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# GIS AND LANDSCAPES OF PERCEPTION

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## Introduction

Theories of space and place, and the concept of landscape, have rarely been of greater interest, for either the archaeological community, or the wider public. In particular, the diverse reactions to the New Archaeology, broadly labelled 'post-processual', have stressed the qualitative and subjective aspects of humanity as emphasized within phenomenological and hermeneutic approaches. Geographical Information Systems, on the other hand, derive from the world of abstraction and quantification, not least the needs of planners, developers and the military, to which post-processualism represents at least a partial reaction. A superficial assessment of the two, therefore, does not cast them as obvious bedfellows.

It is this relationship which is explored in this paper – Its nature, its causes, and some of its implications for the analysis of archaeological data. In particular, GIS has become increasingly central in the analysis of surface survey data, and the following discussion is framed principally within this context. Zubrow (1990) and Harris and Lock (1995) have provided previous reviews summarising the development of theory in GIS and archaeology – progress since their publication is reviewed and, in particular, some attention is devoted to the role of perception as a basis for reconciling methodology and theory.

## Field Survey Data and GIS

GIS has obvious functions in the analysis of physical landscapes, and this has recommended its application to regional survey in particular. The reason for this apparently ideal marriage appears to relate to the strong environmental tendencies towards which both GIS and survey data stray when used uncritically. Surface survey, at its most reductionist, has the potential to produce little more than maps of dots, fixed at certain precise points at certain times in the landscape. This consequently increases the emphasis placed upon easily generated '*post facto'* variables, principally those relating to the mapped environment. Likewise GIS makes use of the same easily accessible environmental data, and through basic processes such as overlaying, can quickly generate endless environmental variables, such as slope and aspect, for our survey dots.

Therefore, in describing and contextualizing survey data, GIS provides the landscape archaeologist with a useful tool. However, a danger lies in confusing such description

with interpretation. Wheatley (1996: 90) and others have placed much emphasis on the need to distinguish association from causation. Further, not least due to the large amounts of environmental data involved, such confusion more often than not promotes an excessive environmental determinism, reminiscent of some schools of approach advocated as part of the New Archaeology.

This article aims to explore how GIS can move beyond simplistic description, and begin to provide an interpretative environment, grounded more explicitly within developments in landscape theory. This is not to deny the importance of GIS for the collation and description of data – Verhagen *et al.* (1995, Fig. 14.2) stress description as integral to interpretation, and Massagrande (1995a; 1995b) also demonstrates this in her attempts to integrate systematic and non-systematic data. GIS also clearly lends itself to work on survey biases, and their identification and elimination. For example, Terrenato and Ammerman's (1996) work on visibility could beneficially be developed within a GIS framework, though van Leusen's (1996) notion of 'unbiasing' archaeological data arguably makes a false assumption regarding the existence of an 'ideal' data set which can be retrieved.

## Notions of Space and Landscape

Landscape is a concept that defies clear definition, and more recent developments in theory have embraced this ambiguity. Archaeologists have begun to embrace landscape as socially constructed, subjectively experienced, and polysemic in nature (e.g. Bender, 1993: 3; Boaz and Uleberg, 1995: 252; Green, 1990: 358). Integral to such hermeneutic and phenomenological approaches has been a de-quantification of space, permitting landscape to be social and qualitative, as well as economic and geometric.

| *Abstract/scientific* | *Humanized* |
|---|---|
| Decentred | Centred |
| Geometry | Context |
| Surfaces | Densities |
| Universal | Specific |
| Objective | Subjective |
| Substantial | Relational |
| Totalized | Detotalized |
| External | Internal |
| System | Strategy |
| Neutral | Empowered |
| Coherence | Contradiction |
| Atemporal | Temporal |
| Absolute | Relative |
| Static | Dynamic |

*Table 3.1. Abstract/scientific and humanized notions of space. After Tilley 1994: 8.*

The apparent contrast between these scientific and humanized perspectives of space is well illustrated by Tilley's summary of the differences between the conceptions of space characteristic of New Archaeology (abstract) and post-processualist archaeology (humanized). The contrast of the two approaches can be summarized as *quantitative: qualitative*, though Tilley stresses that neither group is mutually exclusive (Table 3.1).

