



## PRESS RELEASE

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### When it comes to learning, what's better: the carrot or the stick?

UNIGE researchers have found that we are more confident in our decisions – and execute our choices more quickly – if we're chasing a reward... but we're more flexible when trying to avoid being punished.



Maël Lebreton, scientific assistant at the Centre interfacultaire en sciences affectives (CISA) of the UNIGE.

**High resolution pictures**

Does the potential to win or lose money influence the confidence one has in one's own decisions? Does either of them help learn more quickly? Researchers from the University of Geneva (UNIGE), Switzerland, in collaboration with the University of Amsterdam and ENS Paris, investigated confidence bias in a learning context through a system of monetary punishment and reward. They demonstrated that we become more confident in our choices when learning to seek rewards than when learning to avoid losses. However, this confidence rapidly evolves into over-confidence, which leaves us thinking that we are better than we actually are. Learning in a loss context mitigate these errors of judgment. Moreover, the prospect of monetary gains makes us less flexible, while the fear of losing money preserves our ability to adapt. You can read all about these results in the journal *PLoS Computational Biology*.

Evaluating one's learning performance relies on how confident one feel about her decisions. But can our ability to learn and to judge our decisions be influenced by economic factors? In other words, do we judge our performance identically when faced with a situation that involves monetary gain or loss?

The UNIGE researchers tested 84 participants to investigate confidence bias in the context of reward or punishment-based learning, known as reinforcement learning. "The principle is simple," begins Maël Lebreton, a researcher in UNIGE's Swiss Centre for Affective Sciences (CISA). "Participants were shown two abstract symbols on a screen. One symbol was associated with a 75% probability to win 50 cents in and the second one only 25% probability to win. On each trial, they had to choose one of the symbols to try to win and evaluate how confident they were in their choice. As the task progressed, the subjects learned to refine their decisions by identifying the symbol that paid out the most." The principle was reversed for the loss: participants were asked to select the symbol that was associated with the lowest probability to lose money and then assess the accuracy of their decisions.

#### **Confidence is intensified when the aim is to win money**

The initial results showed that the ability to learn is statistically identical when participants learn to seek gains and when they learn to avoid losses. On the other hand, participants were much more confident when it came to making money rather than avoiding losing it. "There's a 10% boost in confidence!" says Lebreton. Given that the task and performance were the same, one should expect similar

levels of confidence. This difference demonstrates the existence of a bias in learning and confidence judgments introduced by the economic context.

Yet, the increase in confidence in the gain context is not necessarily a good thing. “It’s normal for confidence to increase during the learning process because participants increasingly choose the most profitable symbol. But this phenomenon is intensified when it comes to the pursuit of gain: participants end up clearly overestimating their performance. This over-confidence, which is at about 10%, is not there when it comes to avoiding losing money”, says Lebreton. In fact, in a negative context, people tend to doubt their choices, which means they evaluate them more accurately. “But this doubt could turn to anxiety and potentially make participants ultimately loses all their confidence”.

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### Fear of losing makes people more flexible

Half of the participants then underwent a second experiment: the researchers reversed the quality of the symbols, making the best the worst. Participants in the context of financial gain had more difficulty noticing this change and adapting, while those in the context of financial loss quickly noticed the change and were flexible. “This is probably the result of evolution: when there’s a danger, you have to think quickly and adapt your decisions, while when everything is going well, we try to maintain the positive situation,” explains Lebreton. The implies that the desire for gain induces a certain inflexibility among learners, who think that what has paid out once will always pay out.

These results demonstrate that teaching should be tailored to what we want an individual to learn and how. “The learning context is crucial. The fear of loss makes people anxious and they begin to doubt their choices; yet it also provides more flexibility and accuracy. The lure of profit, on the other hand, boosts self-confidence and well-being but reduces our ability to make assessments. Then it’s a question of striking a balance between the two elements”, continues the Geneva-based researcher. “We also found that participants made their choices faster in the positive context than in the negative.” Accordingly, it is a good idea to list the different forms of learning to see which type you want to prioritise speed, confidence or accuracy? And then to choose between reward and punishment depending on the goal to be achieved.

The scientists will now try to determine which areas of the brain are related to loss and gain, and which areas affect confidence. They will then be able to see how they communicate with each other and affect our judgments and decisions.

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