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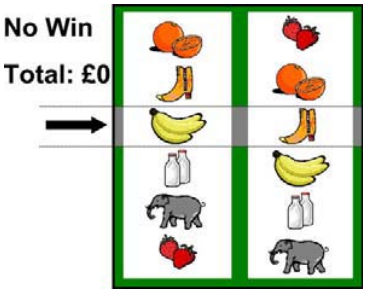

Digital bandit. Slot machines, such as this simplified computer game, entice gamblers to keep playing with near misses.

CREDIT: L. CLARK *ET AL., NEURON* **61** (2009)

Horseshoes, Hand Grenades--and Slot Machines?

By Lucas Laursen
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Before the reels on a slot machine stop spinning, a gambler's brain is already anticipating the potential rewards. And although two bananas on the pay line with a third just barely visible won't pay a gambler any more than three random fruits, such near misses have the well-documented, if irrational, effect of enticing gamblers to try again. The reason, according to a new study, is that these near misses activate the same reward signals in the brain as a win.

Slot machine makers capitalize on the near-miss effect. Researchers have found that they program their games to tease players with near misses about 30% of the time--a number previous studies have found optimal for getting gamblers to keep coming back. Games that offer gamblers the option to stop one reel on a favored icon--say a cherry--until the others spin to a stop also tend to inflate gambler's self-confidence.

Taking these factors into account, a team led by Luke Clark of the University of Cambridge in the United Kingdom developed a simplified slot machine game on a computer. The group asked 15 volunteers--mostly male and with an average age of 26--to play the game while it used functional magnetic resonance imaging (fMRI) to scan their brain activity. The subjects could choose when to stop one of two spinning reels on the screen, each decorated with six icons, including a banana, a pair of boots, and an elephant (see picture). They then watched while the second reel stopped spinning. When the icons matched, the volunteers won £0.50 in real money, but when the icon they chose landed just above or below the pay line, they earned no money, and the researchers logged the event as a near miss. In other trials, the computer chose which icon stopped in the first reel.

In a gambler's brain, a near miss triggered a similar pattern of brain activity as a win. When the researchers compared the scans, they found that near misses drew more blood to reward regions such as the insula and the ventral striatum than full misses did. The insula and striatum are part of a reward network that is known to include the rostral anterior cingulated cortex and the thalamus, which only showed activation during wins in this experiment. The effect was stronger in people whose answers on a survey hinted that they had distorted perceptions of how gambling works; for instance, those who answered affirmative to statements such as, "Specific numbers and colors can help increase my chances of winning."

Finally, the volunteers' desire to continue playing was stronger--as was activity in their reward network--when they, not the computer, had chosen the icon, the team reports in the 12 February issue of Neuron. That suggests, says Clark, that people who have a sense of control are more likely to fall for the near-miss effect.

Clark says that the rewards of a near miss may have ancient origins. In skill-dependent tasks, such as hunting, people do have some control over the outcome, and trying again after a near miss could bring home the bison, he explains. "The healthy brain is looking for ways in which it can control the environment, and gambling games harness that natural system."

The method should also be useful for studying brain activation in very experienced gamblers, says psychiatrist Martin Paulus of the University of California, San Diego, as their sensitivity to near misses might be blunted from overuse. And, says Marc Potenza, a psychiatrist at Yale University, the work suggests that it might be possible to use fMRI to swiftly evaluate the effect of different kinds of cognitive behavioral therapies on problem gamblers.