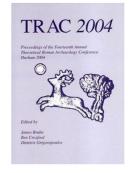
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Houses, GIS and the micro-topology of Pompeian domestic space

Michael Anderson

Introduction

It might easily be thought that the architecture of the 'Roman house' is a topic about which everything has already been written. Excavations have revealed hundreds of examples of Roman period houses from across the empire and numerous books on Roman architecture exist that devote at least a chapter to the exposition of the features and forms of these houses. More recently, Roman domestic life and Pompeian studies have also seen a renewed vogue (Laurence and Wallace-Hadrill 1997; Farrar 1998; Gros 2001; Ellis 2000; Hales 2003; Laurence 1997); following on from the success of Wallace-Hadrill's influential work in Pompeii and Herculaneum (1994). None of these approaches have completely explained the 'Roman house' however, and scarcely any address it from an archaeological or functional point of view. This paper addresses this oversight and challenges current interpretations of Roman domestic space by suggesting new methods of analysis that consider the ways that houses themselves function to pattern social interaction taking place within them.

The Study of the 'Roman House'

Traditional studies of the 'Roman house' (McKay 1975; Richardson 1988; De Albentiis 1990; Barton 1996; Boëthius and Ward-Perkins 1970) often present the impression of a complete and non-critical understanding of Roman daily life that derives mainly from the way that this subject has been approached in the past and from the sources that are studied. Significantly, the majority of our information about Roman daily life comes from the archaeological remains recovered from Pompeii, Herculaneum and the other sites destroyed by Vesuvius in A.D. 79; therefore presenting a rather stilted view of life within the Roman Empire, that focuses attention upon the particulars of what were historically two relatively insignificant southern Italian towns.

However, more than simply biasing our interpretation of 'Roman' daily life, the particular emphasis of Pompeian studies themselves have also had a major impact on the priorities of Roman domestic studies and the ways in which information is interpreted. During the original excavation attention tended to focus upon the richest and grandest houses and the primary concern of excavators was the preservation of standing architecture and decoration. As a result, it is the largest and well-decorated houses that are well preserved and documented today, forming a select group within the larger body of Pompeian houses that ignores the more humble and poorly documented (but equally important) examples.

These 'elite' houses repeatedly appear in scholarly debate (Richardson 1988; Allison 1992; Grahame 1997; Gros 2001, McKay 1975; Zanker 1995), due partially to their prominence in previous literature. Because of their similarities, they tend to give the impression of a uniform and consistent domestic arrangement – a viewpoint that fails to consider the variety present in the Pompeian evidence taken as a whole. This has led to the construction of an ideal 'Roman house,' (Maiuri 1978; Gros 2001: 41; Barton 1996: 31; DeVos and DeVos 1994: 56 *contra*:

Wallace-Hadrill 1997; Tamm 1973; Evans 1987) fabricated from characteristics commonly shared within this group of Pompeian houses, even though not one of them actually mirrors the 'typical' form in every way. To make matters worse, the Campanian evidence has always been interpreted through a direct application of the classical texts towards a typological labelling of this 'standard' model. For instance, the classification of the house type that centres upon a court or hall surrounded by smaller rooms as an *atrium* house depends entirely upon the assumption that Pompeian forms correspond to what the ancient authors Varro, Vitruvius, and others meant when they used the term *atrium*. This is by no means certain, and it seems plausible that the term *cava aedium* was more common, as is evidenced by Vitruvius's discussion of the five main atrium types: 'Cava aedium quinque generibus sunt distincta, quorum ita figurae nominatur: tuscanicum, corinthium, tetrastylon, displuviatum, testudinatum - The courtyards of houses are of five different styles, and the names of them are as follows: Tuscan, Corinthian, Tetrastyle, Displuviate, Vaulted.' (Vitruvius, de Arch. VI, 3, 1). At the same time, Ovid uses the term 'atrium' to refer to houses in general, writing 'nec capient Phrygias atria nostra nurus - And our halls (or houses) will not hold all the daughters of Phrygia' (Ovid, Heroides 16: 158).

