Evolution and Human Behavior 38 (2017) 376–396

Contents lists available at ScienceDirect

Evolution and Human Behavior

journal homepage: www.ehbonline.org

Original Article

Language and cooperation in hominin scavenging☆

Bart J. Wilson *, Samuel R. Harris

Economic Science Institute, Chapman University

ARTICLE INFO

Article history:
Initial receipt 10 February 2016
Final revision received 30 November 2016

Keywords:
Language
Cooperation
Scavenging
Experimental economics

ABSTRACT

Bickerton (2009, 2014) hypothesizes that language emerged as the solution to a scavenging problem faced by proto-humans. We design a virtual world to explore how people use words to persuade others to work together for a common end. By gradually reducing the vocabularies that the participants can use, we trace the process of solving the hominin scavenging problem. Our experiment changes the way we think about social dilemmas. Instead of asking how does a group overcome the self-interest of its constituents, the question becomes, how do constituents persuade one another to work together for a common end that yields a common benefit?

1. Language and the origins of cooperation

Bickerton (2009) makes the bold claim that "without understanding how language evolved, we can never hope to explain or understand ourselves" (p. 12). Language, he argues, is fundamental to the story of human evolution. Not only is language the product of an evolved, human-like mind, it is a key ingredient in the recipe for one. Without the cooperative outcomes made possible through language, we would lack access to high calorie meat necessary for larger, more complex brains. Language is necessary to coordinate behavioral solutions to complex problems. Yet it is the potential benefit of solving those cooperation problems that comprise the evolutionary demand to evolve more complex brains. Understanding how humans made language is thus fundamental to understanding our own evolution, i.e., how language made us human.[1] And so, to understand the genesis of language, we must consider the environmental realities faced by Pleistocene hominins, two million years ago, on the savannahs of East Africa. From that context, we can rationally reconstruct the cause for the genesis of language, which Bickerton hypothesizes was the demand of a new ecological niche.

The "power scavenging" niche, as Bickerton (2009, 2014) terms it, was one in which hominins quickly located carcasses of dead animals and scavenged meat from them with the help of other band members.[2] This was not an open niche. To access these calorie-rich carcasses, hominins had to fend off large fanged-and-clawed predators. In other words, to develop this niche as a reliable source of food, non-kin hominins had to work together for the common purposes of defending the carcass and consuming the spoils at their catchment site (Domínguez-Rodrigo and Pickering, 2003). Non-kin hominins also had to convince other members of their band that this was a worthwhile activity. Recruitment and working together for a common purpose were thus the fundamental problems language had to solve for humans to occupy the power scavenging niche.

Language would be central to constructing such a scavenging niche. Except for ants and bees, all other animal communication systems are bound to the here and now.[3] To power scavenge from a known carcass beyond the hill, hominins needed a way to communicate about objects and events that are spatiotemporally distant from the perceivable present. Language solves this fundamental problem of displacement in communication.

Bickerton's hypothesis is but one of several hypotheses that in all likelihood worked in concert to form a positive feedback loop that supported the development of a new niche (Pinker, 2010). Other proposals

☆ We gratefully acknowledge the financial support of Chapman University and the National Science Foundation (SES 1123803). Wilson specifically thanks the Property and Environment Research Center (PERC) for their generous hospitality and financial support as a Lone Mountain Fellow during the summer of 2015, and Harris thanks the International Foundation for Research in Experimental Economics and Thomas W. Smith Foundation for their generous support to work on this project as a Summer Scholar from 2012-15. We also thank Jeffrey Kirchner for his creative software programming; Bailey Ennis, Jeremiah Ludwinski, Keane Tarrosa, and Sean Weller for their research assistance on this project in its nascence; Joshua Ball, Benjamin Chalmers, Gillian Courtney, Alex Feldman, J. Trent Gerdeman, and Mary Howard for diligently fact checking our narratives; and Jan Osborn and Stephen Semos for their meticulous comments on an early draft of the paper. Finally, we thank Frank Wolak, Erez Yoeli, seminar participants at PERC, and conference participants at the Economic Science Association meetings in Dallas for valuable conversations and comments that have improved the paper. The data and source code are available upon request.

* Corresponding author.
E-mail addresses: bartwilson@gmail.com (B.J. Wilson), samuelroberth@gmail.com (S.R. Harris).

[1] The subtitle of Bickerton's book is "How Humans Made Language, How Language Made Humans."

[2] See also Bickerton and Szathmáry (2011).

[3] See also Deacon (1997) for a detailed analysis on how no other animal communicates with symbolic language. Bickerton also discusses how other animals, perhaps with the possible exception of ravens, do not appear to need to solve the displacement problem.

http://dx.doi.org/10.1016/j.evolhumbehav.2016.11.009
1090-5138/

include direct reciprocity to coordinate among individuals and defend against exploitation by free riders (Tooby, Cosmides, and Price, 2006), indirect reciprocity to maintain a reputation as worthy of future cooperation (Panchanathan and Boyd, 2004; Nowak and Sigmund, 2005), the accrual of collective knowledge about tools, habitat, and so forth (Boyd, Richerson, and Henrich, 2010; Barrett, Cosmides, and Tooby, 2007), group-on-group aggression and defense (Tooby and Cosmides, 2010), and cooking (Wrangham, 2009). Our project is not to compare these different accounts, but to explore what people do in a laboratory experiment motivated by Bickerton's unorthodox hypothesis.

