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9 approach for optimizing the interpretation 110 **New** and 2^{11}_{12} representation of the degree of historical-archaeological evidence in the virtual reconstructions 313

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1020 Abstract

 11^{21} Virtual reconstruction is defined as the visual recovery of a building or object through the creation of a three-dimensional model 1222 of the asset to be reconstructed, in a historical context. To provide the degree of veracity to the virtual reconstructions performed 1323 in the scope of heritage, the so-called historical-archaeological evidence scale emerged. Some authors have already used this 1424 methodology to provide their reconstructions with the degree of evidence, although none of the current propositions of evidence 1525 1625 26 scales have been standardised to date. Moreover, it is still important to disseminate such scales as much as possible, since it has been shown that neither experts in this field of knowledge nor common users know about this methodology.

 17_{27} The aim of this study was to design and create a new proposition of historical-archaeological evidence scale based on the 18 achromatism and implement it in the 'Baker's House' at the archaeological site of Torreparedones (Baena, Córdoba, Spain). 1928 To carry out this investigation, it was essential to compare and analyse each proposition of historical-archaeological evidence 20^{29} scale. The qualitative and quantitative studies about the existing scale propositions also played a fundamental role in the 2130 realisation of this work. These results, in addition to the chromatic study, support the creation of a new proposition of historical-2231 archaeological evidence scale, designed for any type of viewer. Each phase of the study met the quality standards established 23₃₂ for this type of research.

2433 Keywords Baker's House · virtual reconstruction · historical-archaeological evidence scale · quantitative-qualitative study 40

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34 25 35 1 Introduction

 $265\,$ In the archaeological scope, virtual reconstruction <code>plays42</code> 277 fundamental role as a research tool (Machete et al. 20243 288 299 309 Moskvin et al. 2021; Rebec et al. 2022). Regarding the interpretation of heritage, the historical-archaeologicas evidence scale designates the representation of the degree 46 40 veracity of virtual reconstructions through the use of colours7 42 To date, three historical-archaeological evidence scales ha48 been used in the scientific literature: 1) the pioneeriag <u>3</u>3 proposition, i.e., the historical-archaeological evidence scate developed in the Byzantium 1200 project (Byzantium 12005) 2) the proposition of P. Aparicio and C. Figueiredo (Aparic**52** 45 and Figueiredo 2017); and 3) the more recent proposition used for the reconstruction of the Mosque-Cathedral and rivs4 218 landscape of Córdoba (Spain) (Ortiz et al. 2018). **3**97 55 56

The first two propositions of historical-archaeological evidence scale are distinguished by the fact that their evidence levels (10 levels in total for both) are inverted with respect to each other. For the proposition developed in the Byzantium project, the evidence levels are ordered from greater to lower veracity (Byzantium 1200), whereas the scale proposed by Aparicio and Figueiredo is ordered from lower to greater levels of historical-archaeological evidence (Aparicio and Figueiredo 2017; Aparicio 2016; Aparicio et al. 2021). Although the levels were inverted, their colours were not modified, and thus they have a very similar colour range of warm and cool colours. However, the third proposition uses a colour range from dark greens to browns, with eight levels of historical-archaeological evidence (Ortiz et al. 2018).

Table 1 shows the bibliometric study conducted on the implementation of the historical-archaeological evidence scales throughout history.

48 57<u>4</u>9 Table 1 Bibliometric study on the implementation of the existing historical-archaeological evidence scales.

50	Reference	Applied scale	Item	Levels	Chromatic gradation	4	Formatted Table
51 52	http://www.byzantium1200.com/	Byzantium	Byzantium city around 1200	10	From warm to cool colours		Field Code Changed
53	(Byzantium 1200)	1200 project	_ ,,,		evidence)		

Field Code Changed

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Aparicio 2016	Aparicio Figueiredo	&	The crenellated tower of San García, Algeciras (Spain) (17 th -18 th century). Virtual recovery of a military structure using technology	10	From cool to warm colours (lower evidence-greater evidence)
Aparicio and Figueiredo 2017	Aparicio Figueiredo	&	The historical-archaeological evidence degree of virtual reconstructions: toward a graphic representation scale	10	From cool to warm colours (lower evidence-greater evidence)
De Mota and Valle 2018	Aparicio Figueiredo	&	Archaeology of the military orders in Castilla-La Mancha and the virtual reconstruction of its heritage	10	From cool to warm colours (lower evidence-greater evidence)
Ortiz et al. 2018	COR_16		Proposal for the improvement and modification of the scale of evidence for the virtual reconstruction of cultural heritage: A first approach to the Mosque- Cathedral and the river landscape of Córdoba (Spain)	8	Colour range from greens to browns
Rodríguez-Hernández et al. 202	Aparicio Figueiredo	&	Virtual 3D reconstruction of the "Fortified tower" of the Ulaca Oppidum (Solosancho, Ávila, Spain): much more than an image	10	From cool to warm colours (lower evidence-greater evidence)
Aparicio et al. 2021	Aparicio Figueiredo	&	Virtual 3D reconstruction of Gauzón Castle (Castrillón, Principado de Asturias, Spain)	10	From cool to warm colours (lower evidence-greater evidence)
Cáceres-Criado et al. 2022	Aparicio Figueiredo	&	Graphic representation of the degree of historical-archaeological evidence: the 3D reconstruction of the "Baker's House"	10	From cool to warm colours (lower evidence-greater evidence)