Even if modern scholarship is correct in understanding the terms used by the classical authors, it is unclear that these labels explain much with regards to the roles and functions of the various rooms of the Roman house. Little attention had been paid to finds distributions prior to Allison's (1992) innovative work, and excavators seem to have been content simply to apply terms derived from Vitruvius to rooms on the basis of decoration, location, or blind intuition – as though nomenclature was a significant tool in understanding use or function (Mau 1900; Overbeck 1884). Such obsession with typology persists even in more recent research, and frequently in the sources one finds rooms simply labelled uncritically as cubicula, alae, or exedrae, without any explanation either of the reasons for this nomenclature or what it may imply for functionality of the room in question (Richardson 1988; Grahame 1997; contra: Nevett 1997; Leach 1997). These terms have now become embedded into research on Roman domestic space and therefore they provide a useful tool for communication amongst researchers, but it is important to attempt to dissociate them from their supposed ancient meaning. The introduction of new names for these spaces would generate needless confusion and I therefore continue to employ this nomenclature, though no particular function is to be understood from their use.

The origins of the standard Roman *atrium* house have generally been explained by an evolutionary or cultural-historical process that begins with a hypothetical 'archaic' atrium house that is supposedly preserved in skeumorphic representations in Etruscan house tombs or in archaeological traces at sites like Roselle and Acquarossa, and is reflected in the 'older' structures at Pompeii such as the *Casa del Chirurgo* (Carrington 1933; Little 1935; Barton 1996; Pesando 1997; Gros 2001). The development of this form is then traced through the gradual addition of 'non-Italic' features to the layout such as the *peristyle, oecus, xystus* and the various types of *triclinia*, following the culturally charged identifications given by Vitruvius. The history is particularly driven by the same obsession with nomenclature for room types mentioned above, rather than by functional differentiation.

It is quite clear that these approaches are an insufficient explanation of Roman domestic architecture. A typological, cultural-historical explanation of the 'Roman house' actually does very little to further our understanding of Roman daily life. Discussion of the evolution of house form without explanation of why such changes occurred fails to address the functions of architecture or the motivations for its creation. Realization of these problems has led to a more considered approach to the underlying causes and origins of the atrium house by Wallace-Hadrill (1997), but as yet this has not heralded a significant change towards a functional approach.

Furthermore, the attempt to create a standard form for the 'Roman house' implies that it is possible to identify a 'typical' Roman house from the widely ranging variety of shapes, sizes and spatial arrangements found in the archaeological evidence. Rather than attempting to create a standard model in terms of form, it is more important to understand how various individual houses functioned within common cultural norms and practices.

Archaeological theory has long since moved beyond typology and culture-history, and it is important to bring the study of Roman houses into line with more recent theoretical approaches. Wallace-Hadrill's (1994) innovative use of houses as indicators and controllers of status in his work on the urban fabric of Pompeii, and more recent work such as Shelly Hales' (2003) study of houses and identity are certainly steps in the right direction. However, just as one has not studied every aspect of an ancient pot if one only examines its decoration or status, while ignoring its functional use; so with architecture it remains to examine what Roman houses actually do. The remains of an ancient house are a cultural artefact, a product of daily life and a meaningful indicator of what was important to those who occupied it. The archaeological information present in them is not merely symbolic, but speaks of the routines, practices, and social interactions between their inhabitants and visitors. By revealing the functional uses of architectural space and the social relationships patterned by those spaces, it is possible to examine the socio-cultural priorities of the house owners and the ways in which domestic architecture was structured to satisfy those needs. A functional account of the Roman house has never been attempted, and it has been the goal of this research to begin to do so.

A Functional Approach to Houses

While the most natural response to the question, 'How do houses function?' would be to say that they provide shelter to the inhabitants, this does nothing to explain the division of space within them, as a single large room provides shelter just as well as a house divided into multiple rooms (Hillier and Hanson 1984). The reason for this subdivision is to partition space in such a way that it is practical to those that make use of it for a variety of activities. Even a simple, single room structure divides off the interior from the exterior, and this process can be continued through further subdivision of the interior into useful components. A driving force for such division is the compartmentalisation of activities so that, for instance, cooking takes place in a location that is spatially removed from that intended for sleeping. Ethnographic studies of the single-room structures of other societies indicate that even when such structural divisions do not exist, culturally bound divisions take their place (Hodder 1982; Donley-Reid 1990; Bourdieu 1973), providing the appropriate *loci* for various activities. Architectural divisions must therefore be simply a more permanent form of socio-cultural and ideological divisions pertaining to the appropriate *locus* for certain activities. This implies that the house is intimately tied to social practice (Rapoport 1969; 1990) and social interactions, and it is in this role that houses have consistently been a focus of anthropological structural-functional research, including works by Lévi-Strauss (Carsten and Hugh-Jones 1995, Lévi-Strauss 1963). In this way architecture plays a much more active role in the behaviour of individuals and their relationships than is generally appreciated (Hillier and Hanson 1984; Hillier 1996; Hanson et al. 1998).

