

# NGSSA NEWS

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# 2019 – A Landmark Year for NGS

By Mei Weidong and Zhang Lian and Liam Fisher

This year marks the 11th year of the NGS symposium. The symposium has established itself as an annual tradition for all NGS students to learn valuable knowledge beyond their own disciplines. NGS students can showcase their research to all attendees, whether in the oral presentations or poster sessions. This year's symposium adds a new three-minute thesis competition. The participants need to present a brief overview of their research topic and interact with the audience. The winner is decided by the popularity of its presentation among the audiences, rather than by the assessment of the professional judges. Every attendee is free to speak and gain something beneficial from the NGS symposium.



## NGS Symposium 2019: Keynote

This year the theme of the symposium was “towards sustainable development”. We had the honour of Professor Armin Aberle giving us the keynote speech. He first emphasized the extensive efforts that should be made for the goal of achieving a sustainable environment. As the CEO of SERIS (the Solar Energy Research Institute of Singapore), Professor Aberle's main contribution to environmental sustainability is the development of improved renewable solar

technology. The global deployment of photovoltaic systems has had a breathtaking upward trend so far. Aberle suggests that a boom in photovoltaic installations is conceivable in the future, thus helping to reduce further damage to the environment. Several real-world examples of solar energy installations were included in his engaging and motivating talk. Even the researchers outside this field could gain a deep understanding of the notion of sustainable development and appreciate the progress that is being made towards solving the current environmental issues.



## NGS Symposium 2019: Panelist

After the lunch break was the panel discussion. This year we invited three NGS alumni to share their thoughts on life during and after the PhD. All of them are currently working in Academia and gave us valuable advice for doing good research. Dr. Melissa Fullwood, who is now an Assistant Professor in NTU, emphasized the importance of a clear hypothesis from the beginning of a research topic. Dr. Tam Wai Leong, currently working in A\*STAR as PI, said the most important trait he wants to see when recruiting scientists is the right attitude toward

research. Dr. Valerie Chew, who is also an



Assistant Professor of Duke NUS, shared her personal experience of struggling with the Qualifying Examination and encouraged us to network with researchers in the same field. In the light of Women’s Day, a discussion about gender equality was brought to a passionate level. The discrimination still exists in today’s research world just like everywhere else. Dr. Tam gave examples of female scientists in his group who strike a perfect balance between work and life and tend to be more understandable and responsive to feedback. Dr. Melissa rebutted this statement, as she feels female scientists are usually being stereotyped rather than directly discriminated against. Underestimation of women’s’ professional capability and overestimation of their

interpersonal skills are both unfair. Eventually, the two female scientists expressed confidence that the situation can be resolved by time, as more female scientists become involved in this field. After a final round of student presentations, this year’s symposium ended with the prize giving and closing ceremony.

### NGS 15<sup>th</sup> Anniversary Dinner

NGS celebrates its 15th Anniversary this year. To mark this important milestone, NGS invited all supervisors, students and alumni to attend an anniversary dinner. This celebration offers a rare opportunity for the alumni to reunite with their old friends and buddies after a long time, or for current students to catch up with their peers from other parts of the campus. Thanks to the dedicated photographers, every great moment in the dinner was recorded. A special part of the anniversary dinner was the “NGS Got Talent” segment. The participants showed their great artistic abilities in dancing, singing and musicianship. Following the creative talent show, there was an on-site quiz on the history of NGS. All guests forgot for a short time about their busy schedule and focused their thoughts on the competition to win the tempting prizes.

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## SOUND SCIENCE

# Wired for Music

by Moaz Waqar and Liam Fisher

“Playing music to a cow” is an old Chinese proverb from the story of brilliant musician Gong Mingyi, who believed himself to be so talented that his performances could even impress a farm animal. When he actually tested

his theory, the cow in question was visibly more interested in chewing grass than following Gong’s serenade. The phrase is now metaphorically used to describe any mismatch between high artistry and an unsophisticated



audience. However, researchers at the University of Leicester have found that cows may not be as tone-deaf as first believed. Playing calming music to cows can result in an increase in milk production by as much as 3% [1]. In addition, Kobe Wagyu beef is produced from cattle pampered by classical music, among other comforts. Whether this practice really alters the quality of the steaks or only serves to bolster their luxury mystique is unclear. But even if music has some effect on cows, does this mean cows can appreciate a song in the same way as a human does? Music is traditionally considered an artistic domain, but scientific revelations have provided new insight into how music is interpreted by both humans and animals.



### Tale as Old as Time

Physically, sound is the compression and expansion of air. Uncontrolled sound is simply noise, but with the deliberate application of pitch and rhythm, it can become something more. Music is not a recent human invention; the oldest found musical instruments are bone and ivory flutes estimated to be approximately 40,000 years old [2]. Perhaps humans have always been inherently musical creatures, our lives forever accompanied by the steady rhythm of our own hearts. Our brain stem and cerebellum also make rhythms, to help us walk, which is a trait that we share with other

nonhuman primates. Whether these internal rhythms or other human physiological features have anything to do with our appreciation for music is an interesting idea, raising the question of how music might be understood by other animals with different anatomy.