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uses specific colours. Behavioural scientists have report27 that colour affects the reactions of the human organisize produces certain physiological reactions, creates emotion29 states and draws attention (Sierra et al. 2000). 30

Most experts agree that it is ideal to reflect the degree 3fl historical-archaeological evidence in the virtuB2 representation of a heritage asset, for the sake of clarity and authenticity. The graphic representation of the degree 34 historical-archaeological veracity, with a new proposition 35 evidence scale, considers the objectives set in projects conducted in the scope of virtual archaeology (Lópe37 Menchero and Grande 2011; SEAV 2011; The Lond 38 Charter). 39 40

1 Literature review

Previous studies have carried out the virtual reconstruction as the Baker's House, at the archaeological site at Torreparedones (Baena, Córdoba, Spain) (Cáceres-Criado 45 al. 2022). This heritage asset, as is indicated by its name, 45 characterised by the presence of the base of a Roman bread oven, as well as the foundation of what could have been48 rotatory mill (Morena et al. 2016; Morena et al. 2019). It has three constructive phases: late Republican Roman phase; late

Each of the existing propositions of representation scal26 Imperial Roman phase; and Modern-Medieval phase. The virtual reconstruction is focused on the second phase (late Imperial Roman phase).

> For the correct dissemination of the scientific work performed in this Roman house, the historical-archaeological evidence scale was considered a key element. The debate was about which of the propositions of historical-archaeological evidence scales would be the most suitable for the graphic representation of the archaeological remains found. The existing propositions were compared by implementing them in a specific area of the Baker's House (Cáceres-Criado et al. Pending to be published in lectures Notes in Mechanical Engineering). Based on the amount of reconstructive units presented by the virtual reconstruction, the results of such study showed that the best option was the proposition of Pablo Aparicio and César Figueiredo (Cáceres-Criado et al. 2022).

> At this point, a question emerged, which motivated the present study. The scientific character of the evidence scale raises doubts about its objective: Is the evidence scale designed only for experts in the field of archaeology or is it aimed at the viewers of the archaeological sites?

> The creation of a new proposition of evidence scale is considered appropriate to attain a visual representation scale that can be easily employed and understood by any type of

9 1) 1) 1] viewer. To this end, it is fundamental to reduce the evidence levels and the modification of their colours. Moreover, previous studies provide data that support the creation of the 142 new proposition.

153 Furthermore, one step further would be to understand evidence scaling as a technique for evaluating virtual reality 14 systems. The virtual reconstruction of a heritage asset 15 together with the infographic of the scale of evidence helps 196 with the visual interpretation of the veracity of the work 107 carried out. This topic could be included in the so-called **1**18 "Museums of the 21st century", where users would learn about the heritage asset and the 3D reconstruction work, for example, with virtual reality screens (Puig et al. 2020; Baradaran-Rahimi et al. 2022; Scavarelli et al. 2021; 251 Hammady et al. 2021). <u>1</u>62

⊉73 **1.2 Research aim**

The present study aims to disseminate archaeological work 295 through the use of a new proposition of historical-295 archaeological evidence scale. This proposition is supported by a quantitative and qualitative analysis made for the 'Baker's House' at the archaeological site of Torreparedones The main objective of this study was to generate a 2₽ proposition of historical-archaeological evidence scale for the virtual reconstructions as a universal, understandable and **2**50 361 applicable criterion for both experts and viewers in general $\frac{1}{41}$ The aim is to provide the public with greater understanding $\frac{1}{2}$ of both the archaeological heritage and the scientific work <u>3</u>3 conducted in the heritage assets. 44 304

35 32 2 Methodology

337 The present work was conducted in three methodological 348 phases (Fig. 1): comparison of the existing historical 359 archaeological evidence scales; creation of the new historical $\frac{3}{1}$ archaeological evidence scale; and implementation of the new 52 460 37 41 proposition of historical-archaeological evidence scale. 53



Fig. 1 Methodological phases.

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Regarding the first phase of the study, it is important to take into account that the creation of a new proposition of historicalarchaeological evidence scale is based on the existing historical-archaeological evidence scales. After knowing these, they are compared with each other in order to establish common criteria and differences. As was previously mentioned, the building in question already has a virtual 3D reconstruction (Cáceres-Criado et al. 2022), in which the evidence scale proposed by Pablo Aparicio and César Figueiredo (Cáceres-Criado et al. 2022) was implemented (Fig. 2). The comparison of the existing evidence scales required the attainment of computer graphics of the heritage asset from each of the propositions. To this end, the rest of the scales were implemented in the Baker's House at the archaeological site of Torreparedones (Fig. 3 and 4).



In the first phase of this study, and based on the existing
propositions of historical-archaeological evidence scales,42
quantitative study was performed as a result of the Topic4B
Seminar 'Scientific Representation in Archaeology throug44
the Use of Digital Technologies': Implementation of eviden45
scales in the Mosque-Cathedral of Córdoba and in Gauzón

Castle', which was held on March 4th 2022 at the University of Córdoba. This totally anonymous study was carried out online and face-to-face, depending on the modality chosen by each attendee. The questionnaire consisted of 18 closed questions (In Table 2, "Appendix"), which were answered after

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h	receiving the infe	ormation present	ed by Pablo	Aparicio	and
J	Pofool Ortiz				

