Why Mania Leads to Risky Behavior

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Formulation of the problem. It is known that manic patients – the ones who view the world too positively – tend to make risky decision, bet of low probability events, and overall lose. The same behavior – to a lesser degree – has been observed for people who are in an unusually optimistic mood. The more optimistic the person, the more risky this person's behavior can be. On the other hand, more pessimistic people is more risk-averse; see, e.g., [2] and references therein. How can we explain this empirical relation between optimism and risk-taking?

Our explanation. According to decision theory (see, e.g., [1]), when faced with the need to make a decision, people select an alternative for which the expected utility is the largest. For example, in the betting situations, when we have several alternatives i with utility u_i and known probability p_i, we select an alternative for which the expected utility $p_i \cdot u_i$ is the largest.

The difficulty is that usually, we do not know the exact probabilities. All we know, based on the previous n observations, is the frequency f_i of the i-th outcome. The frequency is, in general, somewhat different from the probability; the corresponding standard deviation is equal to $\sigma_i = \sqrt{(f_i \cdot (1 - f_i))/n}$. Thus, with confidence 95%, the only thing we can conclude about the actual (unknown) value of the probability is that this value is located on the interval $[\underline{p}_i, \overline{p}_i] = [f_i - 2\sigma_i, f_i + 2\sigma_i]$. Under such interval uncertainty, decision theory recommends to select the value $\widetilde{p}_i = \alpha \cdot \overline{p}_i + (1 - \alpha) \cdot \underline{p}_i$, for some value α that describes the decision maker's optimism-pessimism level: when α is close to 1, the person only takes into account the most optimistic scenario; when α is small, only the most pessimistic one. The value α is the numerical description of degree of mania or depression (in the extreme case) and of the degree of optimism in general.

In gambling, each person selects an alternative for which $\widetilde{p}_i \cdot u_i$ is the largest, where $\widetilde{p}_i = p_i + 2(2\alpha - 1) \cdot \sigma_i$. We show that for an optimistic person P (with $\alpha > 0.5$), if we have two alternatives i and j with $f_i < f_j$ that are equivalent to a "normal" person (for whom $\alpha = 0.5$), i.e., for which $f_i \cdot u_i = f_j \cdot u_j$, then for P, we will have $\widetilde{p}_i \cdot u_i > \widetilde{p}_j \cdot u_j$. Thus, if we slightly decrease f_i – so that we get $f_i \cdot u_i < f_j \cdot u_j$, making betting on i unnecessarily risky – we will still have $\widetilde{p}_i \cdot u_i > \widetilde{p}_j \cdot u_j$. So the optimistic person will still bet on this risky low-probability option. It is also possible to show that the larger α, the smaller the threshold for f_i at which the person with this α will bet on this alternative.

For a person Q with $\alpha < 0.5$, similar arguments lead to the opposite effect: even when gambling on a low probability option i (with $f_i < f_j$) makes sense for a "normal" person (for whom $f_i \cdot u_i = f_j \cdot u_j$), for Q, we will have $\widetilde{p}_i \cdot u_i < \widetilde{p}_j \cdot u_j$. This explains why more pessimistic people are more risk-averse.

References

[1] R. D. Luce and R. Raiffa, *Games and Decisions: Introduction and Critical Survey*, Dover, New York, 1989.

[2] B. J. Sahakian and J. N. Labuzetta, *Bad Moves: How Decision Making Goes Wrong, and the Ethics of Smart Drugs*, Oxford University Press, Oxford, UK, 2015.