

Can the colour of your shirt really influence the outcome of a fight, a soccer match or even your mark in an exam, asks **Daniel Elkan**

# Winners wear red



**I**MAGINE you are an experienced martial arts referee. You are asked to score a number of taekwondo bouts, shown to you on video. In each bout, one combatant is wearing red, the other blue. Would clothing colour make any difference to your impartial, expert judgement? Of course it wouldn't.

Yet research shows it almost certainly would. Last year, sports psychologists at the University of Münster, Germany, showed video clips of bouts to 42 experienced referees. They then played the same clips again,

digitally manipulated so that the clothing colours were swapped round. The result? In close matches, the scoring swapped round too, with red competitors awarded an average of 13 per cent more points than when they were dressed in blue (*Psychological Science*, vol 19, p 769). "If one competitor is strong and the other weak, it won't change the outcome of the fight," says Norbert Hagemann, who led the study. "But the closer the levels, the easier it is for the colour to tip the scale."

This is just the latest piece of research

suggesting that exposure to certain colours can have a significant effect on how people think and act. Up to now most of the research has focused on red clothing in sport, but other colours and settings are being investigated too. It is becoming clear that colours can have an important, unappreciated effect on the way your mind works – one that you really ought to know about.

The powerful influence of colour on sporting success was first discovered a few years ago, when evolutionary anthropologists





"There is now good evidence that the colour red is perceived as dominant"

Russell Hill and Robert Barton of Durham University, UK, were looking for some way to test the idea that colours influence human behaviour. The 2004 Athens Olympics were coming up, and it dawned on them that in some Olympic combat sports – boxing, taekwondo, Graeco-Roman wrestling and freestyle wrestling – competitors are randomly assigned a red or blue kit. "We realised that this was a ready-made experiment to study the effects of colour on match outcome," Barton says.

When they analysed the results they found

that shirt colour appeared to influence the result, with nearly 55 per cent of bouts being won by the competitor in red. In closely fought bouts it was 62 per cent (*Nature*, vol 435, p 293). "It should have been roughly 50 per cent red, 50 per cent blue, and this was a statistically significant deviation," Barton says. "Skill and strength may be the main factors – if you're rubbish, a red shirt won't stop you from losing, but when fights were relatively symmetrical, colour tipped the balance."

Barton says that the differences may be accounted for, to some extent, by a referee's unconscious preference for red – which he argues is an inherited preference – as seen in the taekwondo experiment. He also believes colour affects the combatants' mood and behaviour. "There is now good experimental evidence that red stimuli are perceived as dominant and that they cause negative effects on performance in those viewing them," Barton says. "It is plausible that wearing red also makes individuals feel more confident, although this hasn't yet been tested."

Red also appears to exert its influence in team games. Last year, a study of 56 seasons of English soccer, led by Martin Attrill at the University of Plymouth, UK, found that, on average, teams whose first-choice kit was red finished higher in the league and won more home games than teams in other colours – which might go some way to explaining why Liverpool, Manchester United and Arsenal have won 38 out of 63 league titles between them since the second world war (*Journal of Sports Sciences*, vol 26, p 577).

An unpublished analysis by Hill and Barton of the Euro 2004 soccer finals in Portugal found that teams who had red as the main colour in one of their kits won more often and scored more goals when playing in that strip.

Meanwhile, a group led by Iain Greenlees at the University of Chichester, UK, found that goalkeepers felt more confident about saving penalties from footballers wearing white shirts rather than red (*Journal of Sports Sciences*, vol 26, p 569).

Clearly the effect of wearing red is strong enough to tip the balance of fights and soccer matches, but where did it originate?

One possibility is that red is simply easier to see than other colours. In common with other primates, humans have a trichromatic visual system which probably evolved to allow us to easily see red (therefore ripe) fruit.