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110	receiving the information presented by Pablo Aparicio and		
11	Rafael Ortiz.		
3 <u>1</u> 2	Table 2 Quantitative study presented in the Topical Seminar held in the University	/ of Córdoba.	
13	Questions	Response options	Formatted: English (United Kingdom)
14	1 1 1 0	Man;	Formatted: English (United Kingdom)
16	1. What is your gender?	•Woman	
17	2. What is your age?	• <u>20-30 years;</u>	Formatted: English (United Kingdom)
18		• <u>30-40 vears;</u>	
19		Over 40 years	
20	3 What is your academic training?	Arts and Humanities:	
21	5. What is your deadenice training.	C since and full manifest,	Formatted: English (United Kingdom)
22		• <u>Science;</u>	
24		Heatth Sciences;	
25		 Social and Legal Science; 	
26		 Engineering and Architecture. 	
27		• Other	Formatted: English (United Kingdom)
28	 Is this the first time you heard about the historical archaeological evid scale? 	ence •Yes;	Formatted: English (United Kingdom)
29 30	seare:	• <u>No</u>	
31	5. Why do you think you did not know about the historical-archaeolog	gical • Its lack of dissemination;	Formatted: English (United Kingdom)
32	evidence scale?	• Virtual reconstructions are not usually	
33		accompanied by an evidence scale;	
34		 I am not interested in this topic; 	
36		 Lack of training in the Degree of Archaeology 	
37	6 How many virtual reconstructions do you know?	0.	
38	6. How many winder reconstructions do you know .	- <u>P</u> .	Formatted: English (United Kingdom)
39		• • • • • • • • • • • • • • • • • • • 	
40		● 3-10;	
41 42		• <u>Over 10</u>	
43	 How many of these virtual reconstructions are accompanied by a histor archaeological evidence scale? 	ical • <u>p;</u>	Formatted: English (United Kingdom)
44		• <u>1-5;</u>	
45		• <u> </u>	
46		• <u>Over 10</u>	
4/	 In your opinion, what kind of audience receives the information present the historical appleacies and an audience scale? 	ed in Experts in the field;	Formatted: English (United Kingdom)
49	the instruction of the original evidence scale :	• The general public;	
50		• Both	
51	9. In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disa	gree,	
52	do you think that the use of a historical-archaeological evidence scale good option to accompany a virtual reconstruction?	is a ● Likert scale*	Formatted: English (United Kingdom)
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10	10. As is proposed by P. Aparicio and C. Figueiredo in one of their studies, the historical actionance acade, contributer to the creation of a	
11	Insurger for all professionals of the field. Do you agree with this?	Fermetted: English (United Kingdom)
12		Formatted: English (Onited Kingdom)
1 2	11. In a scale of 1-3, with 1 being Strongy Jack and 5 being Strongy Julisagree, is the name "historical archaeological avidence scale" descriptive?	Formatted: English (United Kingdom)
13	is the name instorted atometrogical ordenee scale descriptive.	(· · · · · · · · · · · · · · · · · · ·
14	 In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, 	
15	do you consider that the historical archaeological evidence scale helps to discompany on a conservative interpret pat only the barritore accest but also the	
16	archaeologial work contectly interpret not only the nethage asset out also the	
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18	1.3. In a scale of 1-3, with 1 being Strongly Agree and 5 being Strongly Dusagree, if it was compulsary to accompany virtual reconstructions with historical.	
10	archaeological evidence scales, do you think this would help the general	Formatted: English (United Kingdom)
19	public to understand the archaeological remains?	
20	14 In a scale of L5, with 1 being Strongly Agree and 5 being Strongly Disagree	
21	do you think it is convenient for the tourist to accompany the information	
22	presented in the explanatory panels of archaeological sites with the historical-	Formatted: English (United Kingdom)
23	archaeological evidence scale of the virtual reconstruction?	
24	15. In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree.	
25	what do you think about the evidence levels proposed by P. Aparicio?	Formatted: English (United Kingdom)
25	16 In a scale of 1.5 with 1 being Strength Agree and 5 being Strength Disagree	
20	what do you think about the evidence levels proposed by R. Orriz?	Formatted: English (United Kingdom)
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28	1/. In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, what do you think about the adjourney used in the preparation of P. Aparinio?	Formatted: English (United Kingdom)
29	what do you unink about the colours used in the proposition of 1.1. quarters.	
30	18. In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree,	Formatted: English (United Kingdom)
31	what up you think about the corours used in the proposition of K. UfilZ?	
b 2	* Likert scale composed of the following options: Strongly Agree; Agree; Neither Agree nor Disagree; Disagree; Strongly Disagree.	
322	The answers obtained in the questionnaire wave $\mathbf{R} \cap \mathbf{F}$ rom my point of view. I think that the avidance could	
221	statistically analysed which is why information about gendard is useful for all audiences and it grants transparancy to the	
ე ~1 ე4-	age and education was gathered. The mean of these answers virtual reconstructions for both technicians and the general	
35 -5-	was calculated and an analysis of variance (ANOVA) was <u>aublic. In our case, when we started working with the scale, we</u>	
36	performed to compare the variances between the means of t B2 saw that it had to be reduced, and the change of colour was due	
377	'gender', 'age' and 'education' categories in each of tB3 to the work we began, where we made several propositions and	
388	questions proposed in the questionnaire. 34 talked to all the technicians involved".	
399	Moreover, before the Topical Seminar, a meeting was he 36 2. What did you consider for the selection of colours?	
<u>1</u> 9	with professionals of this professional catego36 P.A: "In this sense, since we based our work on the	
٢ŗ	(archaeologists) with the aim of solving doubts about tBo proposition developed in the Byzantium 1200 project,	
1 ²	propositions of historical-archaeological evidence scal 38 considering the need for standardising the scale, we believed it	
4 32	After explaining the propositions, since many of the attende 39 would be most interesting to keep using colours similar to those	
4 4B	did not know about their existence, questions were asked 40 used in the Byzantium project, basically because we	
3151	Pablo Aparicio and Rafael Ortiz in an interview at the understood that they worked very well. We made small	

