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Contextuality-by-default for behaviours in compatibility scenarios

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The compatibility-hypergraph approach to contextuality (CA) and the contextuality-by-default approach (CbD) are usually seen as products of entirely different views on how physical measurements and measurement contexts should be understood: the latter is based on the idea that a physical measurement has to be seen as a collection of random variables, one for each context containing that measurement, while the imposition of the non-disturbance condition as a physical requirement in the former precludes such interpretation of measurements. The aim of our work is to show that the main idea behind CbD is already implicit in CA and to introduce in the latter important ideas which arise from the former. We introduce in CA the non-degeneracy condition, which is the analogous of consistent connectedness, and prove that this condition is, in general, weaker than non-disturbance. The set of non-degenerate behaviours defines a polytope, therefore one can characterize non-degeneracy using linear inequalities. We introduce the idea of extended contextuality for behaviours and prove that a behaviour is non-contextual in the standard sense iff it is non-degenerate and non-contextual in the extended sense. Finally, we use extended scenarios and behaviours to shed new light on our results.

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