"It is plausible that visibility differences could have some effects," Barton says, though this would be unlikely to make a difference in hand-to-hand combat. "We checked this explanation in football, predicting that red- ➤



"Teams who had red as the main colour in one of their kits won more often and scored more goals"

Would England have won the 1966 World Cup in another colour strip?

shirted football teams would have increased accuracy in passing. But we find no such effect. So visibility doesn't seem to be the answer."

Instead, most researchers believe that red directly affects how you perceive the wearer of that colour. In nature, red is often used to signal dominance and aggression, and in humans this is reinforced by cultural symbols such as warning signs and stop signals.

One of the first scientists to explore the effect of red on animal behaviour was Nobel prizewinning ethologist Niko Tinbergen. Around 60 years ago he noticed that whenever a red postal van parked outside his window, the sticklebacks in his aquarium would adopt an aggressive head-down posture normally reserved for encounters with rival males.

Primate behaviour is also strongly influenced by red. Joanna Setchell of Durham University found that mandrills, the world's largest species of monkey, use colour as a means of conflict management. In males, red faces, rumps and genitalia act as a status symbol, communicating fighting ability. "The brighter red a male is, the higher his testosterone level and the more aggressive he is," Setchell says. Between males of similar redness, threats, fights and tense stand-offs are frequent. Where there are large colour differences, the paler male usually stands down (*Ethology*, vol 111, p25).

"Mandrills are powerful animals and have long canines, so any physical conflict risks death," says Setchell. "Fights are costly to everyone, but through this adaptation these males actually avoid fighting."

Other primates use more subtle variations in facial redness to signal dominance. Rhesus monkeys, for example, become redder in the face in the mating season.

## That red flush

Barton believes that red is involved in human behaviour in a similar way. "Subtle variations in redness are conveying information about dominance, vigour and confidence. In an aggressive confrontation, confident individuals flush red with anger whereas frightened individuals go pale. There is evidence for the physiological underpinning of that, with shunting of oxygenated blood to the periphery." Barton points out this is different to blushing because there the redness tends to spread upwards from the neck and can be curiously patchy. He says the context of blushing would also be different.

Recent evidence supports the idea that red exerts its effect on humans via perceptions of dominance. In an experiment, Hill and colleague Tony Little showed 105 volunteers different coloured circles and asked them to indicate which would be "most likely to win a physical competition" and which circle looked "most dominant". Red won hands down (*Journal of Evolutionary Psychology*, vol 5, p 161).

Is this response to red innate or learned? Again, animal experiments give some clues. In July, Sarah Pryke at Macquarie University in Sydney, Australia, published the results of a study into Gouldian finches, which, depending on their genes, have either red or black head feathers. "Red-headed birds dominate black-headed ones," Pryke says. "I wanted to find out whether this results from nature or nurture."

Pryke raised newly hatched chicks with red or black heads in different family groups, so that they grew up in isolation or with adults of both head colours. She now had birds with black or red heads and various experience of colour. Next, to test what difference their experience of colour made, Pryke painted the juveniles' heads either red, black or blue (as a control) and put them into 20-minute contests, where two birds would compete for space at a bird feeder (*Animal Behaviour*, vol 78, p 393).

The results were striking. Red-headed birds won the contests every time, regardless of their inherited colour or the upbringing of both combatants. "Painting the birds did not make them act more aggressively, but they won the food contests because the other birds wouldn't challenge them at the feeder," Pryke reports. "All the birds reacted strongly to red-







Wearing red means you are more likely to be asked on a date

painted birds – even ones that had never seen a red-headed bird before.”

After each interaction, Pryke measured levels of the hormone corticosterone, a reliable measure of stress. She found that birds facing a red opponent had 58 per cent higher corticosterone levels than birds that faced black or blue. “With no prior experience of the colour, these birds had an innate fear of red,” Pryke concludes.

Exposure to red doesn’t just have an effect on fights. In a remarkable series of studies, Andrew Elliot of the University of Rochester in New York has demonstrated that even a brief glimpse of red can change human abilities and behaviour in all sorts of ways.