changes in the colours, that is, we adjusted the colours in a way

that they could be distinguished. However, as was previously

commented, purple may be a bit confusing, and it should be

- R.O: "Solving the problem related to the work we were

doing and also in the colours that were used in geographic

information systems. We attempted to create a scale of colours

that solved the problems regarding the consideration of warm

appropriate one for any virtual reconstruction regardless of the

cool colours that existed in the previous

Do you think that your proposition is the most

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colours-

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propositions".

54 number of reconstructive units?

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mentioned seminar (In Table 3 "Appendix").+

408 discipline, common viewers or both?

further information for the study".

Everyone agrees that the evidence scale, in additida3

purpose, but what is the target audience? Experts in the recalculated a little".

to its scientific value, has an educational and information 44

-P.A: "Exactly, both. I think it is very important that that

scale does not lose its educational character and that looking

at the caption with the warmer or cooler gradation along wi49

level of evidence. Subsequently, we could expand them wi52

54 the image of the virtual reconstruction should be enough f_{50}

852 anyone to understand which areas have a greater or low51

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3 4 5 6 7 8 9 P.A: "It should be. The aim is to make this proposition 1\$ useful for any kind of virtual reconstruction. I was able 57 11 apply it to all virtual reconstructions that I have carried out 58 142 date. There was not one virtual reconstruction in which I sa59 153 'it's impossible here'. However, in some cases, it is necessa60 to reduce a little, such as the number of reconstructive uni61 14 otherwise, it can be difficult. In other cases, it is necessary 62 15 merge reconstructive units into a single unit. The case 68 16 Elephantine City is paradigmatic; it was possible to apply64 107 to the entire city, and I believe that it allows the viewer 65 clearly see the evidence level of each area. We must also 66 **1**b aware that the evidence scale must be flexible and that its u67 13 24 depends on the excavation team or scientific team. It 68 important to understand that this is a tool that shows the 25 evidence level and that we must apply it in each case 30 262 clearly as possible". 71 173 18 R.O: "Unlike Pablo Aparicio, we always work in the sand scope, so I cannot really answer that question. Since v78 ₽đ always work on the same thing, the Mosque-Cathedral, v74 205 cannot export this information to other virtu75 26 reconstructions". 76 As has been previously mentioned, many of the 227 archaeologists who attended this seminar did not know ta8 historical archaeological evidence scale. What do you thin 79 29 this is due to? 80 20 -P.A: "I get emails from Italy, UK, etc., and I see that 81 27 use in virtual reconstructions is increasing. Moreover, I tea82 in the MSc of Virtual Heritage and in the education platfor83 28 29 30 of Koré, and there we aim to disseminate the use of tB4 evidence scale, also through seminars like this. It is importa85 34 to use it in our workplace to increase its dissemination, as w86 35 as to modify it if necessary, although it would be good 87 33; modify it in a consensuated manner in order to achieve 88 3<u>4</u>7 standardisation". 89 R.O: "As Pablo Aparicio says, the use of the historic 90 3,8 archaeological evidence scale is increasing, in Spain and 91 39 other countries, such as Portugal, Italy, etc., so a grea@2 248) number of people will surely know it soon". 93 One of the attending archaeologists proposed t94 <u>3</u>9 5 following: "The main disadvantage is the scarce trainings 41 given to archaeology students. Greater dissemination a96 43 analysis of this system would considerably help in tl97 44 matter". Do you think that it would be possible, fro98 445 research, to show the relevance of the evidence scale, evog teaching it as part of a subject in the university? 100 硩 P.A: "Education is essential for the application 101 47 knowledge. I think it would be very good to explain this the 48 in universities, since, as has been explained, it can be app1103 490 not only to virtual reconstructions, but also to tradition 404 historical drawings, and it allows providing a scient105 ቒዓ 51 section. To date, when virtual reconstructions w106 performed, if you were very lucky you could find an articol 52 that explained how it had been done, but their veracity **108 5**43 never addressed. Therefore, I think it is a very important (109 554 that came here to stay". 110 55

— R.O: "Yes, but it is important to highlight that there are still archaeologists who do not understand digital technologies, so universities should start changing some things to highlight the relevance of this scope, which is widespread".

The aim of the second phase of the study was to assign colours and evidence levels for the new proposition, which required a thorough search for bibliographic material related to the symbology of the colour associated with people. From this bibliographic search regarding colour assignment for the new scale proposition, it was observed that colours with greater wave length (e.g., red and orange) cause a greater physiological activation than green (Díez et al. 2000; Wilson 1966). This is frequently described as a stimulating, energetic and vital colour. On its part, yellow is less exciting than red (Schaie and Heiss 1988), being associated with vitality, mirth and fun (Sharpe 1974). In regard to the colour green, its excitation potential is more limited (Schaie and Heiss 1988), being associated with safety, comfort, calmness, guietness, youth and freshness. The coolest colour of the chromatic wheel is blue, and the preference for it is thought to indicate good control over emotions and behaviours (Díez et al. 2000).

