Perceiving pottery: a view using 3d applications

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ABSTRACT

Our purpose is to present an investigation project carried out into prehistoric pottery from the perspective of visual perception, using a virtual reconstruction in 3D to do so, and carrying out a visibility analysis based on the "socially relevant choices" involved in pottery production processes based on the tenets of Landscape Archaeology. As we understand pottery to be a social product that is materialised in a spatial manner, we may define its visibility conditions by "casting a glance" over the elements of which it is comprised, considering that making 3D reconstructions is a useful tool, as it allows us to rebuild pottery which in Galician contexts always appears in a highly fragmented state. We offer different examples in 3D of pottery taken from sites in the NW of Iberian Peninsula from Late Prehistory, with explanations of their visual features.

1. INTRODUCTION

In the case of archaeological sites in Galicia, one of the most relevant aspects is the virtual absence of any complete ceramic pieces or those with significant portions of their surfaces intact[1]. This problem, which is extended to all of the elements of material culture present in the region, means that in the particular case of pottery it is very difficult to reconstruct these elements using these fragments. Faced with this situation, it is necessary to explore new alternatives or simply to find the answer using the technology available to us, making it possible to reconstruct the element in a way that would otherwise be impossible. In turn, this allows us to reach a series of objectives that are the driving force behind the whole process, within the principles of Landscape Archaeology. Our aim is to present the results of our research via one of the tools used during the process, in this case 3D rendering software, which has proven to be particularly useful for exhibiting and explaining this research. The research was based on two main proposals: (a) we consider that the ways in which a society understands the world are partly expressed through its material products. These products are a representation of how this society perceives itself, and how it wishes to be perceived from outside. For this reason, we believe that perception, apart from being a mental construct (Rock, 1985, p. 3), is also a cultural and social construct, meaning that it is conditioned by both physiological and social factors[2]. (b) Considering that pottery is a social product that is spatially materialized, we may define which are the elements that increase or decrease its visual appearance, or its conditions of visibility. In this case, we conceive visibility as "the way of exhibiting and emphasizing the products of a material culture that reflects the existence of a social group. As the effects are reflected in a spatial manner, we may define the visibility conditions of the archaeological record by casting a glance over the elements that comprise it, which attempts to determine the whys and wherefores of its visual features" (Criado, 1991, p. 23).

As a result of these proposals, we put forward the hypothesis that the desire for visibility varies according to the type of society we study, and therefore the way of representing material culture and the strategies for making it visible change according to the pattern of rationality of these societies. And so, exploring pottery using a comparative and systematic methodology in a diachronic direction for an extensive period of time – some 3,500 years in the Late Prehistory of Galicia – allows us to discover the transformations in intentions and visibility strategies that occurred in each period. In this paper we focus on a journey in 3D through time.

2. METHODOLOGIES

Reconstructing pottery in 3D is not a novel approach (it has been used increasingly since the 1990's), although we do believe that it is an extremely useful working tool for archaeology, as has been demonstrated in numerous publications and forums for debate such as this. In our case, it has allowed us to reconstruct pieces that always appear in a highly

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2 **We should also emphasize that visual perception is the main "tool" we use for dealing with the archaeological record, and therefore takes on greater importance for this study.**

fragmented form in Galicia, and to visualize them as complete objects, giving us the opportunity to contrast our hypotheses. When reconstructing pottery using 3D software, it is important to consider all of the information available about the pieces before making a final selection. It is necessary to carry out a previous study of the pottery from the site, focusing on reconstructing well-contextualized pieces. To date we have made a total of 67 reconstructions in 3D: 8 from the Early and Middle Neolithic, 13 from the Late Neolithic, 37 from the Early Bronze Age and 9 from the Late Bronze Age. The different working phases involved in the reconstruction process are detailed below.

2.1. GRAPHIC ANALYSIS AND DOCUMENTATION

Archaeological illustration: a selection is made of the fragments that make it possible to create a reliable reconstruction of the piece, which must at least include information about its diameter, with a profile that gives us a clear idea of the general shape of the piece.
Reconstructing the profile: the full shape is reconstructed using "AutoCAD" programme, using the information from the illustration. If the pottery is incomplete, information on its height and width is entered according to our knowledge of pottery from the same period, particularly with reference to the finish given to the edge and bottom of the pottery.
Reconstructing the decoration: if the pottery was decorated, a reconstruction is made of the design if the pattern is predictable.
Reconstructing the pot: all of the previous information is brought together to make a full reconstruction of the pottery, with the resulting image providing a basic idea of the piece as a whole.
Photographing sherds: photographs are essential in order to reconstruct the clays (textures, colours and finishes) and the decorations (techniques, stamp shapes, sizes etc.), meaning that they must be high quality, with all of the additional elements that this implies (lighting, positioning, calibration of the cameras' ICE profiles, etc.) (Fig. 1).

