Amazonian clues to the historical development of numeral systems

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A large body of research indicates that humans and other species have an innate ability to distinguish exact quantities from one to three, but that the precise manipulation of larger quantities is enabled by linguistic and cultural scaffolding (e.g. Sarnecka & Carey 2008, Beran et al. 2015). However, this finding presents a significant puzzle: how do languages develop higher-level numeral terms in the first place, if the existence of a count sequence is fundamental for conceptual development? Responses to this question have considered the role of gesture and body tallying (relying in particular on fingers), as well as the relevance of syntactic and metaphorical associations within language more generally (e.g. Spaepen et al. 2011, Weise 2007, Nuñez & Marghetis 2015); however, empirical exploration of the linguistic elaboration of existing numeral systems is constrained by the fact that low-level numerals in most well-studied languages are etymologically opaque, with the initial stages of their development obscured.

Nevertheless, a few areas of the world do offer opportunities to investigate a wide array of numeral systems that can be understood as incipient with respect to evolutionary potential – perhaps most notably Australia and Amazonia (Epps et al. 2012). In this talk, I take a closer look at Amazonian numeral systems and their implications for our understanding of numeral development. As has been observed for Australian languages (Bowern & Zentz 2012, Zhou & Bowern 2015), terms for 1-3 in Amazonian languages tend to be the most basic (and the most reconstructable), 4 is likely to be compositional, and higher terms show evidence of rapid elaboration and areal diffusion. However, in contrast to most of Australia, Amazonia offers a very large number of small language families, and thus provides a wide range of different windows into the (apparently) independent innovation of low-level numeral terms on one hand, and ample opportunity to track cross-linguistic diffusion on the other. The Amazonian context thus suggests several intriguing insights into numeral development: First, the transparent etymological sources of many terms within the 1-3 range (e.g. 'eye-quantity', 'pronged fishing arrow', 'deer footprint') offer evidence for an iconic association between a precise low-level quantity and a specific type of physical object. Second, in at least some cases we have historical evidence that this iconic link has remained salient for speakers over time, in that the reference to the object has been maintained even where the relevant lexical root has not (e.g. a new word for 'eye' enters the language and replaces the older form in the term for 2). Third, we find widespread evidence for widespread cross-linguistic calquing of compositional terms for 4, with the literal meaning 'has a sibling' or 'be accompanied'. This fact suggests a possible answer to the historical linguistic correlate of the 'successor problem' in ontogeny, by which speakers come to recognize that each numeral term in a series represents a quantity that is exactly one more than the preceding term: that is, terms for 4 that make explicit reference to the addition of an element to a group, and their probable association to gestures involving the fingers, provide a plausible bridge between the object-based representations of 1-3 and a more productive counting logic. Moreover, the widespread diffusion of these terms for 4 suggests a mechanism by which this conceptual step may be replicated again and again across a wide variety of distinct languages.

References

Beran Michael, Bonnie Perdue, and Theodore Evans. 2015. "Monkey Mathematical Abilities." In *Oxford Handbook of Numerical Cognition*, ed. Roi Cohen Kadosh and Ann Dowker. Oxford: Oxford University Press, 237–259.

Bowern, Claire and Jason Zentz. 2012. "Diversity in the Numeral Systems of Australian Languages." *Anthropological Linguistics* 54: 133–160.

Patience Epps, Claire Bowern, Cynthia Hansen, Jane Hill, and Jason Zentz. 2012. "On Numeral Complexity in Hunter-Gatherer Languages." *Linguistic Typology* 16: 41–109.

Rafael Núñez and Tyler Marghetis. 2015. “Cognitive Linguistics and the Concept(s) of Number.” In *The Oxford Handbook of Numerical Cognition*, ed. Roi Cohen Kadosh and Ann Dowker. Oxford: Oxford University Press 377–401, 377.

Sarnecka, Barbara and Susan Carey. 2008. “How Counting Represents Number: What Children Must Learn and When They Learn It.” *Cognition* 108: 662–674.

Elizabeth Spaepen, Marie Coppola, Elizabeth Spelke, Susan Carey, and Susan Goldin-Meadow. 2008. “Number without a Language Model.” *Proceedings of the National Academy of Sciences USA* 108: 3163–3168, 3167.

Wiese, Heike. 2007. “The Co-Evolution of Number Concepts and Counting Words.” *Lingua* 117: 758–772.

Zhou, Kevin and Claire Bowern. 2015. “Quantifying Uncertainty in the Phylogenetics of Australian Number Systems.” *Proceedings of the Royal Society B: Biological Sciences* 282: 2015–1278.