The purpose of our experiment is to observe the persuasive work that words do as part of the process of solving a hominin scavenging problem, and our focus will be on coordination/mutualism as opposed to symbiosis (Thomas, DeScioli, Haque, and Pinker, 2014). We design a virtual world in which the inhabitant population cannot sustain itself without scavenging for meat. As part of the experiment, we gradually vary and restrict the vocabularies available to our flesh and blood participants as they make decisions for real salient payoffs. We begin with the unbounded set of natural language and conclude with a vocabulary that consists of 11 non-word symbols. In between, we take a bounded set of 26 words and 11 non-word symbols and, systematically over the course of three more treatment conditions, drop a mere 10 words until the participants fail to solve the scavenging problem. With each successive vocabulary the participants progressively lose their ability to directly communicate features of the problem beyond the here and now. We leave it to our participants to discover the collective scavenging problem for themselves. In doing so, we can observe the process by which participants themselves use language to (1) establish a common end with other people, (2) form groups to solve the problem of achieving the common end, and (3) maintain the group in face of ongoing competing interests and desires.

Vesterlund (2012) updates Ledyard's (1995) initial survey of the voluminous literature on public goods experiments with references to studies that endogenize group formation and test conditions, including free form communication, that support higher contributions. Our inquiry is not into whether and by what degree communication improves cooperation, but into how people use words to persuade each other to solve a cooperation problem. To do so, our experiment implements the very problem that Bickerton hypothesizes required a means for humans to solve cooperative problems, to wit, language. By controlling which words the participants can use, we trace the conceptual work that language does initiating and sustaining profitable cooperation. We also observe what our participants do and do not do when they fail to solve the scavenging problem.

2. Experimental design and procedures

Our project is unrepentantly descriptive. Rather than testing formal hypotheses for a set of treatment conditions specified in advance, we develop some facts with a series of successive treatment conditions that illuminate the process by which language solves a cooperative problem. Whereas many experiments are nomothetic, i.e., designed to test theoretical or empirical "propositions" about the world, ours is heuristic or exploratory in nature (Smith 1982). We are probing a new a line of inquiry with an untested experimental platform. "Science," Smith (1982) explains, "needs the wings of heuristic experiments as much as the foundational support of nomothetic experiments. It is through exploratory probes of new phenomena that attention may be redirected, old belief systems may be reexamined, and new scientific questions may be asked" (p. 942). Our project is also unabashedly artificial. Since we cannot recreate the physical conditions under which protolanguage emerged, we use a computer laboratory to generate replicable conditions for scavenging. [The athletic director denied our request to use the stadium, saying something about the mess of recreating the Colosseum with lions, tigers, and jaguars.] Finally, given the nature of our data, the presentation of the results is unexpectedly ethnographic. As we shall see, most sessions fail to even come close to solving the scavenging problem, but one session per treatment is rather successful. We thus present our results as a systematic description of individual societies, garnered through observation and experimentation. This is largely accomplished by reporting what our participants say and do. Words, even unmeasured ones, are data too.

2.1. Environment and institution

Each participant in the experiment controls a colored avatar to traverse the experimental world and interact with other participants' avatars. The world is divided into two regions: the western 1/3 is designed as a gathering area, and the eastern 2/3 is designed for power scavenging. Appendix A displays a physical map of the entire world. Participants can only view a limited area centered about their avatar. The colored rectangles in the west indicate the limited world view of the participant (see Fig. A1). Avatars move by left clicking on a spot within their field of vision. Participants can track their position in the expansive world by using a mini-map, located in the top-left portion of the interface.

Each experimental session includes 9 participants and consists of 27 periods, each lasting two minutes and 45 s. We subdivide each period into a day (2 min) and night (45 s). Participants earn cash based upon how "healthy" they are. At the beginning of each session each avatar is endowed with 50 units of "health." After every passing second, their current health score is converted into cash at a rate of 1/10 of a US cent per health point. The interface displays their current rate of earning in terms of cents per minute. Every second, the participants lose 0.056 points of health, which is explained to the participants as "metabolism." An avatar's health can neither fall below zero nor rise above 100 points. The participants' task during the day is to replenish their health by collecting resources distributed throughout the virtual terrarium.

The instructions explain how to accumulate health by locating and gathering berries and bone marrow (see the Appendix B for the instructions). Participants can collect berries and marrow by right clicking

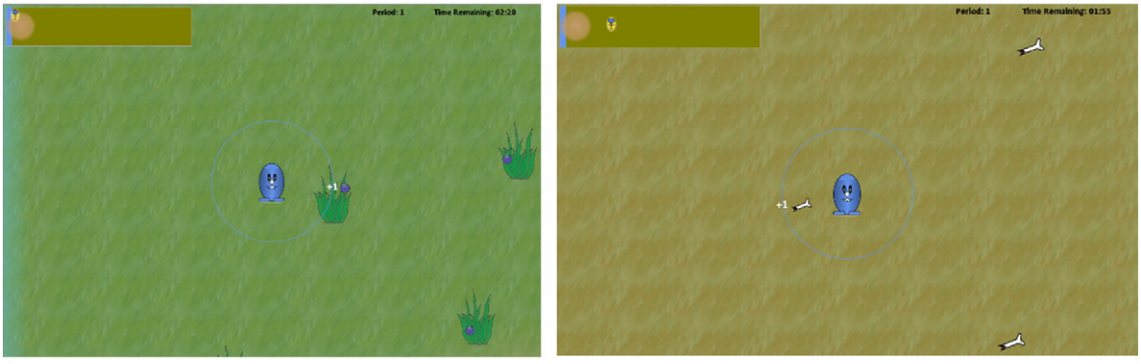

Fig. 1. Screenshots of an avatar gathering berries and marrow.