## The Nature of GIS – spatiality and temporality

A brief review of the historical development of GIS illustrates why it should fit so clearly into the abstract and scientific perspective of space outlined above, and why therefore, it appears to represent a contrast to post-processual approaches which stress the status of space as an active medium.

In its basic principles, GIS is based upon traditional cartography. As such, the two share the same historical context, not least in association with the philosophical developments of the Renaissance. At this time, the notion of space was shifted into the realms of mathematics and physics, and subsequently developed as an atemporal and geometric backdrop. It is this conception of space that underpins both cartography and GIS. Maps, whether paper or digital, thus perpetuate space as absolute and neutral. Yet it is this apparent neutrality which helps to disguise the value-laden nature of this approach to space. As the title of Wood's '*The Power of Maps*' (1992) implies, cartography is far from the objective science for which it is often mistaken. Indeed, much of this eponymous power derives from the fact that cartographers have actively cultivated the myth of the disinterested scientist, through the 'Naturalization of Culture' (Wood, 1992: 76, 94).

Hence cartography not only conveys a specific notion of space, reducing subjective emotions and sensuous experience into pseudo-scientific interpretations of reality; it also constitutes these realities. Each map creates its own version of the world, as mediated by the interests of its author. GIS, is no exception to this, and Martin (1996: 258) succinctly makes this point, by referencing Wood, in a section entitled '*The Power of GIS'*. Miller and Richards have emphasized that GIS might promote an even greater air of authority due to its slick graphics and association with information technology (Miller, 1995; Miller and Richards, 1995: 21; cf. also Gaffney, Stančič and Watson, 1995: 211).

Central to the Newtonian orthodoxy that underlies the generic GIS is the further abstraction of space from time – each is an independent variable. This approach to temporality also contrasts with recent developments in theory (Gosden, 1994; Tilley, 1994 *inter alia*). Tilley's list of contrasts between abstract and humanized space is equally valid for the concept of time. Yet the treatment of temporality in DBMS and GIS is, in general, a complex issue, even when considered as a constant (Castleford, 1992; Langran, 1992). The key problem lies in the ability to combine data that are variables not only in space, but also in time.

Time is obviously of critical importance in archaeological applications of GIS, and there has been much discussion of the problems (cf. Castleford, 1992; Harris and Lock, 1995: 354; Verhagen *et al*., 1995: 189). However, most GIS remain effectively atemporal.

There are various conceptual techniques for addressing this issue, though most commonly it is accommodated through the use of 'time-slices', or discrete map layers, for each archaeological phase (e.g. Perkins 1999). It should be noted however, that such an approach perpetuates the separation of time and space as abstract and independent constants. Addressing concepts of time which are non-linear and intimately related to, and inseparable from, space and social practice represents a much greater challenge than that presented by space alone.

## GIS and Archaeology

This discussion of the historical development of GIS within archaeology is intended to offer some context for the earlier applications of archaeological GIS, and to account for their form. This should serve to contextualize and illustrate the aims of more recent research.

As mentioned above, the main criticism of the first wave of GIS applications has concerned the degree of, often implicit, environmental determinism. Wheatley has labelled the theoretical stance of work by Altschul (1990), Carmichael (1990), Warren (1990) and others as ‘ecological systems theory’ (1993: 133; also Gaffney and van Leusen, 1995; Harris and Lock, 1995: 254-8). With the benefit of hindsight, the degree of determinism in these applications is obvious, being more reminiscent of the 1960s and 1970s than the late 1980s and 1990s. Arguably, the novelty and gloss of GIS was the motivation behind its application to much archaeological work. Many have characterized early uses as a technique in search of an application – driven by the technology, and not led by clearly defined research problems. These have utilized the most obvious and basic of GIS functions, often failing to acknowledge explicitly the need for a clear theoretical standpoint, due to the pretension of neutrality discussed above. Without the parallel development of a body of theory to guide and offer its own inherent theoretical agenda, GIS was always likely – and will continue – to promote interpretations which emphasize economic rationality and environmental determinism.