2.2. THROUGH COMPUTER TECHNOLOGY: VIRTUAL RECONSTRUCTION

This stage is based on the reconstruction of the profile made using AutoCAD (figure 2). Illustrator is used to close the curves for the piece's section or profile. These are filled smoothed and streamlined. We chose to use the EPS format to import the profile from the rendering programme (Strata 3D CX). Using the imported outline and accepting a theorical cylindrical symmetry we obtained a 3D mesh version of the piece. At this stage we added the additional features of the piece that are not symmetrical, such as handles, edging, lugs, etc. After this minimum modelling stage, we decided on the rendering conditions to be used, such as the position of the piece, lighting and camera angle. A frontal render was made to obtain a contour mask, which allowed us to create the textures to be used correctly. Using Photoshop, we created a series of elements: (1) For the *Stencil Map*, we directly used the first frontal render of the piece, leaving the area to which we intended to apply the texture in white, and the area without texture in black. (2) For the *Colour Map*, we had to use photos of the sherds, creating a texture from the images of the different clays, and using the initial rendering made of the piece as a clipping mask. (3) In the case of the *Bump Map*, only required if the piece has decoration in relief, we started out drawing the motifs in Illustrator.
Once these had been transferred to the clipping mask, we softened them using a Blur filter to prevent the decoration from being to harshly defined. Using these three basic maps, we were able to compose the texture of the piece. The final texture was applied to the piece, adapting it to its shape and positioning it at the angle chosen for the rendering process, having chosen the most suitable for our requirements: Raydiosity™ to obtain high-quality finishes, although involving long rendering times, Ray-tracing, with lower quality but faster results, ideal for creating animations and QTVR. Once the rendering process was completed, the image was given a final finish in Photoshop.

2.3. THROUGH ARCHAEOLOGY

3D reconstructions are used as images offering a very close representation of the physical appearance of the pieces, serving as prototypes that allow us to demonstrate the type of visibility intended for them. In order to evaluate the degree of visibility of a piece, it is necessary to define the formal features that characterize it, which are the result of using a specific manufacturing technique within the process of creating object[3]. These features are defined by comparing the visual effect of choosing one series of techniques over another during the process of manufacture. In the table 1, we indicate the features taken into account, and which provide greater or lesser visual impact to a finished pottery item. If we take into account the dimensions and profiles, refinement of the textures and finishes, gloss and tone of the colours and the different decorative elements (such as the size of the design, the depth to which they were incised, their position on the body of the piece, etc.), we may evaluate if there was any intention to make it more or less visible.

3 **This has been defined in detail in a paper that is still awaiting publication (Prieto, 2003).**

Table 1 – Details of technical aspects that produce an effect of visibility in the pottery

Stages	Appearance	Highly Visible	Less Visible
Manufacture	Textures	Fine, compact	Compact or thick, porous
Raw material	Grain size	Invisible	Medium or large
	Grain type	Mica	Quartz or granite
Modelling	Profiles	Composite	Simple
	Sizes	Large	Medium and small
Drying	Before or after finishing	Before	After
Finish	Technique	Fine burnishing and smoothing	Medium or coarse burnishing and smoothing
Decoration	Present or absent	Present	Absent
	Instrument: size	Large	Small
	Instrument: depth	Deep	Superficial
	Number of elements	Few	Numerous
	Motif: size	Large	Small
	Motif: complexity	Abundance	Scarcity
	Scheme: size	Covering	Partial
	Scheme: situation	Exterior	Interior, rim-border
	Scheme: complexity	Considerable	Little complexity
Firing and cooling	Colour	Light (reds) and dark (blacks)	Light (oranges and browns) and dark (browns)
	Tone	Strong	Gentle
	Brightness	Shiny	Matt
Appearance of the product	Carefully or coarsely made	Carefully	Coarsely

If we consider that there is a "social purpose" in the technical choices made during the different stages of pottery production, and that this aim has a visual effect linked with these societies' desire for visibility, then it should be possible to demonstrate this visually with the help of 3D applications. There follow several examples of 3D renderings of pieces demonstrating the 4 visibility strategies recorded: inhibition, concealment, exhibition and monumentalization[4]. We are fully aware of the fact that in this study our perception is "methodological" (Cobas, 2002), and seen from a present-day perspective (figure 3).

