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A GIS of affordances: Movement and visibility at a planned colonial town in highland Peru☆

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ABSTRACT

Archaeological GIS is moving towards increasingly detailed, embodied, multidimensional simulations and analyses of human experience in the past. Most of the emerging GIS research synthesizing spatial modeling and subject-centered approaches has been concerned with practices and perceptions of landscape. This paper tightens the analytical focus to the more intimate scale of a single settlement, combining models of movement and visual experience within a planned colonial town in highland Peru. Such a rendering is important, since controlling movement and visual experience were central to the colonial project that built this and other such towns in the Viceroyalty of Peru. This study centers on an exceptionally well-preserved, relict planned colonial town in highland Peru to investigate affordances of movement and visibility within it. Several GIS-based simulations and analytical techniques are brought together, including drone-based high resolution three dimensional modeling, spatial network analysis, walking models, and cumulative viewshed analysis, to simulate aggregate visual experience as people moved through the town. The results are suggestive of how the layout of the town specifically routed transit to facilitate the visual prominence of the church and original Inka plaza of the reducción, as well as the prominence of indigenous elite households. Both continuities and discontinuities of movement and visual experience relative to Inkaic and Spanish colonial spaces are evident. By extension, this paper also provides a pathway for quantitative and reproducible modeling of site-scale movement and visual affordances as dimensions of subject and community formation in other global contexts.

1. Introduction

Colonialism proceeds in large measure through attempts to reorder space in the likeness of the colonizers' ideal self-image—through a colonization of landscape, settlement, domicile, and ritual space (Scott, 1998; Sluyter, 2002). In the case of the Spanish invasion and colonization of the Americas, such placemaking was anchored to urbanism, as Spaniards founded colonial cities and enacted programs of forced resettlement of indigenous populations (Cummins, 2002; Kagan, 2000). Nowhere are the effects of enforced Spanish urbanism more evident than in the Andean region of South America, where much of the population continues to reside in planned colonial towns built during a mass resettlement program in 1570s (Mumford, 2012).

Rarely, however, have archaeologists attempted to use GIS to explore processes of Spanish colonial placemaking at the level of everyday practice in particular settlements (but see Liebmann, 2012; Quilter, 2011; VanValkenburgh, 2012; Wernke, 2007, 2011, 2012). Here, we use GIS-based modeling to model movement and visual experience within a planned colonial town in highland Peru. We build on the perspectives of Gillings (2012, 2009), Howey (2007, 2011), Llobera (1996, 2012), Lock (2010, 2000), and others (e.g., Kosiba and Bauer, 2012; McEwan, 2012; Rennell, 2012) who explore past placemaking by using GIS as a heuristic and interpretive tool through reproducible and robust spatial modeling. In this sense, this paper works in the "middle ground" (McEwan and Millican, 2012) between quantitative, spatial analytic perspectives and experiential or phenomenological approaches. The model of movement and visual experience presented represents a significant step toward a more comprehensive model of the *affordances* of walking and visibility within the built environment in a planned colonial town. The model builds a high resolution three dimensional model of the town and enables a view of combined and aggregate movement and visual experience—that is, areas where

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people were more and less likely to traverse, and what they were more and less likely to see. This is a different pathway to past experience from that of the phenomenological approaches that first emerged in the 1990s (e.g., Bender, 1993; Tilley, 1994), in which the subject position of the archaeologist was variably privileged as a vessel for conveying experience or sublimated as a kind of ventriloquist's dummy for past social actors (For discussion, see Brück, 2005; Gillings, 2012). Here, no claim is made about experience from any particular subject position, but rather movement and visual experience in aggregate—the affordances of movement and visual perception—is simulated in a high fidelity spatial framework.

Such an experiential approach promises to advance understanding of how a new kind of society emerged in the Andean region of South America following the Spanish invasion. A colossal Spanish colonial program of forced resettlement—what is known as the *Reducción General de Indios* (General Resettlement of Indians; hereafter *Reducción*)—displaced some 1.5 million native Andeans into over a thousand compact towns (*reducciones*) built around plazas and churches in a single decade—the 1570s (Mumford, 2012). After a generation of plunder, indirect rule, and in-fighting among Spaniards, the crown sent the Viceroy Francisco de Toledo in 1569 to hammer out the basic forms of colonial governance in Peru. Toledo's reforms called for the reorganization of Andean settlement and community life from the ground up through the Reducción and an accompanying census (to calculate a new head tax), a regimented tribute and labor quota system, and a corps of provincial magistrates (*corregidores de indios*) to oversee it all (Spalding, 1984). As the centerpiece of the reforms, the Reducción was predicated on the notion (based on certain Mediterranean cultural assumptions) that building idealized urban spaces in miniature would *produce* a new kind of colonial society. That is, Toledo saw resettlement as not just a precondition for the production of properly Christianized and civilized subjects, but as actually generative of them (Cummins, 2002; Mumford, 2012; VanValkenburgh, 2012; Wernke, 2013).