Some theoretical support for the environmental emphasis of both survey and GIS applications may be found in the *Annales* paradigm, and notions such as the *longue durée* (Bintliff, 1991; Knapp, 1992; Small, 1995). This stresses the importance of the environment in the long-term development of human settlement, but also attempts to integrate this with the historical events and demographic trends that occur on shorter time scales. The aim is to bring together the disparate strands of historical and archaeological data which, on the surface, ‘do not seem to stem from the same culture’ (Small, 1995: 15), in order to produce a more rounded interpretation of the past. Although the actual interaction of these different scales of time remains ambiguous, this model stresses the inadequacy of just one source of evidence, in this case environmental, in interpreting the past, and GIS offers potential for collating and integrating these various temporal scales and sources of evidence. To date, however, analysis of survey data has tended to promote the significance of the *longue durée* with its associated determinist approach to culture/environment interaction, at the expense of the *conjoncture*, and especially, *l’histoire événementielle*.

## Post-Processual Applications?

Given this apparent incompatibility between recent theoretical perspectives on landscape and space, and the nature of GIS, is the latter really a suitable environment for the interpretative analysis of archaeological data? In particular, the apparent contrast of quantitative and qualitative perspectives might be seen as critical (cf. Tilley, 1994: 9 and 16). But does GIS research have to be restricted to the economic and environmental? Building on the criticism of earlier applications, there has been recognition of the need to focus increasingly upon social, ritual or cognitive aspects (cf. Stead, 1995: 313; Wheatley, 1993). In other words, research is beginning to humanize GIS. This is not to suggest that more explicitly post-processual applications of GIS are to abandon a quantitative approach. As stressed above, this is embedded in the developmental context of GIS, and to operate in a purely qualitative fashion is to exclude much of its functionality and minimize its potential. What is does mean, however, is that through the quantitative framework of GIS, we should be focusing our investigations towards subjective aspects of the past. An example of this progress is Gaffney, Stančič and Watson's (1995: 213 - 219) reinterpretation of the Hvar data (cf. Gaffney and Stančič 1991).

Some of the research that has arisen in response to criticism of earlier work has been undertaken on a superficial level. Arguably much has been driven by the availability of various the functions of widely-used GIS software packages, a trend noted by Martin (1996, 186)in general applications. The two most popular examples are visibility analysis and cost-surface analysis, both offering seemingly simple alternatives to conventional environmental perspectives. However, in the rush from environmental determinism, there is a danger of failing to acknowledge the theoretical baggage that accompanies such software. For example, cost-surface analysis utilizes software designed to generate drainage patterns. Consequently, it utilizes the doctrine of minimum effort and least cost, relying upon, and perpetuating, economic ideas widely rejected within archaeology in general, for example, catchment analysis and Central Place Theory (cf. Hodges, 1987: 119-120). As discussed below, visibility software is also far from value-free.

Other research has developed within more explicit theoretical frameworks and this offers the greatest potential in integrating developments in both theoretical and GIS theory. Again, visibility and cost-surface analyses are the most popular approaches, but these attempt to acknowledge the assumptions inherent in the software. The most effective also go beyond simple description, and statements such as whether or not A is visible from B, and attempt to consider the wider social context of these visual relationships (e.g. Boaz and Uleberg, 1995; Lock *et al*. 1999; Ruggles *et al*., 1993; Wheatley, 1995). More subtle use of cost-surface analysis also acknowledges the rational and economic ideas behind such software and, for example, attempts to model movement across the landscape in terms of time, rather than simple Euclidean distance or effort. The results have been used variously to determine the extent of territories, modify simplistic site catchments, and explain spatial relationships (e.g. Gaffney, Stančič and Watson, 1995: 213 - 219; Stead, 1995; Verhagen *et al*., 1995).