Inhibition implies a lack of interest in emphasizing or consciously hiding social products as such, meaning that there is no intention to produce special types of pottery, and the techniques used lead to relatively invisible pieces. This type of pottery has simple profiles and is small or medium in size, with medium and rough finishes (both burnished and smoothed), with gentle, matt tones. When decorated, the designs are simple and occupy a small part of the piece, and are difficult to see. Their final overall appearance is quite rough. This desire for visibility is mainly seen in undecorated pottery for daily use, from the Early and Middle Neolithic until the Early Bronze Age.

Concealment involves a conscious strategy to make the products invisible, covering up elements that should be visible, implying an explicit rejection of their presence. The final appearance of these pieces is as rough as those found using the inhibition strategy. The strategies of concealment are achieved in three different ways: (a) Using the finish to cover up part of the decoration; (b) Using decorative instruments and techniques in a highly superficial manner; (c) Situating the decorative elements on sections that are difficult to see, such as the rim. Pottery of this kind is documented from the Late Neolithic and Late Bronze Age, and corresponds to a small number of decorated pieces in daily use.

Exhibition implies the conscious desire to show the products within the social present, emphasizing their spatiality: there is the intention of producing pieces that are attractive as a whole, meaning that a conscious choice is made of the techniques that produce an exhibitive effect from within the range of techniques used to manufacture pottery. The strategies used

4 **These are redefined (Prieto, 2003) using the definitions of Landscape Archaeology for social landscapes (Criado, 1993) so that they may be applied to pottery.**

to obtain highly visible pieces are diverse: in this case it is possible to use large sized pieces, with compound profiles, burnished and finely polished finishes, or with strong, bright colours. When decoration is used, this makes use of the size of the pieces to show the contrast in direction of the motifs or their large size, depth or relief, or how they cover the whole body of the piece. They have a good or high quality final appearance. The desire for visibility varies depending on the period, and different resources were used to achieve the "exhibitive" effect. Pottery of this kind is documented from the Late Neolithic onwards.

Monumentalization involves the conscious desire to demonstrate social products within the social present, emphasizing their spatiality (as with exhibition) and their temporality: something with an intentional spatial and temporal projection. Only bell-beaker pottery corresponds to this desire for visibility because: (a) It is a type of pottery that is widespread throughout much of Europe, and is easily recognisable; (b) It lasted for a period of one thousand years (2600-1500 cal BC); (c) And all of the technical resources used to manufacture it were aimed at making it highly visible, maintaining the same standard shape through space and time.

3. EVALUATIONS AND OPTIONS FOR THE FUTURE

The wealth of possibilities offered by 3D applications makes it possible to extend the scope of our work in several areas:

- Basic research: allowing us to explore how material culture operated socially from Late Prehistory, in our case in relation to the transformations seen in style over time, and in this specific case, in relation to visibility.
- Applied research: It will be useful in helping us to build up a Reference Collection based on representative materials from the periods studied, it helps us recover lost pieces, such as the case of the four lobed piece from the barrow of Monte Pirleo 5, reconstructed from graphic and textual sources (figure 4).
- Transfer of technology and services: it allows us to reassess and make full use of the results of our research in the direct social and cultural surroundings, by presenting them to the public, making it possible to go beyond the traditional methods used for exhibiting pieces in museums, 3D applications may contribute towards supporting the work of other professionals, such as those working in the fields of restoration and conservation.

