Title
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Terminologies, Hypothetical or Extant, Are Optimal Solutions

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In a recent article in *Science*, Charles Kemp and Terry Regier (2012) claim that variation in 'real world' kinship terminologies is constrained by "two domain-general principles: Good systems of categories are simple, and they enable informative communication" (2012: 1049). We welcome their claim and demonstration that the range of variation in extant kinship terminologies is not unconstrained. The two principles are not controversial and are consistent with the anthropological notion that kinship terminologies communicate information about kinship relations in a cognitively less complex manner than would occur through just using genealogical specifications of kinship relations defined as kin types.

In general, information will be communicated more effectively by simple categories that are more easily understood and are less subject to communication errors than by more complex categories that are harder to understand, hence more subject to communication errors. However, the extensive variability among kinship terminologies, ranging from those with kin terms whose meaning closely tracks genealogical differences among kin to others whose organization and structure seem to have little relationship to genealogical differences among kin, indicates that there is more variation in the complexity among kinship terminologies than would be expected were it the case that the driving constraint for all extant terminologies is one of satisfying these two principles based on kin type denotation of kin terms, as Kemp and Regier suggest.

Kemp and Regier attempt to substantiate their assertion by locating actual terminologies in a hypothetical design space for kinship terminologies consisting of what they consider to be all possible kinship terminologies and then showing that extant terminologies only occupy a very limited portion of this hypothetical space in which their two principles are satisfied. Underlying their claim is the assumption that extant terminologies are the consequence of an evolutionary search across a design space guided by their two principles. This search supposedly led to convergence, regardless of the society, onto a small subspace of the hypothesized design space that encompasses extant terminologies and satisfies these two principles.

That extant terminologies are located in such a subspace implies there is order in the kin terms making up a kinship terminology, but their account determines little more than this. The difficulty with their approach is that their hypothesized design space is not derived from a theory of kinship terminology structures predictive of the specifics of individual terminologies.

Additionally, their analysis presumes an astronomically large space of possible terminologies, in which they construe a "possible terminology" as any way to classify a set of genealogically defined kin types using a partition of the set of

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possible kin types. It would be like saying that the domain of possible sentences consists of any possible combination of a set of vocabulary words. In fact, like the grammatical constraints inherent to sentences in languages, kinship terminologies are limited to systems of classification constrained by a logical/formal structure. They are generative, and their categories provide for classifications that are reciprocal (Read 2007; Leaf and Read 2012). The generative logic already assures their two principles, hence any evolutionary search across the design space of possible terminologies is within a space of terminologies that already satisfies their two principles, hence the two principles do not distinguish between extant and hypothetically possible kinship terminologies, as they claim.

The design space for kinship terminologies devised by Kemp and Regier consists of all possible partitions of a set of 24 possible kin types (a kin type is a genealogical string such as ego's mother's father's son) for a female and 32 possible kin types for a male (they include nephew and niece kin types for males but not for females due to nephews and nieces of female egos being less frequently reported in descriptions of kinship terminologies than for male egos). Even with the counter-factual restriction of possible kin types to 24 for females and 32 for males, the size of their hypothesized design space is astronomically large and consists of "the 10^{55} [terminology] systems that are possible in theory" (2012: 1050). Even this enormous size is a vast understatement of the size of the design space they have defined as they have limited kin types to a maximum of two ascending and/or descending genealogical generations from ego. Extant terminologies are obviously not the consequence of a step-wise search, guided only by natural selection, across a design space of this magnitude, supposedly ending at optimal terminologies.

A further difficulty is their arbitrary limit of kin term complexity to just a few of the genealogical relations referenced by kin terms that are close to ego, hence to kin terms that refer to these genealogical relations. This distorts the conclusions that would be drawn regarding terminologies with a different pattern for the relationship between genealogical relations and kin terms outside of the genealogical relations considered by them. For example, the classificatory terminologies distinguished by Lewis Henry Morgan (1871) in his seminal work on kinship terminologies are defined as terminologies that do not consistently separate collateral from lineal genealogical relations. A term in a classificatory terminology that we would translate as 'mother' may include an indefinite number of increasingly distant, collateral genealogical relations. When speaker says, "she is my 'mother'," the listener does not know, from that fact alone, if the person in question is speaker's birth mother or a distant genealogical relation, such as mother's mother's mother's daughter's daughter, as discussed by Jane Goodale for the Tiwi of Australia (1971), a group with a classificatory kinship terminology. Terminologies like this occur among indigenous groups in the Americas, Oceania, Australia and southern India. By ignoring kin term usages of this sort, their analysis further distorts what terminologies actually are and do.

