Cultural Transmission and Technological Transitions during the Late Paleolithic in Korea

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Archaeologists have applied evolutionary concepts linking material evidence and cultural phenomena to understand human behavior. Evolutionary approaches suggest that technological transitions can occur through changes in social learning processes, and transmission biases are important loci of changes. The onset of the Late Paleolithic period in Korea, represented by the appearance of stemmed points and blades, is a key event in understanding modern human dispersal in Northeast Asia. Previous studies mainly focus on possible origin locations of new technologies, but they rarely address the process of the technological transition. In this research we use a cultural transmission framework to investigate the social contexts that can give us insights into the emergence of these new technologies. Our main question is: what was the dominant mode of cultural transmission during the time of technological innovation in the Korean Late Paleolithic? Inspired by Bettinger and Eerkens (1999), we build two models using guided variation and indirect bias. To test the models and understand the transmission processes, we use coefficients of variation (CV), and Principal Component Analysis (PCA). Here we show that the information about the new technology was transmitted via selective combinations of guided variation and indirect bias. We found that some attributes including length and width were transmitted through indirect bias, while other attributes appear to have been more dependent on raw materials or other factors.

# Keywords

Stemmed points; Korean Paleolithic; Cultural Transmission; Learning process, Transmission Biases

# Introduction

The application of evolutionary theory to archaeological research has guided the interpretation of technological transitions and related human behaviors (Dunnell 1980; Lipo et al. 1997; Bettinger et al. 1997; Bettinger and Eerkens 1999; Mesoudi and O’Brien 2008). For example, archaeologists have used evolutionary theory and methods to study human behavioral ecology, cultural transmission, artifact phylogenetics, and niche construction in the past Garvey (2018). We use cultural transmission theory to investigate technological transitions during the Korean Late Paleolithic. This technological innovation is not just the appearance of new tools such as stemmed points and blades, but may also represent a key event related to modern human dispersal in East Asia, if the appearance of these new technologies represents the first arrival of modern humans in this region (Chuntaek Seong 2009). Previous studies mainly focussed on the possible origin locations of stemmed points, to connect Korea with global patterns of modern human dispersal. Questions about the processes of technological change remain largely unanswered (Chuntaek Seong 2008; K. Bae 2010; C. J. Bae, Douka, and Petraglia 2017). In this research, we apply a cultural transmission framework to investigate the social contexts of the emergence of new technologies in the Korean Late Paleolithic. Our main question is: what is the dominant mode of cultural transmission for technological innovation in the Korean Late Paleolithic? Additionally we ask: Do the modes of cultural transmission vary over space? Do the modes of cultural transmission vary over time? We consider three possibilities, guided variation (trial and error), or indirect bias (copying others), or a combination of the two. Our results can help to determine if these new technologies were introduced from outside of the Korean Peninsula, or if they were locally, independently developed.

# The Late Paleolithic of the Korean Peninsula

The onset of the Late Paleolithic period is marked by the appearance of stemmed points around 40-35 ka. The stemmed point is a projectile point made out of an elongated flake or blade with slight retouch on the proximal end to shape an acute tip, and on the distal end to make a stem, which connects to a shaft. The stemmed point is the first composite tool type and represents new hunting strategies in the Korean Peninsula, as well as other adjacent regions (Chuntaek Seong 2008; G.-K. Lee and Sano 2019). Stemmed points, combined with blade technology and multi-stage production sequences, and evidence of being resharpened and reused, are important aspects of Late Paleolithic technological innovation in Korea because these features are rarely seen in earlier periods (Chang 2013; Bamforth 2009; Chuntaek Seong 2015). Currently the earliest stemmed points in Northeast Asia are from Yongho-doing site in Korea dated to 38.5ka and made on elongate flakes (Chuntaek Seong 2009, 2015; C. J. Bae, Douka, and Petraglia 2017). After their first appearance in Korea, the stemmed points spread to the Japanese archipelago (Chang 2013).

Previous studies of technological transitions during the Late Paleolithic in Korea mainly focussed on possible origin locations of stemmed points, along with the issue of the timing and routes of the dispersal of modern human dispersals in eastern Asia. The debate about the origin of stemmed points can be summarized into two competing models: in situ evolution (Chuntaek Seong 2009) and heterogenic migration (K. Bae 2010). The in situ model claims that stemmed points and other Late Paleolithic assemblages including blade industries autonomously emerged in the Korean peninsula, as a form of convergent evolution (C. Seong 2006; Chuntaek Seong 2008, 2009). To support his claim of an in situ development, Chuntaek Seong (2009) examined the blade-to-flake ratios of stone artifact assemblages. In his view, the blade industry represents a new technology while flakes indicate a continuously-used existing one. He argues that the increased ratio of blades in stone artifact assemblages during the Late Paleolithic shows an expansion of the new technology after its local invention. In addition, Seong argues that increased numbers of stemmed points over time, and standardization of their shape, supports the idea of gradual, local, evolutionary process.

The migration model argues that the new blade industry including stemmed points and the earlier simple flake tool tradition, including large cores, polyhedrals, choppers and handaxes, came from different origins (K. Bae 2010; C. J. Bae and Bae 2012; C. Bae, Bae, and Kim 2013). While the in situ model claims that the heterogenic character is the result of indigenous development, the migration model proposes that it is the result of the continuous influx of modern human populations from both north and south. Specifically, the blade technology was introduced from Siberia, Mongolia, or other regions of northeast China following the Liaohe and Sunghe rivers around 35 ka BP while the simple flake tool tradition came from southern China (C. Bae, Bae, and Kim 2013). The migration from the southern route is supported by genetic studies of the Y chromosome, indicating that the O3-M122 M122 haplotype originated from southern East Asia and moved to northeastern Asia including Korea in 30-25 ka BP (Shi et al. 2005). Bae et al. (2012) assume this southern migration was related to paleoenvironmental fluctuations during the MIS 3 to 2 transition, which made the Yellow Sea/West Sea region open.

Lee (2013) argues that the transition to the Korean Late Paleolithic might be more complicated than those models of migration or in situ development. He partly agrees with the in situ model that simple flake tools had continuously been used in Korea as the result of ancestor-descendent relationships, under conditions of low effective population size. With regard to the blade industry, he claims that low degrees of uniformity and small quantities of blade-associated toolkits indicate an origin outside of Korea, perhaps resulting from trade or migration. We explore these three options, in situ, migration, and a mixture of the two, by measuring transmission biases in assemblages of stemmed points.

## Cultural transmission and transmission biases

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