2. Toward a theory and GIS of relational affordances

Toledo was mistaken, of course, since relationships between the built environment and social forms and forces are not so deterministic. As Thomas Gieryn succinctly put it, "Buildings stabilize social life. They give structure to social institutions, durability to social networks, persistence to behavior patterns … And yet, buildings stabilize *imperfectly* … Buildings don't just sit their imposing themselves. They are forever objects of (re)interpretation, narration and representation" … (Gieryn, 2002: 35, emphasis in original). Buildings channel movement, constrain and accommodate possibilities for interaction, and afford certain experiences. But they are also products of human agency. Settlements and buildings are embedded in and constitute landscapes, even as they are rebuilt, remodeled, repurposed, reinterpreted, abandoned, and demolished (Lefebvre, 1991; Smith, 2003). In a colonial context such as the viceroyalty of Peru in the late 16th century, the significance of buildings, settlements, and cities was very much in flux in semiotic terms (what buildings mean, and thus, what buildings do) and in relation to their historical landscapes (Cummins, 2002; VanValkenburgh, 2017; Wernke, 2011, 2013). Clearly, building gridded towns around plazas and churches would not so unproblematically produce model Christian subjects.

It is appropriate to begin an analysis of the built environment in a colonial settlement with an eye to the *affordances* of movement and visual experience. Here we build on the concept of affordance as a framework for examining the experiential qualities of the built environment. The affordance concept was initially adapted in archaeological GIS by Llobera (1996), and recently has been further elaborated by Gillings (2009, 2012).[1] The term is derived from the theory of direct perception as first articulated in the field of ecological psychology by James Gibson (1966, 1979). Gibson's theory begins with the premise that in an act of perception, meaning is not just produced in the brain of the perceiving agent (human or nonhuman animal), but rather that it is embedded in the environment. The corollary is that the environment is not only made up of its physical constituents, but meaning as well. Such a construction runs counter to the modern consensus of the world as irreducibly physical, so the theory of direct perception requires an ontology (Chemero, 2003). This is what Gibson's concept of affordances intended to provide.

However, as pointed out by Chemero (2003), and more recently in the archaeological literature by Gillings (2012), Gibson's own writing on affordances was not entirely coherent. His most commonly cited formulation suggests that an affordance is essentially a resource "out there" to be gathered through the abilities of an interacting organism; thus, an environmental affordance is "… what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill" (Gibson, 1979:129). But elsewhere he describes an affordance as evanescent and dependent on the presence of an interacting organism: it is "… neither an objective property nor a subjective property; or it is both if you like." Later, perhaps most clearly, Gibson comes around to affordances as the essential perceptible properties relative to one's habits of biophysical and cognitive engagement with the environment:

> The psychologists assume that objects are *composed* of their qualities. But I now suggest that what we perceive when we look at objects are their affordances, not their qualities … what the object affords us is *what we normally pay attention to* (Gibson, 1979:134, emphasis added).

Subsequent debate hinged on whether affordances were essentially resources or emergent properties (Chemero, 2003; Gillings, 2012:605; Jones, 2003; Stoffregen, 2003). Llobera (1996), and recently Gillings (2012), building on Chemero (2003), advocate a *relational* theory of affordances, which bridges this dichotomy by positing that affordances are properties of neither animals nor environments, but rather exist as *relations* between the two. In this framing, affordances are conceived as the possibilities for action under a given set of environmental features and a given set of *abilities* by the interacting agent (Stoffregen, 2003:118). "Ability" here is doing some heavy conceptual lifting. Much of the discussion settled on ability as directly related to body scale and biomechanical measures (Heft, 1989; Warren, 1984; Cornus et al., 1999). For example, Warren (1984) has modeled the affordance of stair climbing as a ratio between leg length and stair riser height. Others in the ecological psychology literature have emphasized abilities as mutable biophysical and cognitive capacities or aptitudes—in the case of stair climbing, how ability over the life course can change independent of leg dimensions (Chemero, 2003; Stoffregen, 2000; Turvey, 1992). However, both approaches are concerned with the epistemological status of affordances as objective (albeit relational) properties.

It is on this point that positions appear to diverge in the importation of the affordance concept in anthropology in general, and archaeological GIS in particular. Gillings (2009:606) advocates for their objective status, citing an illustrative example by Chemero. Chemero (2003:193), likens a (relational) affordance to an object that is "lovely"—in his example, a female hippopotamus. As he puts it, a female hippopotamus is lovely regardless of the presence of a

[1] For an overview of the concept, see Jones (2003).