All of these approaches, whether explicitly or not, build upon the notion of experiencing the landscape from within – they locate us in alternative realities. This represents a step away from the 'specular landscape' of the distribution map (Thomas, 1993: 25), towards the relative and qualitative landscapes of a more embedded past. The underlying tenet of these applications can be theorized more explicitly. Tilley (1994: 13), in his discussion of spatial philosophies, emphasizes the need to steer a course between the two extremes of empiricist objectivism and cognitive idealism. The former promotes an external reality, denying the existence of any (human) subject. On the other hand, cognitive idealism champions the subject, to the exclusion of the world outside. In terms of archaeological applications of GIS, these polarities can be seen to correspond with environmental determinism (e.g. Warren, 1990a), and cognitive processualism (e.g. Zubrow, 1994) respectively.

Tilley's (1994: 13) criticism of both relates to their failure to tackle the crucial question of perception. Rodaway (1994: 10) defines two relevant meanings for the term 'perception':

> 1) perception as the *reception of information* through the sense organs associated with sight, hearing, touch, taste, smell.
>
> 2) perception as *mental insight*, or a sense made of a range of sensory information, with memories and expectations.

For the sake of clarity, the former might better be considered as observation, though should not be confused solely with visual stimulus. However, it can be seen that neither cognitive idealism nor empiricist objectivism addresses both of these aspects – the former demands no *reception* of external information, as perception is reduced to a wholly internal process, and objective empiricism demands no *mental insight*, as there is an unquestioned external reality (cf. Martin, 1996: 185). The role of perception is therefore of central importance in the mediation of these extremes. To this end, Tilley proposes a compromise through the concept of *body*, or *Being* (1994: 14; cf. Gosden, 1994). This body mediates between the world outside, and the mind within, and houses the senses with which we understand and structure the world. Rodaway (1994: 12) also considers this relationship between mind and world to be negotiated via the body, for example its size, location and locomotion. Further, if we follow Rodaway's (1994: 12) claim that 'perception is corporeal', then the mediation of the world and the mind through the concept of body or Being, and the act of perception, can be considered as synonymous.

Hence, much recent visibility and cost-surface research is grounded in the idea of a physical presence within a landscape – the provision of a body as a point of contact, between the world and the mind. For all intents and purposes, such analysis offers us eyes and legs – we can see the environment; we move across it. Both Green (1990: 6) and Lock *et al*. (1999) have gone as far as to claim that the incorporation of hermeneutic theory has actually given GIS something of a mandate. But such analysis needs explicitly to encompass both the aspects of perception discussed by Rodaway above. Visibility and cost-surface analyses provide the information that is observed –

but we need to think carefully about how we relate this to the actual mental insight, the perception, such information offered to past populations.

Such claims appear to rest principally upon visibility analysis, and some interesting results are beginning to emerge. For example, Belcher *et al.* (1999) discuss the contrast between physical and visual access to Etruscan cemetery sites. However, there are still several underlying assumptions, relating to the Western conception of landscape, which deserve to be acknowledged more clearly. For example, our own society places great emphasis on sight and the visual. Yet as Rodaway (1994: 12-13) stresses, the use of senses to order the world is socially and culturally bound. As such, it is unwarranted to assume that such visual emphasis is universal. It is also over-simplistic to abstract the senses. Experience of landscapes is multi-sensual – they can be touched, smelled, and heard as well. Research is now beginning to incorporate these other 'Sensuous Geographies' (Rodaway 1994), for example, through the definition of auditory landscapes. However, beyond sensual encounters lie a wealth of emotional geographies (note the work of Tuan, 1977) which are not clearly suited to GIS analysis at all, yet still form a vital part of the phenomenon and experience of landscape (cf. Gillings and Goodrick 1996 for initial theoretical approach).

As discussed above, the simplistic application of convenient GIS software to archaeological data does not offer any quick solution to the accusation of determinism, and has the potential to perpetuate other equally untenable conceptions of the world. Any post-processual use of GIS needs to be conceived far more carefully, and the assumptions entailed given much more explicit discussion. In other words, we need to develop a much more reflexive approach to our research.