Certain rooms are assigned functions based on their suitability for a given social interaction or function, a quality that in turn depends upon them providing an appropriate social environment for that activity. House owners logically arrange space within their houses to suit their social, political and economic needs and aim to provide the most advantageous environment to further their own status, influence and power. This was particularly true of the Roman house, whose prominent role in the social, political and economic life of its owner in Roman times has been suggested by authors ranging from Cicero (de Officiis: 138) to Laurence (1994). Moreover, the constantly evolving chains of signification suggested by post-modern theorists suggest that house functions and their associated meanings are not static. As individuals make use of architecture their behaviour is influenced by the structures of social meaning associated with locations and the physical possibilities presented by the built environment. Each and every social interaction that takes place within the spaces created by a building is patterned by those spaces, either so as to make sense in terms of current social meaning or to create new social meaning. This suggests that the house can be seen as a focus of cultural tradition in the sense of Bourdieu's habitus (1977) or as an instrument in the creation of new structures of significance in the manner of Giddens' structuration (1979, 1984).

As the needs of particular owners, or the owners themselves change over time, houses are altered to reflect altered priorities. Eventually, the built domestic environment becomes a palimpsest of activities, goals, desires, and functions, some of which are currently active, and others that are remnants of older patterns. The interplay between these and the emphasis placed upon new arrangements of space expresses the priorities of the most current house owners.

More than the result of grand forces of change, however, the arrangement of space within houses is the consequence of the action of individuals, and it is important that any functional study of domestic space should be centred upon activity at this level (Dobres and Robb 2000). This means that it is necessary to define the types of 'actors' and various activities that may engage across architectural spaces. Since at its most basic level, a building divides off space from the exterior two major classes of actors can immediately be identified: visitors and inhabitants (Hillier and Hanson 1984). The interaction of these two groups lies at the heart of the distinction between public and private. Inhabitants are those who normally are found within the house, which from a Roman perspective might include the *pater familias* and his immediate family, slaves, freedmen, and tenants. Visitors on the other hand, are those who do not normally inhabit the house, but by definition enter it only temporarily. Friends (*amici*), *clientes*, business associates, workmen, messengers, those delivering goods and the like must all be so classified.

It is also important to identify the activities associated with these actors. While some of the functions of the Roman house are noted by the classical sources, others go unmentioned. The use of the house for entertainment (in particular dining and the reception of clients, the *cena* and *salutatio*) and political advancement associated with these rituals received the most attention from the ancient authors, and has in turn also been the major function discussed by modern scholarship (Drerup 1959; Jung 1984; Bek 1980, 1983; Thébert 1987; Dunbabin 1991; Ellis 1988). These may be supplemented by a range of domestic activities including the supply of food and drink, water, and other goods necessary for the daily functioning of any household, the removal of wastes, either from food preparation or discard, weaving, cleaning, bathing, cooking, sleeping, non-elite eating, sex, use of the toilet, storage, repair, and relaxation. In addition, there must have been periodic activities relating to domestic ritual such as have been mentioned by Clarke (1991), relating to marriage, death, coming of age and so forth, as well as less formal periodic events such as building repair and the supply, storage and preparation of

building and restoration materials. Economic transactions should also not be overlooked, and the finds at Pompeii suggest that temporary storage of shipped items was also a possible function for the domestic environment.

Having concluded that a house's primary role is to divide space into appropriate environments for a variety of social interactions, both between visitors and inhabitants and between various inhabitants, it remains to provide a means for identifying these social qualities. Aside from specific cultural rules or norms, (many of which may be irretrievable in archaeological cases) it is the phenomenological qualities of the built environment that provide the background for social behaviour (Moore 1996; Hillier and Hanson 1984; Hillier 1996; Hanson *et al.* 1998). The active role of spatial characteristics has been the major contribution of 'spatial syntax' studies within architectural theory. Physical qualities and phenomena produced by the arrangement of space itself can be seen to play a part in social activity taking place within the built environment. Thus, phenomenological effects can be examined to gain insight into the possibilities and restrictions presented by spatial arrangements with regard to social interaction. The spatial arrangement of a house itself will facilitate certain types of activities and hinder others; creating situations of privacy or openness, and creating power relations between actors in these spaces. The combination of these factors is interpreted by their users as 'appropriateness' for certain functions.

Method: How Can It Be Measured?

