Systemic structure of kinship is shaped by evolutionary processes

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Kinship terminology is a category system that groups and distinguishes relatives. The number of terms and which relatives are categorised together varies cross-linguistically. For instance, the English kin term *uncle* groups parents' brothers, but the same relatives are split into three categories in Hindi: *cācā* 'father's younger brother', *tāū* 'father's older brother', and *māmā* 'mother's brother'. However, this variation is constrained (Murdock, 1970). Similar categories are distinguished in unrelated languages, and not all theoretically possible categories are attested (Nerlove and Romney, 1969).

What underlies these constraints on diversity? Category systems have been proposed to maximise communicative efficiency (Kemp et al., 2018). Kemp and Regier (2012) show that kinship systems in natural languages near-optimally balance simplicity with informativeness, meaning they tend to have the simplest possible grammar given the number and specificity of the kin terms in the language. Further to this, Passmore et al. (2021) suggest that emergent kin categories are constrained by internal co-selection: an evolutionary process where terminological changes in one generation of the kinship paradigm co-occur with parallel changes in other generations, increasing system-wide predictability. For instance, the collapse of a distinction in Ego's parents' generation may lead to a related collapse in Ego's generation – in Latin and Italian, the merging of terms for mother and father's brothers (*patruus* and *avunculus* collapse to *zio*) was accompanied by a parallel merger in the terms for their children (*frater patruelis*

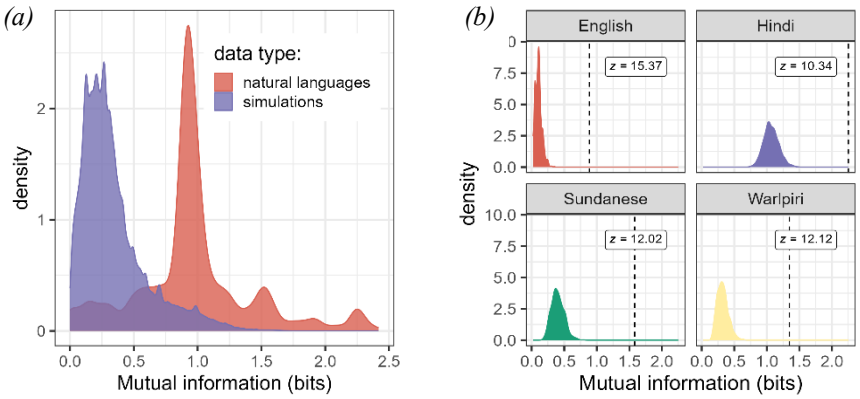

Figure 1. (a) Distribution of mutual information across all natural languages and all simulations. Mutual information is substantially lower in the simulated dataset. **(b)** Distribution of mutual information across simulations for a sample of languages. Dashed line marks the mutual information of the attested kinship system; *z*-score is given relative to the mean of the null distribution (i.e. the distribution of each system's simulated counterparts). For all four languages, mutual information of the natural language is greater than we would expect to arise by chance ($z > 1.96$).

and *filius consobrinus* collapse to *cugino*). Here, we investigate whether kinship systems truly exhibit this predictive structure between generations of kin.

We measured predictive structure between relatives in Ego's generation (i.e. terms for one's siblings and cousins) and Ego's parents' generation (i.e. terms for one's parents and their siblings) as mutual information: an information theoretic measure of how much we can know about the terms in one generation by observing the other. Using kinship terminology data from Kinbank (Passmore et al., 2023) for a sample of 544 languages, we tested whether kinship systems have higher mutual information than chance via a permutation analysis. The mutual information of each language's kinship system was compared to simulated baselines that randomly redistributed kin terms within the paradigm, maintaining the number of terms in each generation but scrambling any predictive structure.

We found 458 kinship systems (84%) had significantly greater mutual information between generations than would be expected if kin terms were distributed randomly ($z = 2.34$, $p < 0.05$) (Figure 1a). Looking at individual kinship systems, we found mutual information is substantially greater than their simulated counterparts (Figure 1b). This tendency to structure kin terms in a predictable way suggests a selective pressure for internal co-selection.

We propose that the internal co-selection process is adaptive because it facilitates the trade-off between simplicity and informativeness (Kemp and Regier, 2012): the more structural information we can predict, the more cognitive resources can be invested in finer-grain kin category distinctions.

Acknowledgements

The first author gratefully acknowledges funding from the Economic and Social Research Council [grant number ES/P000681/1].

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