## Landscapes of Perception

An explicit acknowledgement of perception therefore offers the potential to greatly enrich rational economic approaches to landscape, and to assess *how* the environment was constructed, and consequently used (cf. Stead, 1995; Wheatley, 1993). The reason GIS offers a potentially good environment for this relates to its ability to manipulate abstract space, and assign it divergent values. As such, Wheatley (1993: 135) talks about 'developing relevant transformations of the physical landscape with which to model and understand this perception'.

Use of the concept of perception in GIS analysis to date has taken several forms. One of the most popular has developed a methodology using the idea of preference. This aims to discern perception of landscapes, through the environmental preferences of sites. This has been achieved inductively, using the known 'preferences' of settlements (Carmichael, 1990; Gaffney and Stančič, 1991; Warren, 1990a; 1990b), and deductively, comparing predicted with actual distributions (Wheatley, 1995: 172; Zubrow, 1994). These studies all work in the same basic way – the landscape is classified by various criteria, and the preference towards these units is quantitatively measured. Various environmental attributes can then be combined, through map algebra, in order to generate maps of complex multivariate responses, showing areas of greater or lesser attraction to settlement. These are then used to offer explanation for

spatial patterning in past settlement, and to construct potential past perceptions. This approach to culture/environment interaction clearly attempts to avoid the simplistic cause-and-effect interpretations outlined above, allowing for a greater degree of agency. Further, we do not have to rely solely upon environmental attributes. For example, we might attempt to classify the landscape according to such variables as fertility and security. These might be based upon interpretations of the values placed upon environmental attributes, not the attributes themselves. We might also incorporate information derived from cost-surface and visibility analyses.

The basic theoretical foundation of these applications can be found in the concept of the 'mental map' (cf. Downs and Stea, 1977; Gould and White, 1974). Derived from 1970s behavioural theory, the 'mental map' is both the notional map of one's surroundings allegedly held in the human mind, and its visual representation in the form of a contour map. The latter is generated by the mapping of individuals' responses towards spatially defined units, and summing their values to produce maps of perception. This approach has been examined by Attema (1992) in a non-GIS study, where the results are interpreted with reference to changes in subsistence, technology and socio-political structures.

## Some Problems of Perception and Preference

However, the concept of the ‘mental map’ is embedded in a positivist, rather than a phenomenological epistemology. Its loss of favour with psychologists and geographers is based upon its unwarranted assumptions, especially concerning rationality, continued reliance on stimulus-response, and the emphasis on the visual (Rodaway 1994: 16 - 18). A further problem concerns the creation of societal perception, through an aggregate of individual responses, implying communality as the aggregate of individuals. Arguably, however, community is something more than the sum of its parts, and the perceptions of both communities and individuals conflict and compete. For example, Tilley (1994: 16) differentiates perceptual space, being the egocentric space perceived by individuals, and existential space, being the space constructed by individuals socialized within a group. Hence the ‘mental map’ approach fails to acknowledge any of the power asymmetries encoded in landscapes and, much like the distribution map, promotes an universalist perspective.

This problem, however, is not solely a fault of GIS research, but is related to the interpretation of survey data in general. For example, it is implicit that the presence of settlement can be directly equated to use of the landscape – however, the practice of transhumance is an obvious example of landscape use which leaves few archaeological correlates (Barker 1989; Gaffney, Stančič and Watson, 1995: 212 on landscape value). There is an assumption that the number of sites can be equated with the relative importance of, or preference for, a certain area. Again, this betrays a reductionist approach assuming all sites are of 'equal value' in understanding how areas were used, and which areas of the landscape were 'preferred', and hence perceived. We should therefore guard against allowing GIS simply to perpetuate existing interpretative frameworks – it should both make us think more critically about our data, and allow us to develop new ways of interpreting it. As noted above, if the relationship of survey data

and GIS is based upon environmental issues alone, the results will be less than satisfactory.