In one experiment, volunteers were asked to carry out a 5-minute IQ test. They were assigned a bogus “participant number”, written in either red or black, on the corner of the test paper. Volunteers whose numbers were written in red scored consistently lower on the tests. Elliot also gave the students different coloured folders and asked them to choose their preferred level of difficulty for an IQ test. Students given red folders tended to choose easier tests (*Journal of Experimental Psychology: General*, vol 136, p 154).

Even more remarkably, Elliot has found that viewing red for just a few seconds can make people more timid. Elliot’s team told 67 students that they would be taking either a vocabulary test or an analogies test, and asked them to look inside a folder to find out which one. The students saw either the word “analogies” or the word “vocabulary” on a red or green background – and the colour had a profound effect on their subsequent behaviour. When the students were instructed to walk to an adjacent laboratory to take the test, they found a sign on the door saying

“Please knock”. Those who had seen a red background knocked fewer times, and more quietly, than those given green.

This isn’t the only example of “avoidance behaviour” caused by momentarily seeing red. Another set of participants with movement sensors attached to them were seated in front of a computer monitor and told they were going to be given an IQ test. When the computer screen was red rather than grey or green, the volunteers leaned away from the screen. “These results show that at a very basic level, your body is pre-wired to move away from red,” says Elliot.

## Red = Danger

Elliot believes the effects of red on both IQ tests and avoidance behaviour arise from the same underlying factor that leads to its association with sporting success. In both cases the effect is on the person viewing the colour. “We view the red-equals-danger link as the linchpin of the effect,” he says. “A dominant other and failure both represent danger. Achievement contexts [such as IQ tests] are one of many types of situation in which danger, such as failure, is a possibility.”

When Elliot’s volunteers exposed to colours on a computer screen were scanned with EEG equipment, results showed that those who viewed red had more activity in the right frontal cortex, an area of the brain associated with emotional activity, particularly emotions associated with avoidance behaviour.

Elliot points out that it may have real-world consequences. “IQ tests are standardised tests used for selection in careers, but factors such as the colour of the pencil used, or the clothing worn by the test administrators, could significantly affect the result,” says Elliot.

However, exposure to red during a task does not always produce worse results. Ravi Mehta and Juliet Zhu of the Sauder School of Business at the University of British Columbia in Vancouver, Canada, found that red enhances performance on detail-orientated tasks, whereas blue improves the results of creative tasks (*Science*, vol 323, p 1226).

In one experiment, the researchers asked volunteers to come up with new uses for a brick, presenting the instructions on a screen with either a blue or a red background. Although the blue and red groups came up with just as many uses, the blue ideas were more creative while the red group’s were more practical and conservative. A second task – designing a child’s toy from 20 different components – produced similar outcomes.

Red does not always affect us through its association with danger. When Elliot and his colleague Daniela Nesta showed male volunteers photos of averagely attractive women on red and white backgrounds, the men rated the women on red as more attractive. Men asked to compare women in red or green shirts, and then red or blue shirts, said that they would be more likely to ask a red-clothed woman on a date and spend more money on that date (*Journal of Personality and Social Psychology*, vol 95, p 1150).

“Red is clearly context specific. In achievement situations red means danger, which leads to avoidance, but in romance situations red means sexual availability or romance and that leads to approach behaviour,” says Elliot.

It is this context-specificity that Elliot and colleagues are now exploring. Their latest work has investigated innate preference in infants. The team have found that one-year-olds shown red and green Lego bricks tend to reach out for red bricks. Yet when the infants are shown an angry face before being exposed to the blocks, they go for green.

What consistently impresses researchers is the fact that their volunteers rarely suspect that colour plays an important, or indeed any, role in the outcome of an experiment. In Elliot’s study of sexual attraction, almost none of the participants correctly guessed the purpose of the experiment and they thought colour had a minimal effect on their ratings.

“Colours function as a subtle primer, exerting a direct influence on motivation and behaviour without individuals’ conscious awareness,” Elliot says. “Given that the influence of colour on our behaviour is so prevalent, it’s shocking that we aren’t more aware of it.” ■

Daniel Elkan is a writer based in London