Analyzing asymmetric proximity relations in transaction matrices: The case of journal cross-reference matrices

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In science mapping, the common methodological approach is to treat relations between bibliometric entities as symmetric proximities. Usually, this entails the calculation of co-occurrences between entities, and a subsequent transformation of the co-occurrences into a similarity matrix used for mapping.

Recently, the application of transaction matrices has become the focus in mapping studies. A transaction matrix contains asymmetric relations between its entities. Especially, the utilization of the citing-cited journal relations available from the *Journal Citation Reports*® has been in focus in recent science mapping studies. For a set of journals, it is possible to construct a matrix of cross-referencing activity, where the rows represent journals giving references *to* the other journals, and the columns represent the same journals receiving citations *from* the other journals.

Interestingly, analyses of the essentially asymmetrical relations between journals in the transaction matrices are done by use of the symmetric cosine similarity measure. However, the cosine measure is only capable of capturing one relational aspect in the matrix at a time, either the citing or the cited profiles of the journals. Several matrices and maps are therefore needed to investigate the multidimensional aspects that reside within transaction matrices. Such an approach fails to simultaneously model the cross-referencing activity in the matrix, diminishing the information eventually projected into the science maps.

The aim of the present research is to investigate the ability to simultaneously capture the asymmetric relations residing within transaction matrices by use of a proposed alternative proximity measure, and an unfolding scaling technique, respectively. Hence, our aim is to simultaneously model citing, cited and self-citing relations, in order to enhance science mapping based on transaction matrices. The eventual goal is one map expressing several of these relations.