GIS analysis to date, however, has also continued to focus on the issue of human/environment interaction. This is clearly a symptom of the dearth of socio-economic data, beyond viewsheds and cost surfaces, with which to divide the landscape into perceptible zones. The challenge lies in producing geographically anchored information, the lack of which is noted by Gaffney and van Leusen (1995: 368; Green, 1990: 5).

The key criticism however, is its failure to clarify the nature of perception, and its relationship with preference, visibility and observation or sensing. In each case there is a danger of assuming a simplistic one-to-one correlation, promoting a form of systems thinking, whereby we know the input and output of a system, and consequently can identify the perceptions which mediate the two. A clearer approach to the relationship of preference and perception considers the former to be the *product* of the latter. Hence, it is not the environment *per se* which determines landscape use, but perception of it (Rodaway, 1995: 13; Wheatley, 1993: 135). People's decisions to settle and exploit one area in preference to another, are related to how that landscape and its attributes have been perceived and structured (Stead, 1995: 313). As discussed above, it is this role of perception as mediator between the world and the mind, which forms the key to constructing more balanced interpretations of the past.

## A Role for GIS?

The definition of landscapes – social and political, rather than purely physical – has been a feature of archaeological research for some time. Perhaps the best known of these are so-called 'ritual landscapes' and 'landscapes of power' (Renfrew, 1984: 244; also cf. De Guio, 1995: 15 for computer modelling of 'landscapes of power'). However, there are a host of other potential landscapes – of status or competition and of inequality or exclusion (e.g. Mrozowski, 1991). All of these offer socio-political input to landscape archaeology. As such, they offer guidance for our attempts to humanize GIS models, particularly through perception, and to develop a theoretical body which more explicitly harmonizes with recent archaeological thought.

The central problem raised here is whether GIS is a suitable environment with which to transcend the problems of determinism, and attempt to look at the concept of perception, and if so, how we go about it. Do we, for example, wish to represent more abstract readings of the landscape in two (or more) dimensional forms? Should we attempt to map a 'landscape of power', and if so, how? Alcock (1993: 17) alludes to the problem in her non-GIS synthesis of Greek surface survey data, though does not make clear how, or if, this is possible or even desirable. Gaffney, Stančič and Watson (1995: 222) also refer to a 'mappable, spatially variable index of perception'.

The idea of creating two-dimensional surfaces to represent perception stems from the notions of 'landscapes of power' – if we can map physical landscapes, why can we not give cartographic form to more abstract landscapes, such as power, resistance and ritual? It is an obvious extension of GIS's abilities, in particular, assigning different

values to different units of space. In other words, can we turn the Cartesian system to our advantage on the assumption it is a 'universal' language within which to express ideas? If so, we must acknowledge the observations of both Gould and White (1974: 30) and Downs and Stea (1977: 6) on the problems of measuring and mapping perception, the latter stressing this perception as 'process, not object'. We need to explicitly theorize how we express such processes in terms of both conventional and innovative cartographic techniques, mapping social spaces within the formal grammar of GIS (cf. Barceló and Pallarés, 1996; Llobera, 1996).

## Constructing perception surfaces

As an offshoot of predictive modelling for Cultural Resource Management, some US archaeologists have adopted a deductive approach to this problem. These include Zubrow's (1994) *'Knowledge representation and archaeology: a cognitive example using* GIS*'*. Although developing a cognitive approach to the data, we might use his suggestion that a deductive approach to such abstract surfaces can allow us to find better or worse explanations. Hypotheses cannot be proved, but they can be falsified, or their relative suitability assessed.

An example may illustrate both the potential and the problems of such an approach. In creating a 'landscape of power', we might state that the strength of political power is in direct proportion to proximity of its source (Cherry, 1987: 164-66; Cosgrove, 1989: 128). As such, we could construct a surface that mapped power around its point(s) of origin (cf. Cherry, 1987: 160 on storage of social power through monuments). We could then compare this predicted or ideal landscape, with known settlement locations, in order to identify whether sites avoid such power, or are clearly within its extent. There are several key problems here:

Assigning spatial extent to the abstract notion of power. This is both the strength and the weakness of the approach. GIS offers a flexible environment in which space can be assigned different values in order to model or simulate certain processes. Yet, these surfaces are totally artificial, and the values involved are abstract. Hence, we must be honest and explicitly acknowledge these limitations from the start.