A recent study conducted in Spain about the emotional connection with colour shows the concepts associated with each colour (Bazán 2018; Corbin), including the following:

- Blue: tranquility, calmness, peace, serenity, stillness, relaxation, quietness, harmony and well-being.
- Green: mirth and life, tranquility, serenity, relaxation, quietness, calmness, peace and hope.
- Red: strength, passion, mirth, life, energy, love, heat, intensity, vitality, optimism, beauty, emotion, power, fire, dynamism, self-esteem, action, revolution and struggle, effort and excitement.
- Purple: serenity, tranquility, peace, relaxation, calmness, mirth and happiness, balance, harmony, well-being, women, femininity, freedom, beauty, profoundness, transformation and spirituality.
- Yellow: mirth, fun, light, luminosity, life, liveliness, energy, positivity, good vibes, heat, warmth, tranquility, peace, optimism and happiness.
- Orange: mirth, optimism, fun, energy, strength, vitality, life, liveliness, spark, creativity, warmth, heat, showy, intensity, cheerfulness and sympathy.

In addition to the meaning of the colours, several studies show that the preferences for them change throughout life (Dittmar 2001; Mohebbi 2014; Terwogt and Hoeksma 1995). This could be attributed to the alterations in the discrimination of colours and also to the decrease of the functions of the mechanisms present in sight with ageing (Dittmar 2001).

The change in colour preferences in older people could be attributed to the alterations in the discrimination of colours and in visual images, the yellowing of the lens and the decrease of the function of the blue cone mechanism with ageing.

After selecting the colours and evidence levels for the new proposition, the last phase of the study was conducted. These colours and evidence levels were implemented in the virtual 3D

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reconstruction of the Baker's House, obtaining computes
 graphics of the virtual model and a table associated with sudle
 graphics presenting information of the evidence levels that
 correspond to each reconstructive unit.
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3 Results and discussion

185 The representation of the degree of historical-archaeological
197 evidence of the 'Baker's House' through a new scale
108 proposition required the comparison of the existing evidence
119 scales. Their implementation in the Baker's House provided
120 results of their use in this heritage asset (Table 43). On the
121 and, the scale proposed in the Byzantium 1200 projects
122 results of Aparicio and

Figueiredo (2017) than to that of Ortiz et al. (2018). It could be said that the second proposition is more recent than the first proposition and, thus, it is an improved version of it. Their colour range is quite similar and, in both scales, warm colours represent greater historical-archaeological evidence, whereas cool colours represent lower evidence. Both scales are very visual, and each of the evidence levels are easily identified. Regarding the third proposition (Ortiz et al. 2018), it is visually very different from the other two propositions. The colour range is different, and the reduction of the evidence levels is observed in the computer graphics, showing less colours. Visually, the evidence levels are not so easily distinguishable, due to the similarity between their colours, unlike in the other two propositions.

23 24	Level of evidence	Colour Byzantium	Definition Byzantium 1200	Colour Aparicio	Definition Aparicio and Figueiredo (2017)	Colour Ortiz et al.	Definition Ortiz et al. (2018)
25 26		1200		and Figueiredo (2017)		(2018)	
27	1		Exists in its original form		Imagination		Still existing in its original form
28 29	2		Partially or with modifications		Conjecture based on similar structures		Still existing with modifications
30	3		Photographs or plans available		Basic textual reference		Detailed graphical evidence
3⊥ 32	4		Archaeological information		Descriptive textual reference		Slight graphical evidence
33	5		Detailed graphical evidence		Simple graphical reference		Archaeological hypothesis
34	6		Simple graphical evidence		Detailed graphical reference		Textual evidence
35 36	7		Textual and comparative evidence		Basic archaeological information or simple base plans		Based on similar structures
37 38 39	8		Textual evidence		Strong archaeological and documental evidence in photographs and detailed plans		Based on historical context, nature and culture
40	9		Based on similar structures		Still existing (or partially existing) with modifications		
41 42	10		Imagination		Still existing in its original form		

Table 43 Identification of the evidence levels, colours and definition of the propositions of historical-archaeological evidence scales.

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414 Regarding the colours used in the pioneer scafe 225 (Byzantium 1200) and in the proposition of Aparicio a45 Figueiredo (2017), several observations emerged. Firstly, tl46 13-04-75 14-14-75 colours selected are not pure, that is, their value and intensi47 are altered as they are mixed with achromatic colours (whi48 46 and black). These colours identified as pastel colours stared 479 out less, despite corresponding to warmer colours. F50 380 399 40 instance, by mixing orange with white, this colour loses puriby and thus yellow stands out over orange, in spite of the fate2 that the latter is warmer. Likewise, the use of pink in t53 52 historical-archaeological evidence scale would alter t54 523 colour range, since pink results from modifying the intensity 434 of the colour red. Lastly, regarding the proposition of

Aparicio and Figueiredo (2017), the colour purple does not allow the proposed evidence scale to go from cool to warm colours, since purple is not a cool colour. Purple results from mixing the primary colours blue and red, which would imply inverting the chromatic circle, obtaining a scale of warm to cool colours.