If we were able to somehow measure and quantify the effects of the physical arrangement of space and their phenomenological effects, it should then be possible to gain a better understanding of not only the functioning of individual houses, but also the social priorities of the house owners. While a complete consideration of phenomenology ought to take into account all aspects of human interaction within the environment, including sight, smell, hearing and movement, it seems reasonable that the two most important are visibility and access. The built environment in particular occludes and permits vision in purposefully designed ways and intentionally structures the possibilities of movement, making some areas remote and others easily accessible. My doctoral research has used a range of analyses to examine visibility and access; two of which are presented here:

Fortunately, much work has already been done on the quantitative analysis of access, which was one of the major suggestions of Hillier and Hanson in 1984. Since then, an entire field of architectural study devoted to the topic of spatial syntax has developed, and it has therefore been possible to borrow from their suggested analyses (Hillier and Hanson 1984; Grahame 1997, 2000; Blanton 1994; Jiang and Claramunt 2002). Central to spatial syntax analysis is the creation of j-graph, a division of spaces of a house into 'nodes', with lines connecting them (Cf. Fig. 1).

Graph theory indices can then be calculated that numerically describe the connectivity and spatial arrangement of the graph. The most diagnostic of these is called Real Relative Asymmetry (RRA): a measure of how central or isolated a given space is with the house as a system. Roughly speaking, it is generated by summing the distance between a given space and all other spaces in the system and then dividing by the number of rooms in the system minus one. RRA is important because it indicates how central a given space is in the traffic flow of the house. Areas of high asymmetry will receive very little traffic and hence, little social

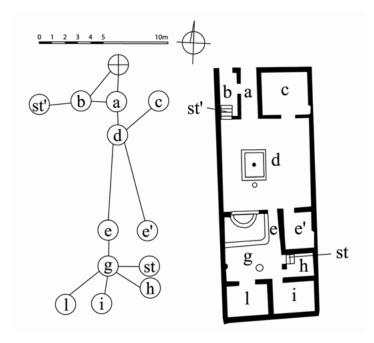


Figure 1: The j-graph and corresponding floor plan for a Pompeian house (I, 7, 2) After Corpus Topographicum Pompeianum

interaction, whilst lower asymmetry indicates a high chance of two actors in the same system, 'bumping into' each other whilst carrying out their daily tasks.

While RRA presents a good general measure of each room or space's role within the house structure, it is not without its problems. The most glaring are that the actual shape of each node is not considered, such that a large room and a small room are both a single node in the graph, and that the division of space into nodes is left entirely to the researcher's personal opinion. I have therefore developed a system that I call 'extended' Real Relative Asymmetry (eRRA). The method of calculation does not dramatically change from that suggested above, but rather than assigning a single node to each space, nodes are assigned by placing a grid of squares over the house in question, and counting each internal grid square as a node. Then, just as in normal spatial syntax calculation, the distance from each node to every other one in the system is calculated, summed and divided by the total number of nodes less one. Obviously, in even a relatively small grid such a calculation would be impossible to achieve by hand, and the process has therefore been computerised. The most effective way to divide a house plan into a grid of squares is to use a digital image, which is simply a mosaic of pixels, with one colour representing interior space and another walls. A script written in Perl calculates the distance to each other square of internal space by flood filling in the manner of standard paint programs. These values are summed and present the basis for the generation of a new image, colour coded according to degree of asymmetry.



Figure 2: The final result of eRRA analysis for the Casa di Trebius Valens (III, 2, 1)

For visibility the situation was rather different. It was necessary to develop a range of new analyses, as relatively little previous work seemed to have been done on this subject (with the notable exceptions of: Beatriz Arruda de Campos 1999; Turner and Penn, 1999; Desyllas and Duxbury 2001). The most intuitive and straightforward characterisation of visibility is the 'point viewshed' in which a colour or shading represents visible areas, and is achieved by tracing rays from a single point until they are blocked by architectural features (Cf. Fig. 3).

However, such an approach does not permit movement on the part of the actor involved, and while therefore being quite good at examining the visual effect of the built environment at one particular moment, does not produce a general measure of the effects of the spatial arrangement. If, on the other hand, an actor is allowed to move entirely within the built environment, the result is a situation that could be called total visibility - there will be no part of the architecture that is not visible at one moment or another. The ingredient that resolves this predicament is introducing time as a factor in the analysis. A grid of points may be placed at regularly spaced intervals across the architecture and point view sheds calculated from each one. The combination of these individual viewsheds means that those areas which can be seen by the most points are effectively the areas which

receive the most attention over time, while those that are visible from few places will rarely be noticed. Thus, a general measure of the visual effects of a given spatial arrangement can be calculated.

