Why did the kitten cross the road? A meditation on positive versus negative reinforcement in addiction

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Why did the kitten cross the road? One possibility is that there is something better on the other side (e.g., warm sun or sun-paired cue) (Box 1a). A second possibility is that there is something lacking or depleting on the first side (e.g., temperature sapping cold). Distinguishing between these possibilities is challenging and cannot be answered by experimental designs using positive versus negative reinforcement.1–3 If the kitten is more likely to cross the road following temperature changes on the opposite side, it is called positive reinforcement. If the behaviour is emitted following temperature changes on the starting side, it is called negative reinforcement. Yet in both scenarios the kitten is approaching the warmer side.

So, why did the kitten cross the road? As a start, the kitten is unlikely to cross unless it has evidence that the other side is preferable; i.e., in and of itself, cold temperature might trigger a motivational state, but it will lack direction unless the kitten has either previously associated the other side with warmth or can feel the radiating heat.

Does the magnitude of temperature differential matter? If the difference is small, there might be little motivation to cross. If the difference is large, the motivation to approach could be greater. Most work suggests that this differential is more important than the absolute values, a phenomenon called a “contrast effect.” Indeed, the relative difference between options is more important than the absolute reward for prompting nucleus accumbens dopamine release and motivated behaviours.4–9

There has been much discussion about whether these processes are relevant for understanding clinically problematic drug seeking. This includes proposals that repeated substance use initially occurs because the individual is seeking reward but later switches to avoidance of withdrawal symptoms. However, most evidence suggests that, in and of themselves, abstinence syndromes are low motivational states.10,11 With further experience, withdrawal symptoms may come to serve as occasion setters (Box 1b), increasing striatal dopamine release and the ability of drug-paired cues to elicit approach.12,13

Together, this evidence suggests that debates about positive versus negative reinforcement are largely semantic and uninformative. The relevant processes are more complex than captured by these terms;11,14–20 people with severe addictions alternate between high and low reward-seeking states,17–21 and their drug seeking, per se, continues to reflect approach behaviours, now invigorated by the contrasting alternatives and elevated readiness to respond (Box 2).

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