Their claim that existing kinship terminologies occupy what they call a nearly optimal portion of the space of possible terminologies as defined by

them also depends upon an outdated assumption that a kin term can be any combination of attribute values for genealogically defined dimensions such as sex and generation. Research over the past four decades has established that kinship terminologies have a core structure constructed from a few primary kin terms by using a kin term product to generate new kin terms, subject to structural equations that express the culturally salient kinship ideas embedded structurally in a kinship terminology (Leaf 1971; Read 1984, 2001, 2007; Read and Behrens 1990; Bennardo and Read 2007; Leaf and Read 2012 and references therein). Kin term products are determined by the calculations culture bearers make with kin terms to determine kinship relations without referring back to genealogy. As Anthony Good (1981) has expressed it for the Kondaiyankottai Maravar of South India, "If ego knows what term to use for alter A, and also knows what term A uses for alter B, he can easily work out what term he himself should use for B" (1981:113). For English speakers, if the speaker refers to a male as uncle and that male in turn refers to a female as daughter, the speaker knows to refer to that female as cousin even if the speaker does not know her/his genealogical relation to the female in question.

To briefly illustrate the generative construction process, consider how the English kinship terminology is generated from the concept of *self* and the *parent* and *spouse* kin terms, using the kin term product to generate new kin terms. (Other terminologies will have different generating terms and structural equations, but the sequence of generating steps is the same.) The construction begins with an ascending structure of kin terms formed from repeated products of the parent term: parent, parent of parent = grandparent, parent of grandparent = great grandparent, and so on. Next, an isomorphic descending structure is formed: child, child of child = grandchild, child of grandchild = great grandchild, and so on. Kin term reciprocity – a fundamental property of all kinship terminologies and referring to the idea that if speaker has a kin term for a reference person, then the latter has a kin term that can be used by the reference person to refer to the speaker – is defined structurally among the consanguineal kin terms by the kin term product equation, parent of child = self. Next, sex distinguished kin terms are introduced. In English, this is done by bifurcating terms into sex-marked terms; e.g. parent → [mother, father]. In the classificatory terminologies, sex distinguished kin terms are introduced in a different manner through a structure of male terms and an isomorphic structure of female terms that are linked together to make a single structure. Following this, the affinal terms are either generated by a marriage term such as *spouse* in English or, in some societies with classificatory terminologies, through prescriptive marriage rules defined using consanguineal kin terms (see Read 2007, 2010; Leaf and Read 2012 for details). Consequently, the actual range of possible kinship terminologies is not the astronomically large design space defined by Kemp and Regier, but instead is composed of a vastly smaller number of possible terminologies generated in the above manner. Structural differences among terminologies arise from different ethnographically validated primary generating terms (e.g., whether a sibling term is a primary term or a secondary, composite terms such as "child of parent" for English speakers) and different, ethnographically validated, struc-

tural equations.

All terminologies in the wide range of terminologies analyzed to date have been found to be generated in this manner, although with many interesting variations (Read 2013). All such terminologies are communication systems that enable informative judgments to be made about possible genealogical relations (though with different degrees of specificity) since the kin terms of a kinship terminology can be mapped homomorphically into the genealogical space of possible genealogical relations (Read, personal observation). All terminologies generated in this manner are, then, relatively simple when Kemp and Regier's criteria are applied to the structural equations, hence, according to their criteria, all possible terminologies are nearly optimal solutions. Thus, being nearly optimal does not distinguish extant terminologies from other possible but supposedly not optimal terminologies, as they claim. Their criterion only distinguishes actual terminologies from imaginary terminologies that have no valid, theoretical basis. Further, their criterion implies a degree of homogeneity among terminologies that is belied by the striking differences between terminologies such as a descriptive terminology like the English kinship terminology and Morgan's classificatory terminologies, such as the Iroquois terminology that was instrumental in his distinction between classificatory and descriptive terminologies.

Published data on the Tongan terminology (see Bennardo and Read 2007, 2011) illustrate further empirical problems with their argument. The Tongan terminology, unlike the English terminology, has sibling terms marked by age, but only for same sex siblings. According to Kemp and Regier's criteria, these are more complex than the English sibling terms, brother and sister. However, when Tongans are asked questions that involve computing kin relations using sibling terms, they consistently answer the questions more rapidly than do Americans for comparable questions involving English kin terms. When asked questions that involve just mother/father and son/daughter terms (where the terms are equally complex by their criteria) Americans consistently answer the questions more rapidly than do the Tongans. The difference in performance relates to the difference in the generating logic of the two terminologies: the Tongan terminology is based on sibling (as well as terms for 'mother' and 'father') a generating term (hence making it a simple term) whereas sibling is a compound term, child of parent, for Americans, making it a more complex term. For Americans, parent is the generating term but 'father' and 'mother' are both generating terms for Tongans, thus questions involving parental terms are less complex for Americans than for Tongans.

The criteria they use for comparing terminologies, information and simplicity, are outcomes, then, not drivers, of the properties of kinship terminologies. Kinship terminologies are based on a few generating terms with a generative logic and this is the driver for the properties of kinship terminologies. Thus the logic of a kinship terminology accounts for the outcomes they have discussed.

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