Moreover, from the proposition of Ortiz et al. (2018), it is worth mentioning that the colour palette used is too large and difficult to understand for the users who are not familiarised with colour theory. By modifying the attributes of the colours, the proposition of evidence scale is little intuitive, since it uses atypical colours that result from the mixture of primary and

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> secondary colours. To sum up, it is a much personalis82 palette and, thus, it is poorly universal. 33

The evidence levels also show differences between tB4 142 propositions. Firstly, the evidence levels of the pione 35153 proposition (Byzantium 1200) and the proposition 36Aparicio and Figueiredo (2017) are quite similar. TB7 difference lies in the fact that the Byzantium project orde38 the levels from higher to lower veracity, whereas the secobo proposition orders them from lower to higher evidence level0 Although the levels are ordered in the opposite manner, that colours associated with them are the same for bo412 propositions, with the warmer colours corresponding 43 greater evidence and the cooler colours corresponding 44 lower evidence. Regarding the evidence levels proposed 145 251 Ortiz et al. (2018), there are significant differences wi416 262 respect to the previous propositions. In this case, the authors reduced the levels from 10 to 8, ordering them from greates to lower historical-archaeological evidence. Moreover9 another difference lies in the veracity levels aimed at the 265 archaeological hypotheses. Ortiz et al. (2018) associate the **51** 216 with lower veracity compared to the graphic evidences2 whereas the two previous propositions associate tb3 archaeological hypotheses with greater veracity compared 54 the graphic evidence. 55

As was previously mentioned, and as a result of tbb Topical Seminar held in the University of Córdoba, a list 371 382 3930 304 interview was carried out with Pablo Aparicio and Rafa 58 Ortiz. Different aspects are worth highlighting from su59 interview. Firstly, Aparicio and Ortiz consider each other60 propositions to be correct, and they answered most of the questions with similar answers. They both thought about the same type of audience when they created their propositions of evidence scales, i.e., both experts of the discipline and the general public. This is different from the selection of colours since, although both of them considered all types of audience, the interpretation of the colours from all viewers is different for each proposition. While the colours used by Pablo Aparicio are focused on the use of the chromatic wheel. Ortiz et al. (2018)use a more difficult palette in terms of colour theory. Furthermore, according to Pablo Aparicio, the works that implement their proposition of evidence scale and its corresponding colours show its validity for any type of reconstruction, whereas Rafael Ortiz could not carry out independent studies in the Mosque-Cathedral, thus they could only validate the evidence levels and the corresponding colours of their proposition in said heritage asset. Although each author has implemented the scale in a larger or smaller number of scopes, they both agree that their scales are being used with increasing frequency to support virtual reconstructions, and they also know that they are being used in other countries. Lastly, it is worth highlighting that they both agree that this research field should be taught in subjects at universities, and they are doing everything they can to disseminate it, both in their workplace and through teaching.

Additionally, as a result of said Topical Seminar, the questionnaire was administered and completed, with the participation of 30 people. To obtain the results of this questionnaire, the mean of each of the questions (except for the first three: gender, age and education) was statistically analysed. Moreover, the variance of the means of the 'gender', 'age' and 'education' categories with each of the questions was also explored. Next, Table 54 shows the results of the analyses.

λης Τ	able <u>5</u> 4 Statistica	l results obtain	ned from the questionnaire.		
20	Question	Mean	ANOVA ('Gender' variable)	ANOVA ('Age' variable)	ANOVA ('Education' variable)
31	4	1.37	Pr(>F): 0.271	Pr(>F): 0.74	Pr(>F): 0.0746
38	5	2.07	Pr(>F): 0.546	Pr(>F): 0.866	Pr(>F): 0.71
39	6	2.50	Pr(>F): 0.184	Pr(>F): 0.69	Pr(>F): 0.0885
40	7	1.90	Pr(>F): 0.491	Pr(>F): 0.848	Pr(>F): 0.0757
41	8	2.27	Pr(>F): 0.64	Pr(>F): 0.118	Pr(>F): 0.854
42	9	1.73	Pr(>F): 0.101	Pr(>F): 0.236	Pr(>F): 0.298
43	10	1.90	Pr(>F): 0.00375	Pr(>F): 0.213	Pr(>F): 0.0568
44	11	1.23	Pr(>F): 0.489	Pr(>F):0.147	Pr(>F): 0.706
45	12	1.20	Pr(>F): 0.253	Pr(>F): 0.708	Pr(>F): 0.0233
46	13	1.43	Pr(>F): 0.607	Pr(>F): 0.0361	Pr(>F): 0.705
47	14	1.20	Pr(>F): 0.346	Pr(>F): 0.119	Pr(>F): 0.959
48	15	1.83	Pr(>F): 0.345	Pr(>F): 0.466	Pr(>F): 0.00863
49	16	1.86	Pr(>F): 0.626	Pr(>F): 0.312	Pr(>F): 0.208
50	17	1.80	Pr(>F): 0.279	Pr(>F): 0.596	Pr(>F): 0.726
51	18	2.59	Pr(>F):0.412	Pr(>F): 0.0086	Pr(>F): 0.00539

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is important to take into account that not all questions ha69 the same number of response options. Question 1, 2 and 3 are

For the correct interpretation of the results of the means, **68** not focused on the historical-archaeological evidence scale, as they were used to characterise the respondents.