It was found that the easiest way to produce such an analysis is to use software designed for the production of Geographical Information Systems (GIS). This research used ArcGIS 8, but most GIS software would have produced similar results. Though GIS software has generally been designed to examine landscapes on the scale of cities, regions or nations, it is possible to use it on an extremely localised scale. The general methodology was first to create a digital map of each house in the study in AutoCAD. This digital plan could then be used to produce a bitmap image for input to the GIS. This was used to tell the program that walls were higher than surrounding walking surfaces and would block line of sight. While in theory it should have been possible to incorporate more accurate elevation models into the system, no data of this level of detail was found to be available for Roman houses. Once in the GIS, a grid of points was placed across the interior of the house, and the software traced viewsheds from each one, layering the results. The resulting 'grid' viewshed or visibility map presents visual space in general, characterising the experience of actors travelling through that space.

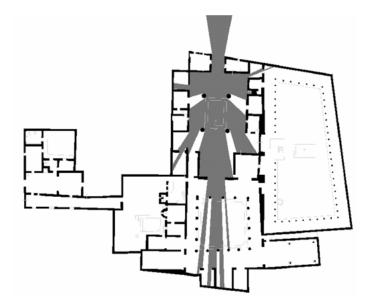


Figure 3: Point viewshed for the Casa delle Nozze d'argento (V, 2, i)

Results: The Casa di Trebius Valens (III, 2, 1)

The research presented here initially involved a sample of over two hundred houses from around the Mediterranean, but the sixty-five examples taken from Pompeii have been chosen for more detailed examination in the final analysis. Although this does mean that the research will relate primarily to the functional aspects of Pompeian, rather than Roman houses as a whole, the sample nevertheless provides an excellent initial test of the analyses due to the richness of functional, decorative, and architectural information present at this site. The group of houses chosen from Pompeii consists of seven complete *insulae* of houses (Regio I, Ins. 6, 7, 10 and 13, Regio II, Ins. 2, Regio VI, Ins. 10 and 16) as well as those houses discussed by Allison (1992) and Franklin (2001). While there is not space here to detail the results for all of the houses considered, the visibility map and eRRA results for a single house will be representative.

The Casa di Trebius Valens, located at Pompeii, Regio III, insula 2, doorway 1 presents a good example of the results of the research. This modestly sized house is located about two thirds of the way down the Via dell'Abbondanza, and is one of the few houses excavated on the northern side of the street. Excavation began in 1915, during which time room letters were assigned. These will be noted in the following discussion and are present in Figure 4. In the past the house was famous for having a significant number of electoral programmata on its fine facade (Spinazzola 1953; De Vos and De Vos 1994), the interpretation of which, combined with graffiti inside the house, traditionally assigned it to the younger A. Trebius Valens, probably the son of a similarly named *quinquennial duovir* of 60's A.D. who was running for the position of *aedile* at the time of the eruption of Vesuvius (Franklin 2001; Della Corte 1954;

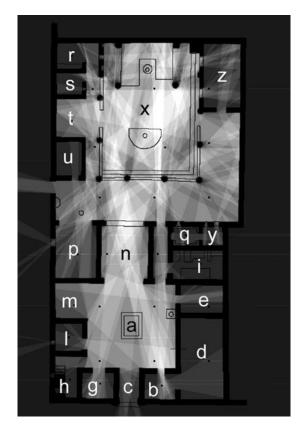


Figure 4: The visibility map for the Casa di Trebius Valens (III, 2, 1) – light areas are highly visible while dark areas are not. Room letters were assigned during excavation

Castrén, 1975; *contra*: Mouritsen 1988). Its famous facade was excavated in 1913, but the excavation of the house proper did not occur until two years later. Though Allison (1992) has concluded, in her examination of the finds present at the time of the excavation, that the house was in a 'downgraded' or temporary state of restoration, the remnants of fine decoration present in the house indicate that it had once played a significant role in the social and political life of its owner, though it is quite possible that this was not, in fact, A. Trebius Valens. Unfortunately, the house was one of the unlucky victims of Allied bombing in 1943, and its famous facade, as well as most of the atrium was levelled at this time (Spinazzola 1953).

