I BET YOU DIDN'T KNOW...

that computers can measure the happiness of a city.

PSTT College Fellow **Dr Rebecca Ellis** links **cutting edge research** with the **principles of primary science**

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Happiness is not an easy parameter to put a number to. Do we measure smiles? How can we differentiate between a grimace, a polite smile and true pleasure? Emotion measurement does not seem like a natural area for a computer to be more effective than a human. However, Chinese researchers[1] have found them very useful to measure how air pollution affects the happiness of their population.

Children will know what makes them happy. From eating chocolate to scoring a goal, there are many things that can bring a smile to their faces. Try measuring what makes the class happiest by identifying reasons to be happy. Then give every child two votes to cast anonymously. Produce a pictogram to show which activity makes the class happiest.

But how can scientists measure happiness?

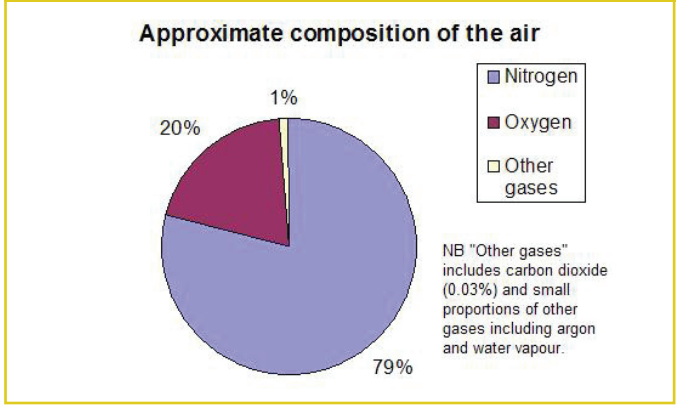
Their method was to construct a daily city-level happiness measurement, based on the feelings in the contents of 210 million geotagged tweets on the Chinese largest microblog platform, Sina Weibo. This is a government-monitored social media platform, often just called Weibo (pronounced 'way-bo'). It is very popular in China, despite the government control, and combines features of YouTube, Facebook and Twitter. Users tend to post more frequently than those on Twitter and the posts are more personal[2]. The researchers applied a machine-trained analysis tool and the people were unaware that their happiness was being measure in this way, which may make the results more convincing.

The scientists were comparing happiness of the population to the quality of the air in the cities.
To understand air pollution, children may need to explore what air is. The Science Museum's rocket mice[3] demonstration is a fun way to demonstrate that the bottles are filled with air rather than 'nothing'. If there is time, children could investigate the relationship between bottle size and height of 'mouse'.

Do the children know what air is made from? You could demonstrate the presence of oxygen in air by burning a candle (Figure 1). Safety guidance for using candles in the classroom is available from CLEAPSS[4]. Most of the rest of air is a gas called Nitrogen (Figure 2). Use the analogy that if air was their hand, four fingers would be Nitrogen; the thumb Oxygen and half the nail of their forefinger other substances.

*Figure 1: An experiment to show that a lit candle uses oxygen from the air in order to continue burning. If you limit the amount of air available, the candleZs Jame eventually goes out when there is insuCcient o xygen to sustain it. ©Suzette, licenced through Creative Commons and accessed **here***

*Figure 2: Composition of air. ©Charlie123, licenced through Creative Commons and accessed **here***



What are the other gases making up the final 1% of air? We need careful observations and tests to work out which gases are there. On 'Explorify'[5], show Fantastic Flicker (or try to demonstrate this yourself). This shows that candle smoke is made up of vaporised wax which can cause the flame to 'jump' and reignite the candle without touching it!

There are invisible solids in the air too. Hold a tile just above a burning flame for a few seconds and show the children the black soot marks. Wipe them away to show that the tile has not burnt. The tile collects the tiny unburnt soot which is produced when most things burn.

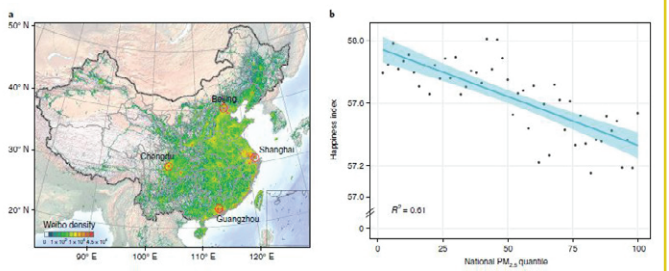
In this research, small particulate pollution (called $PM_{2.5}$ concentration) was recorded and compared to the daily happiness index. $PM_{2.5}$ measures fine particulate matter with diameters equal or smaller than 2.5 µm, which is the most prominent air pollutant in Chinese cities (Figure 3). Particles this size (ten times smaller than the width of a hair[6]) can hang in air for a long time and are so tiny they can enter deep into the lungs. This increases cardiovascular and respiratory disease, and cancers. In 2016, the Word Health Organisation estimated that exposure to $PM_{2.5}$ air pollution caused 4.2 million premature deaths worldwide[7].

*Figure 3: Air pollution in Beijing. © Kentaro IEMOTO, licenced through Creative Commons and accessed **here***

To find out whether this type of pollution changed people's happiness, the scientists plotted a graph with 'happiness index' on the y-axis, against $PM_{2.5}$ levels across the x-axis (Figure 4).

We could ask children to draw a 'predictive graph' to show what they think the scientists' results were. How does their prediction compare to the actual results? The trend is for happiness to decrease as the PM2.5 increases. All the points aren't exactly on the line. What other factors might be involved? **The paper[1] reports that happiness was higher at the weekends and when there was national 'good news'. Increased cloud cover decreased happiness, as did extreme temperatures (17.5ºC was the 'ideal'). They also found that women were slightly more sensitive to the pollution levels than men.**

*Figure 4: **a**. The four Chinese cities where happiness and pollution were compared. **b**. the relationship between PM25 concentration and the happiness index. (The happiness index ranges from 0 to 100 where larger values indicate a more positive mood).*



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The results from this research could help Chinese scientists to continue to campaign for improvements in $PM_{2.5}$ levels, which is good for the Chinese people and for the environment. The use of social media combined with a computer to measure happiness is new and very clever. However, the scientists identified weaknesses with the method; the views of the elderly may not be fully represented because they do not use social media as much.

How do the children feel about the government monitoring social media? What are the positives and negatives? Currently, the governments in other countries, including the UK, are trying to improve the way that social media sites regulate their content to prevent violent or inappropriate content. YouTube, Facebook and other social media companies have defended their self-regulation records[8]. Government intervention might lead to people feeling that they have less freedom of speech; they might be unable to disagree with the government. Considering how dangerous $PM_{2.5}$ levels are, does this work justify government monitoring social media in other countries as the Chinese government has?

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The research paper that generated this work was:

Air pollution lowers Chinese urbanites' expressed happiness on social media

by Siqi Zheng [1,6*], Jianghao Wang [2,6], Cong Sun [3*], Xiaonan Zhang[4] and Matthew E. Kahn[5]

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