Focusing on the most interesting results for the creation **56** a new proposition of historical-archaeological evidence scafe7 it is important to highlight that, regardless of gender, age a58 education, the mean value in question 4 was 1.367. The 153 indicates that over half of the respondents (maximum method) value: 2) had heard about the evidence scale for the first tinfe1 In question 5, half of the respondents agree that this is due 62 the fact that virtual reconstructions are not usual 63 accompanied by an evidence scale (mean value: 2.07). F64 questions 6 and 7 (maximum mean value: 4), the responder 65 answered that they knew between 1-5 and 5-10 virtufat reconstructions, and that, among these, between 0 and 167 were accompanied by a historical-archaeological eviden68 scale. Regarding question 8 (maximum mean value: 3), tb9 respondents stated that the information presented in the 262 evidence scale reached the general public (mean value: 2.277)1 The rest of the questions (9-18) belong to the Likert scale on the level of agreement or disagreement (maximum means value: 5). As can be observed in Table 54, except for question4 18, none of them exceeded the mean value of 2. This indicates **216** that, from question 9 to 17, the respondents 'strongly agreed 76 with some of the questions being close to 'agree'. However?

question 18 obtained a mean value of 2.59, being close 78
reative agree nor disagree' regarding the opinion about the colours used in the proposition of Ortiz et al (2018).
After the analysis of variance (ANOVA) carried out the gender', 'age' and 'education' categories with each of the colours with each of the colours

questions, the following results were obtained: 83
with respect to the 'gender' category, for 84
questions, except question 10, the p value was over 0.085
did not influence the responses at 95% confidence level. 87
question 10, the p value was below 0.05, which indicates that gender did influence the responses given to this question, th89
gender did influence the responses given to this question, th89
the null hypothesis was accepted. 90

For the 'age' category, for all questions, except f91 questions 13 and 18, the p value was over 0.05, exceeding f92 5% significance level, thus age did not influence t93 responses at 95% confidence level. Regarding questions 13 and 18, the p value was below 0.05, thus age did influence the responses given in these questions, and the null hypothesis was thereby accepted.

In the 'education' category, except for questions 12
and 18, the p value was over the 5% significance level,
showing that education did not influence the responses at 95%
confidence level. For questions 12 and 18, the p value was not
over 0.05, indicating that the null hypothesis was accepted since education did influence the responses given in the 99
questions.

Based on the fact that this project pursues a proposition focused on the common viewer, without losing its scientified character, we firstly evaluated the historical-archaeological evidence levels to be shown. The aim was to obtain a view visual scale, without excessive information, that can be understood by any person regardless of their age or education Since virtual reconstructions are created to show how a heritage asset was in a specific time (López-Menchero and Grande 2011), we believe that, visually, the archaeological remains that require highlighting the least are those that are preserved, as, due to the fact that they can be personally observed, their intensity should not be highlighted in the evidence scale implemented in the virtual reconstruction. Therefore, this would imply ordering the evidence levels from lower to greater historical-archaeological veracity, with the former being associated with a greater visual colour intensity.

Furthermore, it is important to consider that not all visitors of archaeological sites are experts of the discipline, thus, the greater the number and information of evidence levels, the greater the difficulty to interpret them. To solve this, it was decided to reduce the historical-archaeological evidence levels, in order to omit information of these which not all users know how to interpret. Based on the existing propositions of evidence scales, six historical-archaeological veracity levels are proposed:

- 1. Elements of the historical and natural context. Elements close to the historical and natural context.
- Representation through compared architecture. Structure or object represented by compared architecture or similar contemporary elements.
- Archaeological hypotheses. Information based on the result of the archaeological excavations.
- 4. Textual references. Textual description of elements.
- Graphic references. References of elements in drawings, prints or paintings.
- Preserved archaeological remains. Structure or object preserved in the present.

As was previously mentioned, the intensity of the colours is fundamental in the present proposition. Some studies show that one of the attributes of colour is value (Edwards 2004; De Grandis 1985). By transforming the chromatic scale to achromatism, the value scale can be observed (Fig. 5), which shows the darker and brighter colours of the chromatic wheel. In other words, the intensity of each colour can be observed.



Fig. 5 Transformation of the chromatic wheel to achromatism.

As was previously mentioned, the discrimination of colours can be affected by age (Dittmar 2001; Mohebbi 2014; Terwogt and Hoeksma 1995; therefore, it is important to use colours that can be distinguished from each other by their intensity. The new proposition of historical-archaeological evidence scale aims to denote the levels of lower veracity with darker and more intense colours, while associating the greater veracity

levels with clearer and less intense colours. To this end, it wa \vec{s} to select a scale composed of warm colours, from greater to 1/2 Moreover, the 3D model was essential to apply the differend blue and the secondary colour green is due to the pursuit for a 153 groups of colours and verify how they worked in it. After 164 13 several colour tests performed in the 3D model, it was decided visually harmonious scale.

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fundamental to transform the chromatic wheel t& lower intensity (Table 65). Analog colours were used to create achromatism, thus observing the intensity of the colours9 a warm colour scale. The discrimination of the primary colour gradation without leaps in the chromatic wheel, thus creating a

Table 65 Evidence levels and their associated colours of the new proposition of historical-archaeological evidence scale.