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FIGURES

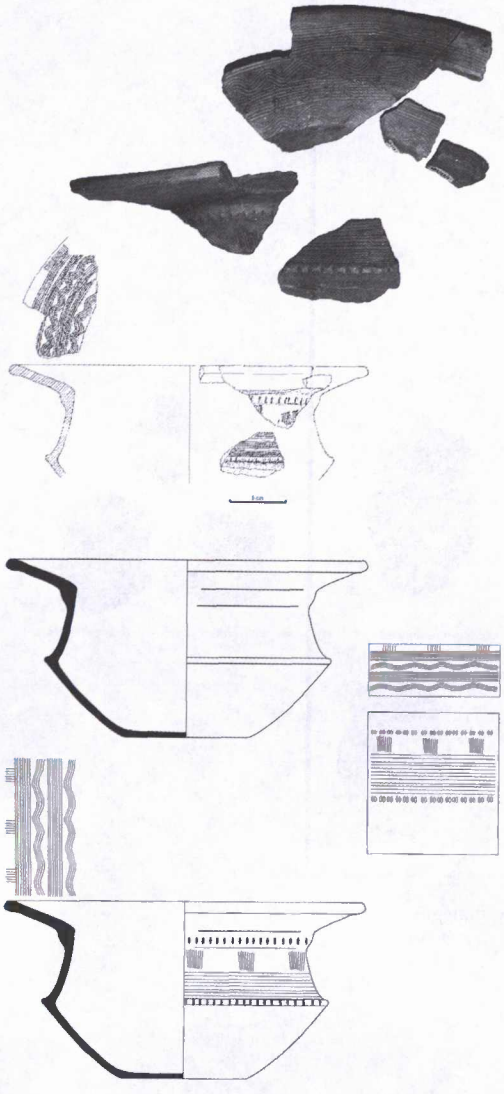

Fig. 1 – Drawing, the first stage.

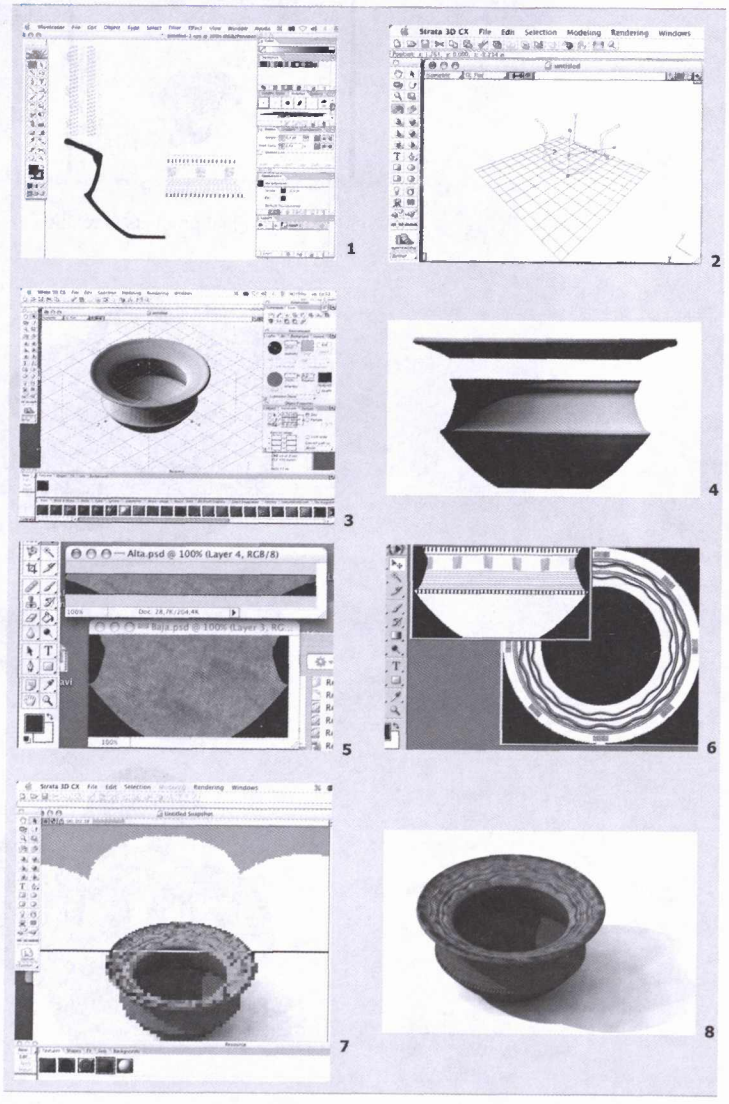

Fig. 2 – The process at glance.