### Blackbird

Snowball, a male cockatoo, is the first nonhuman animal shown to be capable of perceiving music by tapping along to the beats. This ability has earned Snowball millions of views on YouTube, and the rarity of this ability in the animal world has garnered the interest of both internet audiences and the scientific community. However, Snowball is not the only animal to respond to music in this way. A 2016 review of ‘rhythmic entrainment’ found evidence of this behaviour in other animals, including primates (a chimpanzee, a bonobo, and Japanese macaques), a sea lion, and a horse [3]. It was noted that fireflies can match the rhythm of their luminescent flashes to the ‘music’ of the flashes of their neighbours, but it was argued that this is not comparable to the response of the more complex animals because it is a reflexive trait that the insects cannot control. Noting that the sea lion could at first only move to a plain, metronomic beat, and was only able to find the beat in complex songs after further training, the authors conclude that it is likely many species may in fact have this capability, but lack the appropriate conditioning to express it properly. “Other species will filter out the stimulus via attentional mechanisms, fail to hear the beat embedded in the stimulus, choose not to initiate the behavior, or lack the motor control to produce a repetitive behavior that is not part of their natural repertoire. Greater neurological sophistication can lead to apparent failures of entrainment, but for

reasons that yield insights about the animal's cognitive architecture.”

There is also evidence that some animals can appreciate an unspecified quality of music they hear, even if they do not necessarily have the ability to ‘dance’ to it. In 2013 Japanese researchers published results of a study where they trained goldfish to differentiate between the compositions of Johann Sebastian Bach and Igor Stravinsky [4]. This is an interesting paper, partly because their IACUC allowed the fish to be forcibly exposed to Stravinsky, but also because the goldfish could differentiate between the two styles of music but did not have a preference for either one. A similar experiment with sparrows showed that they could also be trained to tell the difference between the two, but did have a preference (correctly, for Bach) [5]. Different animals may be able to perceive elements of music, but the neurological mechanism for having an emotional response appears to be independent from this.

### Feel Good Inc.

In humans, music can produce the same sensations in the brain as other pleasurable experiences do, such as eating delicious food and talking to a loved one. “Listening to the music you love will make your brain release more dopamine, a crucial neurotransmitter for humans’ emotional and cognitive functioning” says Luara Ferreri, an associate professor in cognitive psychology at the University of Lyon [6]. Professional athletes listen to music to calm their nerves and to increase their motivation, so they feel ready to compete. Listening to music with faster, driving beats can boost athletes’ spirit, increase reaction speed, and improve their emotional state. [7] Music is processed by the same parts of the brain which process

movement, balance and coordination. Rhythms can therefore be used for medical rehabilitation, known as neurologic music therapy [8]. Music can facilitate movement and gait improvement in people with Parkinson’s disease, known as rhythmic auditory cueing. Music has also been used to help people with speech disorders. People who cannot utter even one or two words in a sequence can sometimes sing a whole song fluently. Brain injury or neurological disorders can lead to the loss of speaking ability, but even if the parts of the brain responsible for processing speech are damaged, music can help to train other parts of the brain to take over this role. Anecdotally, some students find that listening to music helps with memorization, or to concentrate and focus while reading. The effects that music can have on the brain are complex, and perhaps we are only beginning to realize their significance. Although animals do not appear to share the same level of understanding of music as humans do, it is possible that to some extent we are all wired for music.

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## SCIENCE IN SCI-FI

# Netflix's Black Mirror: A Looking Glass into the Future.

by Cavin Ng and Liam Fisher

Netflix's sci-fi anthology series Black Mirror is an immediate conversation starter among any of its viewers. It frequently explores the idea of current or upcoming technology leading society down a slippery slope, and this not only makes for good entertainment but is thought-provoking for any potential stakeholders. The most frightening episodes are those when the science is tangible in the present day, for instance the episode "Metalhead", where a terminator-esque AI 'dog' pursues a group of human survivors. The design of the fictional robot drew heavy influence from Boston Dynamic's own robotic creatures. For any scientist watching Black Mirror, the issue of 'dual-use research of concern' should become apparent even when only part-way through binge-watching its 20 episodes. Here we consider "Nosedive" (Season 3 Episode 1) and



"Arkangel" (Season 4 Episode 2) as hypothetical situations for a discussion on technology and ethics. If you have yet to watch these, beware because spoilers are ahead.

