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Developing A Third Degree Of Freedom For Opinion Dynamics Models Using Scales

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Abstract : Opinion dynamics models use an agent-based modeling approach to model people's opinions. Model's properties are usually explored by testing the two 'degrees of freedom': the interaction rule and the network topology. The latter defines the connection, and thus the possible interaction, among agents. The interaction rule, instead, determines how agents select each other and update their own opinion. Here we show the existence of the third degree of freedom. This can be used for turning one model into each other or to change the model's output up to 100% of its initial value. Opinion dynamics models represent the evolution of real-world opinions parsimoniously. Thus, it is fundamental to know how real-world opinion (e.g., supporting a candidate) could be turned into a number. Specifically, we want to know if, by choosing a different opinion-to-number transformation, the model's dynamics would be preserved. This transformation is typically not addressed in opinion dynamics literature. However, it has already been studied in psychometrics, a branch of psychology. In this field, real-world opinions are converted into numbers using abstract objects called 'scales.' These scales can be converted one into the other, in the same way as we convert meters to feet. Thus, in our work, we analyze how this scale transformation may affect opinion dynamics models. We perform our analysis both using mathematical modeling and validating it via agent-based simulations. To distinguish between scale transformation and measurement error, we first analyze the case of perfect scales (i.e., no error or noise). Here we show that a scale transformation may change the model's dynamics up to a qualitative level. Meaning that a researcher may reach a totally different conclusion, even using the same dataset just by slightly changing the way data are pre-processed. Indeed, we quantify that this effect may alter the model's output by 100%. By using two models from the standard literature, we show that a scale transformation can transform one model into the other. This transformation is exact, and it holds for every result. Lastly, we also test the case of using real-world data (i.e., finite precision). We perform this test using a 7-points Likert scale, showing how even a small scale change may result in different predictions or a number of opinion clusters. Because of this, we think that scale transformation should be considered as a third-degree of freedom for opinion dynamics. Indeed, its properties have a strong impact both on theoretical models and for their application to real-world data.

Keywords : degrees of freedom, empirical validation, opinion scale, opinion dynamics
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