science project about it. And help all these parents to design and run their own experiments to find out what they need to know.'

I realized that person was me, so I put in an application to Wellcome's People Award scheme and, happily, they thought it was a good idea and gave me some money. Nappy Science Gang was born.

Nappy Science Gang was a user-led citizen science project, run through a Facebook group. Facebook groups are where a lot of people get their parenting advice and support. And there's a whole world of nappy groups on there. On the first day, I put up posts in a couple of nappy groups, and soon Nappy Science Gang had 70 members. By the end of the project, a year later, we had 2,000 members. Scientists often don't realize how many members of the public are actually interested in their research. In that year, we had about 30 online Q&As with different experts. When we asked for their feedback afterwards, they would often say, "*I was amazed so many people wanted to know about our work.*" If the topic is relevant and the format works for them, and is not too intimidating, lots of people really are interested in science. Even the people who don't think of themselves as 'sciencey' and who dropped science in school early.

I also have good news for microbiologists, if you are wanting to engage parents of small children. Parents talk about pretty much nothing but poo and sleep for the first year of their child's life. And as poo is mostly microbes, it's pretty much your area.

We asked our members who they wanted to talk to, and they wanted microbiologists, detergent experts and washing machine designers. They wanted public health and infection control experts. They wanted epidemiologists and textile experts. They wanted to know about biofilms, and water chemistry. But most of all, they wanted to know, what is the best washing

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agent to use to wash my nappies? And what is the best temperature to wash them at?

So we talked to all these people, and we found out what we could. But none of them could answer those last two questions. So (with some advice from scientists), the group set out to design some experiments to answer them. Around this time, we were contacted by Dani Sharlott, a mature student doing an MSc in microbiology. She used reusable nappies with her children and was interested in what we were doing. She offered to do tests for us in her lab, as part of her MSc project, which was a godsend for us, and also helped her out. We gave her an interesting project, we paid her equipment costs, and we sent her a fortnight's worth of groceries and ready meals from Ocado, to make sure she could finish all the tests on time. So, MSc students, it's always worth giving it a try.

The group spent months discussing how to design the experiments to be scientifically rigorous. For the washing agent experiment, they wanted the test to be blind and to test a range of different detergents, but also 'soap nuts' and 'Eco Eggs', which are commonly utilized by some reusable nappy users as they are marketed as an environmental choice. (An Eco Egg is a reusable plastic egg filled with magic beans, sorry, ceramic pellets, which some people use instead of detergent. Feel free to google 'Nappy Science Gang Eco Egg' if you want to know more about our thoughts on this.)

It's easy to put scoops of mystery detergents in small plastic bags (labelled A, B, etc.) and the recipient won't know which one is which when they are putting them in the machine. But how do you blind an Eco Egg or soap nuts? Especially when the Eco Egg clunks around making a noise throughout the wash? In the end they decided each experimenter needed a spare Eco Egg shell and a confederate. The confederate (partner, neighbour, etc.) would put the washing agent into the machine. And put the empty Eco Egg shell into every wash (unless it was the Eco Egg test, in which case they would put the filled Eco Egg in). This was a slightly awkward experimental design. But as the experimenters were also the experiment designers, they understood the reason for the faff, and were very committed to making the experiment work.

We then realized another possible obstacle. Someone in the group suggested it might be an issue sending small bags of white powder through the post. So we phoned Royal Mail and asked them. It turns out that, no, you are not allowed to send unidentified white powder in small Ziploc bags through the post. Their workaround was that we would need to put a label on each bag, listing all the ingredients, which would rather defeat the object. Eventually we found a courier firm who would take it, if Wellcome sent them a letter certifying that it was all for a scientific experiment. So, should you ever need to send small bags of white powder through the post, there's how to do it.

Once experimenters got their packs through the post, they used each of three mystery detergents, three times in a row, on their normal nappy washes. Then they scored their nappies for look, feel and smell, and swabbed them, and sent the swab off to Dani Sharlott, in her lab, for culturing. What we found was that:

1. Swabs from nappies washed in biological washing powder plus 'miofresh' nappy sanitizer resulted in the fewest bacterial colonies.
2. Swabs from nappies washed with soap nuts or Eco Eggs gave the most bacterial colonies.
3. Untrained volunteers will vary quite a lot in how they interpret swabbing and labelling instructions.
4. You should always do a test run/pilot to hopefully avoid problems from #3. Even if you think you don't have time. ESPECIALLY if you think you don't have time.

We asked the participants what they had learned from designing and running their own experiment. They said, *"That designing experiments is hard."* So we think they've had a great insight into science...

What they also got, was a real, memorable insight into how experiments work and how you design them. They understand variables and how hard they are to control for. And they understand these things in an internalized way that's different to memorizing a list to pass your GCSEs. Our hope, as a project, is that this gives them

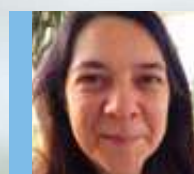
tools they can use to evaluate scientific information during the rest of their parenting life.

And this is why, a year later, I found myself standing in front of 15 eminent strangers, talking about finding sick on your sleeve in a supermarket, and why new parents needed help. And how a bigger project – Parenting Science Gang – could give it to them. With this project, we have taken the Nappy Science Gang model, and expanded it, to work with eight different parenting groups from Facebook, and are giving them each the chance to design and run their own experiment to answer a question that matters to them. Each group has managed to find a topic which science has overlooked, and design and run their own experiment to answer it.

I think the key to why this approach works is that many ordinary people are really interested in what science can do, and what scientists know. And also they have insights that the scientists themselves may not have, into their experiences and what matters to their day-to-day lives. Non-scientists (who are members of the group affected by your research) can be the perfect collaborators. And if you give them some real say, they will work hard to engage with you.

One of our groups is a breastfeeding support group who really wanted to know more about the composition of breast milk produced for older children. Almost all published research on what's in breast milk focuses on the first few weeks. A few papers look at months. A single, recent, longitudinal study, looked at how breast milk changes up to 17 months post-partum <https://www.ncbi.nlm.nih.gov/pubmed/26776058>. We know that human milk contains oligosaccharides which the baby can't digest, but their intestinal flora can. We know that the gut microbiome of the child continues to change for several years. We know that the traditional weaning age for human infants is between four- and seven-months-old. But we are far from understanding the relationship between breast milk and the microbiome. And our volunteers had questions.

Our volunteers, in collaboration with Dr Natalie Shenker and Dr Simon Cameron of Imperial College London, designed a cross-sectional study, where over 100 breastfeeding mums, with nurslings of different ages, came and donated a sample of breast milk, to be tested in a mass spectrometer. Dr Cameron said afterwards, *"At first, I just thought, oh, this is an interesting new substance to test in my new machine. And then, when I started looking at the results, I realized, this research could make a difference to every single human being."* One way to make a difference is engaging the public.



**Sophia Collins**  
Director, Parenting Science Gang