## "Nosedive"

Nosedive introduces us to Lacie Pound, living in a futuristic world where everyone can rate

every interaction they have with others, similar to the rating system we use today for private-hire vehicles like Grab. The 5-stars rating system regulates everyday life to the extent that certain events or neighbourhoods require a person to have a minimum number of stars in order to enter. A cascade of unfortunate events causes Lacie's score to plummet, and her initial obsession with the ratings is transformed into a realization of the freedom she gains by ignoring them. A rating system that totally permeates society may seem far-fetched but has been prominent in the service industry since the advent of social media. Yelp, Tripadvisor, Zomato, and Google are applications we use to pre-emptively avoid a disastrous experience and steer us towards establishments with high ratings. While high ranking doesn't guarantee a good experience, a bad rating serves as an effective deterrent for anyone with access to the internet. A rising trend in tourism is 'Instagrammable Places', which might not have any historic or entertainment value, but are highly photogenic and thus look amazing on one's social media profile. Our obsession with ratings has become more and more obvious over time. Oobah Butler, a writer for VICE, became the owner of one of TripAdvisor's top attractions by serving reheated frozen food from his shed. He was able to manipulate the ratings with fake reviews and a bogus website. This journey of how the shed snowballed its way to the top was documented on Youtube, in a video aptly titled "How to Become TripAdvisor's #1 Fake Restaurant." On the other end of the spectrum, a new video series by VICE called "One Star Reviews", sends their reporter to get a service done (eg. Haircut, Tattoo) from Yelp's worst-rated shops, to evaluate the true quality of the service and to investigate the repercussions of having a one-star rating. Real-world ratings systems are not

exclusive to the service industry. The Peeples app was launched in 2016, giving users the ability to review people "based on professional, personal and romantic relationships." It was redesigned during its development after it was criticised for potentially enabling cyberbullying and harassment. China's Social Credit System aims to give a standardised assessment of one's economic and social reputation. Using big data analysis to evaluate citizens and business, a low social credit ranking indicates low "trustworthiness" and thus imposes restrictions on flights, trains and even hotels. With reviews and ratings becoming more accessible for anyone to read and write, should we be placing so much emphasis on judging a book by its cover? The Nosedive episode could very well be vision of the future.

### "Arkangel"

The Arkangel episode is a story about a single mother, Marie, watching over her daughter, Sara, as she grows up – all the way from a toddler to a teenager. In this world, the 'Arkangel' medical implant allows Marie to comprehensively monitor Sara. Synced to a tablet, Marie can check Sara's health condition, location, see what Sara is seeing, and even control what Sara sees, by automatically pixelating her view of any violent or adult scenes in realtime. While the Arkangel implant seems useful for young Sara, things start to go awry as she ages, as the blanket censorship of her reality leaves her emotionally stunted, and permanent access to her field of view and location allow her mother to invade her privacy. A clear theme of this episode is the issue of "helicopter parenting" where a parent figuratively hovers around their child, constantly attempting to control every aspect of their child's life and development. As a scientist, the ethical issues should be apparent.



The intended use of the fictional Arkangel device is to protect vulnerable children, and as with many decisions involving children, the child has limited agency. The choice of getting the implant therefore lies with the parents. Both the parent and child benefit from Arkangel initially, however as the child grows up, the implant becomes useless or even harmful to the child, and only serves a purpose for the parents. The critical feature of Arkangel is that the implant is non-removable and cannot be disabled. The duty then lies with the parents to discard the tablet when their child is no longer vulnerable, and ready to live in an unmonitored, unsanitised world. In hindsight, the inventors of Arkangel were naïve to assume every parent would eventually put their child's interests ahead of their own. It is the due diligence of inventors to anticipate the ethical implications of their device, not only during the intended period of usage, but the entire lifetime of the product. A real-life example of this is radioactive waste from nuclear plants. When a radioactive source is spent, unable to generate electricity, it becomes waste. Radioactive waste still contains dangerous amounts of radioactivity and thus international efforts were made into exploring different ways to dispose of it. The current consensus is a holding period (50 years) before geological disposal. Different types of waste are categorised so that a safe and standardised disposal can be carried out for each type. Radioactive waste disposal is non-trivial, and fortunately for the environment it has not been taken lightly.

The science behind Arkangel may seem unrealistic, but remotely monitoring one's health is one of the goals of biomedical engineering. Lab-on-a-chip refers to a class of microchip devices that can perform numerous medical tests, possibly implantable within the human body. Recent advancements in machine

learning for image recognition mean a device that can identify undesirable sights is within the realm of possibility. However, an implant that can either intercept the neural signal sent from the eye to the brain, or manipulate the way the brain interprets that signal, currently seems fantastical. A more realistic implementation of the Arkangel censorship function might involve an externally worn augmented reality device, similar to Google Glass.

Black Mirror may often explore these slippery slopes to achieve a dramatic ending that leaves viewers entertained. However, the series serves as a reminder that technology does not always follow the path its inventors envision for it. There is a common saying, "the road to hell is paved with good intentions". How can we be sure that the work that we are doing may not result in unintended consequences?

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