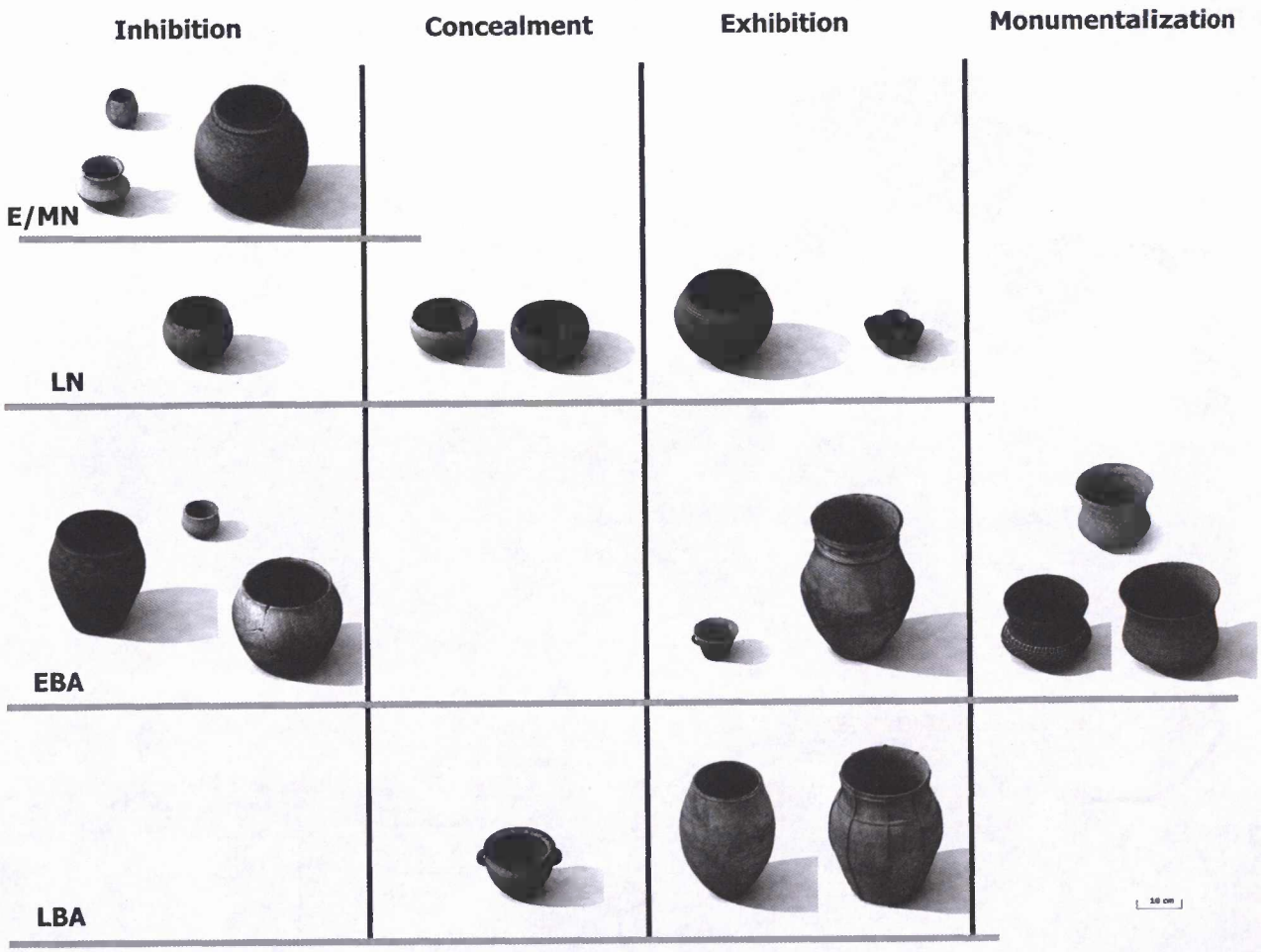

Fig. 3 – Final products in relation to visibility strategies.

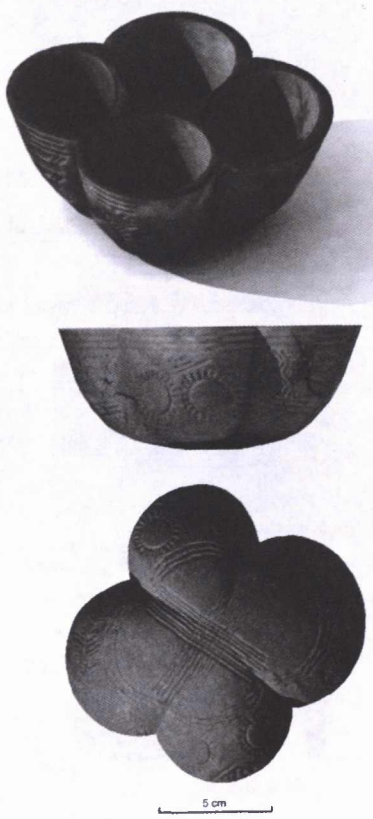

Fig. 4 – Example of lost piece revored by 3D reconstruction.