Equating power with distance is rather simplistic – there are many well-known techniques to overcome this problem in periods pre-dating the telecommunications era. For example, coinage and literacy.

It is necessary to offer a perspective – who is perceiving this power? Does it represent what an elite believed they controlled, or how certain social groups perceived such power?

## Future Directions – GIS and perception

The above discussion has reviewed the nature of GIS in terms of its historical context, and the role of perception as part of an on going 're-humanizing' of the technique. The implications of some of these are summarized below:

GIS, as a methodology, is not theory-neutral. It therefore has potential to produce quite specific interpretations of the past (Wheatley, 1993: 134 on GIS's 'hidden agenda' and Gaffney, Stančič and Watson, 1995: 231 on GIS as 'a tool to create spatial relationships according to *values we regard as important*.' (my emphasis)). We must therefore guard against circularity in our interpretations.

GIS, like the distribution map, has the potential to be specular. Without care, interpretations built upon these foundations risk the charge of meaningless abstractions. This is where the role of perception offers the archaeologist a useful tool. Careful use may also allow us to break down simplistic blanket labels, such as Roman and Other, and to explore the more subtle shades of identity which operate on different scales through the landscape.

The act of perception presupposes a subject – it is therefore vital that we define the situation or context of any perception surface. In other words, whose perception are we reconstructing? As stressed throughout, landscapes are the infinite interpretations placed over the world (Tilley, 1994: 11 on landscapes as 'contextually constituted') – there is no single correct perception of the world. As such, to talk of a 'landscape of power' is meaningless without some idea of the social or cultural context of the person(s) doing the perceiving (cf. Mattingly, 1997 for discussion of discrepant discourses or experiences of empire with bearing on multiple interpretations of landscape).

Discussions of the expressions of power and social order across the physical landscape have tended to concentrate on planned or designed examples, most obviously the centuriated landscapes of the Roman period. Despite this, we might note the assertion that all landscapes are symbolic (Cosgrove, 1989: 126; Meinig, 1979: 228 quotes Jackson). Hence we need to develop ways with which to detect similar expressions in so-called 'ordinary' or 'vernacular' landscapes in order to spatially-reference our perception surfaces (Cosgrove, 1989: 126).

These points need to be considered in the light of several recent observations concerning ideas of space and the use of GIS within archaeology generally:

There is an apparent contradiction in ideas of landscape and space as discussed by Tilley, Gosden and others, and discussion of the nature of GIS. For example, Tilley's (1994: 7) 'questioning of 'scientific' conception of space abstracted from human affairs' might well be directed at GIS. Gosden (1994: 16) adds that 'the space of human action is not a geometric entity to be easily represented on a piece of paper'. Yet despite this, through the explicit coupling of post-processual theories and GIS methodologies, it is possible to use GIS as an environment in which to create and tests models of the past. Recognising that our world view abstracts time from space need not prevent us from working through this widely understood paradigm, in order to create and understand the past. To reject it entirely risks paralyzing any attempt to understand the past on anything other than a completely parochial basis.

As an alternative to the behaviour/cognition approaches to perception, Rodaway (1994: 19 – 22) has adopted and developed Gibson's Ecological Model (not to be confused

with Wheatley's ecological systems theory discussed above). This approach to perception is built upon the notion that the world does not consist of random stimuli, but is structured by the environment – surfaces, edges, textures and movements – through which it passes. It therefore provides ordered information, and not just raw data, to the senses (cf. also Gillings and Goodrick, 1996; Ingold, 1992; Llobera, 1996). As a middle course through the two principal philosophies outlined above, this theory has much potential in the study of perception. For example, rather than assuming a static environment, the Ecological Model is based upon a mobile observer. This has implications for the construction of viewsheds – we might therefore attempt to model the way in which monuments come into and out of view as we move across the landscape (Exon *et al*., 1996).