The house centred upon a Tuscan atrium (a), found covered in coarse plaster, but which was surrounded by a range of decorated rooms including a room that preserved significant traces of the Second Style (i), and a larger room painted in a black Third Style that contained a large cupboard (d). To the west of the fauces there was an undecorated room (g) and a stair to the upper storey (h) while on the east was a smaller room (e) with simple black socle and white upper zones. The tablinum was provided with a large window in the north wall, and was flanked by a corridor leading into a peristyle colonnade that surrounds the garden on three sides. It was decorated in the Third Style with Dionysiac imagery. Against the north wall of the

peristyle, a masonry dining bench stood inside a small pergola in front of an unusual wall painting of isodomic courses of red, yellow and blue blocks. The peristyle was flanked by smaller service rooms to the northwest, a decorated exedra (t) and a storage room (u), to the south. To the east there was a large room with windows onto the garden (z). A doorway on the west has been blocked, presumably during excavation, but originally led to the currently unexcavated side street. On the south-eastern side of the peristyle a tiny bath suite (y, q) was situated next to the kitchen (i). In this corner were found four skeletons, which, since the front door was closed during the eruption, may reasonably be assumed to belong to the occupants (Spano 1915, 1916; Allison 1992).

Examination of the eRRA analysis of this house reveals that the most central locations were the south wing of the peristyle and the corridor leading from the atrium to the peristyle. Conversely, the garden triclinium area is exceedingly removed from the system, as is the rectangular room to the east, and the large eastern room off of the atrium (d), which from its shape and decoration could well be a winter dining room.

Looking at the visibility map for the Casa di Trebius Valens, it is clear that the areas which received visual attention for the longest period of time were the garden triclinium area, the tablinum and to a lesser extent, the atrium itself. Surprisingly, the surrounding rooms, including some of the finest decoration, remain virtually unseen. We can confirm the emphasis upon the peristyle triclinium through modern photographs, pointing to the fact that it is framed by the wide window at the back of the tablinum, and made perhaps more striking by the unusual wall painting found beyond it.

What does this mean for the relationships between visitors and inhabitants in this house? Following Wallace-Hadrill's (1994) discussion of public and private, it should be assumed that the peristyle is amongst the most private locations in the house, as it is the most remote from the front entrance. However, the eRRA and visibility analyses indicate that it was in fact, amongst the most publicised areas, receiving a degree of visual emphasis despite being physically remote. At the same time, rooms that are actually quite close to the entrance such as those surrounding the atrium and which would previously have been seen as relatively public, are rendered nearly invisible because of their spatial arrangement; this is particularly true of the stairway room to the south west of the structure (h), which led to upstairs rooms that are not preserved. The provision of storage areas under the stairs and the occlusion of this space points to low status or service functions for this area.

Perhaps most fittingly, the kitchen, while very centrally located in terms of movement within the house as seen by the eRRA analysis, is also virtually invisible. At the same time the bath suite is both remote and invisible. This fits with their roles, and in particular speaks to a utilitarian force behind the structuring of the house. The kitchen is integrated so as to facilitate its role in supplying food to the various triclinia of the house, while the bath suite provides privacy appropriate for bathing.

This arrangement indicates that a variety of factors and priorities were involved in the structuring of the house. Visitors during those most commonly discussed social rituals; the *cena* and *salutatio* would have first entered the atrium, where their focus would have immediately been turned toward the tablinum, and the triclinium beyond. The division between those who were permitted to enter further and those who may not must have reinforced their relative statuses vis-à-vis the house owner, ultimately supporting him as the arbiter and controller of access. While this suggestion may not be a new dynamic in the study of Roman houses, the fact that visibility should play such a prominent role in this phenomenon is completely new.

The phenomenological properties of each room can also be more carefully classified since different degrees of visibility interact with degrees of access in each case. For instance, finds from room (e) off of the atrium might suggest a role as a bedroom (*cubiculum*). Indeed the original excavators thought it to be the master's bedroom on the basis of luxury finds discovered in a wooden box in this room (Spano 1915, 1916; Allison 1992). In terms of access it is the most integrated small room within the structure, and hence controls admittance to the rest of the house. At the same time, it is relatively invisible on the visibility map. These features may support the conclusions of the excavators, making it a perfect location from which to simultaneously be in charge and whilst also being removed from daily activities within the house.

Conclusions and Future Directions

These results involve only two of the analyses used in this research, and are only the first step towards a functional classification of Roman domestic space. Trends and indications visible in one house will have a much greater meaning when examined across a larger sample and amongst houses of various sizes and categories. Nevertheless, even in this brief discussion, it has been possible to examine the functioning of space within the Casa di Trebius Valens more closely. Future work will look for larger trends in the priorities and motivations of Pompeian house owners, as well as other aspects of the phenomenological environment.

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