New insights into skier-triggering of slab avalanches

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Most skiers trigger the slab avalanche in which they are caught. Preventing those accidents necessitates a better understanding of the factors contributing to the failure of the snowpack under the action of a skier. Our contribution gives a number of insights into a newly developed mathematical model of skier triggering based on the principles of mixed-mode anticracking. We give various examples of how the direction of the applied force and the penetration depth of the skis influence the chances of triggering fracture in the weak layer, and we investigate how the skier’s stance influences that risk. We also ask how the critical loads for triggering fracture depend on slope angle in general. We find that, for weak layers prone to anticracking, fracture is not easier to trigger on steep slopes, but is equally difficult or marginally more difficult to trigger the steeper the slope. We carried out extensive field experimentation to test this proposition using the extended column test method, the detailed results of which are given in a companion paper. As usual, our formulation includes simple shear cracking as a limiting case, so that the anticrack model is well-suited to emphasize the differences between the two fracture mechanisms. The results emphasize that the anticrack mechanism for fracture in snow requires scientists and practitioners to rethink previously accepted - and practically relevant - paradigms.