The physical extent of both archaeological and environmental data, be they individual sites, geological areas or political boundaries, often defy the spatially deterministic nature of GIS (Harris and Lock, 1995: 358; Miller and Richards, 1995: 21). As such we need to develop ways in which our research might accommodate such degrees of confidence, and avoid the dangers of GIS creating the impression of reliable and complete data (Miller 1995). Fisher's (1994) work on probable (and possibly fuzzy) viewsheds has potential here.

The representation of sites as dots is unacceptably reductionist (Harris and Lock, 1995: 354; Millett 2000). However, this is principally a problem of the data. Given survey data collected in an appropriate manner, site definition becomes a practical, not theoretical, problem. For example, GIS is a continuous environment, yet most Mediterranean surveys to date are not – this issue is currently being explored as part of the Sangro Valley survey (Lock *et al*. 1999). The full benefits of off-site survey have yet to be realized within a GIS, and as such we might add the generation of such data sets to Kowalewski's (1990: 37 - 75) list of benefits of full-coverage survey.

Simplistic use of GIS, as with any cartographic technique, has the potential to disguise significant power asymmetries, skimming over the diversity of the landscape. The failure to incorporate density into landscape analysis is therefore to risk denying the spatial aspects of knowledge, and its use in the maintenance of power relations (Thrift, 1985: 366). Thomas (1993: 25) cites this bias to the visual or the specular as a general problem in landscape archaeology.

## Conclusions

This article has discussed attempts to reconcile the abstract and scientific nature of GIS with the more subjective and phenomenologically grounded approach to the past, which has become prevalent in general archaeological theory. This has principally focused upon the concept of perception, especially as a method of mediating the extremes of spatial theory.

Used uncritically, the rational and geometric environment of GIS will not only generate deterministic explanation, but will also perpetuate existing approaches to the interpretation of survey data, for example, confusing systematic survey, full-coverage survey, and the 'ideal distribution map (Dewar and McBride, 1992; Hamond, 1980).

Within the discipline of geography, Martin (1996: 187-8) has questioned whether GIS simply represents an automated method to speed up existing research, or whether it has the ability to fundamentally change the conduct of the subject. This should work on two levels in the integration of GIS into archaeological survey work. Firstly, it should help us challenge the existing interpretative frameworks, and to use survey data more effectively. And secondly, we need to consider the abilities and demands of a GIS before we start to collect our data. This is not to make GIS the sole methodological director of our fieldwork, but, as in any discipline, to consider how we want to use our data, before we actually collect them. Current retroactive applications of GIS suffer from working with data generated by unsuitable methodologies, leading to less than optimal returns upon the investment of time needed to make them usable. Hence, through the integration of data collection and analytical methodologies, there is the potential to derive far more information from our data, and to break away from existing conceptual frameworks. In this way, we can begin to assess, not just the interaction of culture and environment as two independent and juxtaposed concepts, but how the two act to define and structure each other as part of a dialectic.

There has been much research published since the papers of Zubrow (1990) and Harris and Lock (1995). This paper has attempted to expand upon some of these developments, and the reasons why other areas have experienced less significant progress. GIS offers significant challenges to the integration of post-processual theories, yet the observations of this paper should be interpreted positively. Cultural behaviour undoubtedly has a spatial consequence (Downs and Stea, 1977: 12-16 on influence of perception on spatial behaviour; Gaffney and van Leusen, 1995: 370), and despite recognition of the lack of complete objectivity in landscape perception, it is equally impossible to claim total subjectivity either. Beyond data collation, storage and simplistic description, GIS offers a method of huge potential in both the extraction, and interpretation, of these patterns. Perception surfaces, in particular, offer a technique of great value. Possibly one of the greatest challenges however, lies with the data, especially that derived from survey. Much work is needed to clean and process the data before any such interpretative work can be completed, though GIS does offer a potential role here as well. However, we must not confuse the tasks of collecting and cleaning the data with their actual analysis – to quote Stead (1995: 317, my emphasis), 'The inclusion of sophisticated models of human perceptions of landscape...is both *challenging and essential*'.

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