High-powered computer sees red

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In almost all human cultures, colors are associated with different emotions such as hate, love, anger and sadness.

Now for the first time, scientists have used machine learning to analyze how we associate particular emotions with particular colors and say the results mean the application of this type of artificial intelligence is likely to become much more common.

The research team included five psychology researchers and one computer scientist, Dr. Joerg Wicker from the University of Auckland.

The researchers collected raw data from an online survey of 711 people from China, Germany, Greece and the United Kingdom. Participants were given a list of 12 color names and asked which emotion they associated with which color. They had 20 emotions to choose from including love, hate, sadness, guilt and disgust.

The study used machine learning—the ability of a computer to learn from data rather than having to be programmed—to analyze the survey results.

Dr. Wicker says the computer was able to detect hidden patterns in the data and a higher number of patterns than more orthodox methods.

After being trained to produce a particular model based on the data, the computer was able to determine the country someone was from by the emotions they associated with a particular color.

It was also able to predict which color participants meant when they listed the emotions they associated with it: if a participant said I associate this color with love and anger, the computer knew they meant red.

Machine learning did however produce more accurate results from the data if it was from people who came from a single country: for example results were more accurate if all the survey participants were from

China.

It also found it easier to classify some colors when a color association was consistent across participants from different countries: for example red is commonly associated with love in many cultures.

Other findings included the association between the color brown and disgust which was stronger in Germany than other countries, including in China where it was almost non-existent. Participants from Greece were the only group that strongly associated purple with sadness while white was frequently associated with negative emotions in China compared with the other countries.

Dr. Wicker says that, as a computer scientist, the study was both challenging and rewarding.

"Machine learning and data mining is my field of interest and I feel really strongly that this type of data analysis should be applied in other disciplines such as psychology or any research on emotion.

"This work contributes directly to fundamental understandings in psychology research and wouldn't have been possible without applying machine learning."

Associate Professor Paul Corballis from the University of Auckland's School of Psychology, who was not involved in the current study, says the novel machine learning approach taken by the researchers revealed patterns from a complicated dataset that would be more difficult to detect using traditional methods.

"The way we associate color with emotion addresses a very old question in psychology: is our response to color innate, that is, hard-wired, or is it determined by culture and therefore learned?" he says.

"I think a really interesting aspect of this latest study is that it goes some way to resolving this question by suggesting response to color is both innate but is also modified by culture."

The study is published in *Royal Society Open Science*.

Provided by University of Auckland