Level of evidence for virtual reconstructions	Definition	Colour	RGB	HEX
1	Elements of the historical and natural context		$\frac{67}{852}$ 0	4300528 0034
2	Representation through comparative architecture		<u>134</u> 243 <u>30</u> 3 4 <u>5</u> 7	86002DI 3212F
3	Archaeological hypotheses		2 <u>27</u> 41 <u>27</u> 78 3 <u>6</u> 7	<u>E31B24</u> 14E25
4	Textual references		24 <u>3</u> 9 <u>84</u> 153 <u>47</u> 33	F <u>3542F</u> 9 921
5	Graphic references		2 <u>55</u> 39 2 <u>4506</u> 55-4	E <u>A9F4E</u> CE04
6	Preserved archaeological remains		255 2 <u>45</u> 34 55 15	FFF <u>537</u> ≨ ₽

In order to accurately evaluate the intensity (brightness 22 scale of greys corresponding to the selected colours shows different intensities among them, with the levels of lower historical-archaeological evidence being more intense than those of greater veracity.

darkness of the colours used), the scale of greys associat2d3 with the colours used was created. Additionally, this sca24 was used to calibrate the degrees of value of the select25 colours (Edwards 2004). As can be observed in Table 76, the

Table 76 Scale of greys of the veracity levels of the new proposition of historical-archaeological evidence scale.

Level of evidence for virtual reconstructions	Definition	Colour			
1	Elements of the historical and natural context		•	(Formatted Table
2	Representation through comparative architecture			(
3	Archaeological hypotheses				
4	Textual references				
5	Graphic references				
6	Preserved archaeological remains				

<u></u> The 3D model played a fundamental role in the selection **36** the 3D model to verify that the same effect was obtained (Fig. $\frac{31}{324}$ colours, as it was used with different colour values until it was **45** appropriately adjusted. In the scale of greys, it was confirm**38** that the selected colours were optimal to show the eviden **39**

6). Lastly, the outer terrain of the Baker's House, which is not part of the veracity of the heritage asset, is associated with a neutral colour, which does not stand out among the colours that $\frac{35}{10}$ scale from greater to lower intensity. This was also tested $\frac{40}{10}$ correspond to the evidence levels.

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29 evidence scale has six levels of veracity (Table 65). The colours of greater intensity show the levels of low¹/₂6
 colours of greater intensity show the levels of low¹/₂6
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19 Therefore, the new proposition of historical-archaeologich4 produced computer graphics with 31 reconstructive units (Fig. 7). Next, we present the table associated with the historical- $\underline{87}$). This table identifies the number of the reconstructive unit,

 22
 Colours (ress intense) represent greater

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 implementation of the new proposition of historical-archaeological scale for the digital reconstruction of the *domus*.

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 Fig. 7 Computer graphics of the new proposition of historical-archaeological scale for the digital reconstruction of the *domus*.

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 Table §7 Identification of the RUs, evidence archaeological evidence scale of the virtual reconstance

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 Evidence

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RU4 RU6 **RU10** RU9 RU11

Table 87 Identification of the RUs, evidence levels, name, description, chronology and bibliography of the new proposition of historicalarchaeological evidence scale of the virtual reconstruction of the Baker's House of Torreparedones.

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39							
40	RU	Evidence level	Name	Description	Chronolog y	Bibliography	
41	1	6	Pavement made of large stone	This building technique consisted in extending	Early	(Moreno 2015) 🔸	Formatted Table
42			slates	a bed of opus incertum and irregular flagstone	Roman		
12				paving, being a parallel technique to the one	Empire		
43				used in the paving of the streets of the city of			
44				Torreparedones.			
1 5	2	6	Pavement of opus signinum	Pavement of <i>opus</i> signinum in the room	Early	(Morena et al.	
+J				identified as <i>cubiculum</i> .	Roman	2016; Morena et	
46	2		Non-processed performant	Payaments of the downs that are not preserved	Empire	al. 2019)	
47	3	3	Non-preserved pavement	Pavements of the <i>aomus</i> that are not preserved.			
48	4	6	"A bagnarola" water tank	Supplied with rainwater gathered in the roofs,	Late	(Morena et al.	
10				given its location in one of the corners of the	Roman	2016; Morena et	
49				atrium.	Republic	al. 2019)	
50	5	3	Stairs	Stairs proposed for bridging the different levels			
51				of the rooms.			
- <u>-</u>	6	2	Latrine	The presence of a limestone slate that stands		(Morena et al.	
52				out in size in all the pavement could be an		2019)	
53	_			indication of the location of the latrine hole.			
54	7	4	Structure designed for the sale	Garret made of large 20cm-high slates, located		(Morena et al.	
51			of bakery products	in the southern half of the space.		2019)	
55							
56							

6	Impluvium	Square pond that gathers rainwater and discharges to the street through a canalisation system connected to a larger canalisation	Early Roman Empire	(Morena et al. 2016; Morena et al. 2019)
3	Impluvium columns	system. First building phase of the <i>atrium</i> .		(Morena et al. 2016; Morena et al. 2019)
6	Base of the lararium	Square structure that could correspond to the base of the recess that held the figurines for domestic worship.	Early Roman Empire	(Morena et al. 2019)
2	Lararium	Due to its chronology and location, it seems to correspond to a variant of the aediculae type, pseudoaedicular, characterised for being made of walls or a solid block, with an inner recess- like cavity, where domestic worship figurines would be placed, crowned by a gable.		(González 2003; Corrales et al. 2016)
4	Kitchen structure	Masonry structure		(Morena et al. 2019)
6	Circular base associated with the rotatory mill	Circular base of slightly over 1 m in diameter that seems to correspond to the base of a rotatory mill.	Early Roman Empire	(Morena et al. 2016; Morena et al. 2019)
2	Roman rotatory mill	Formed by two hollow cones placed upside down, one over the other, with the grain remaining between the two cones and being milled by the friction between the two cones.		(Flores 1993; Morales 2008)
2	Oven vault	In Augusta Emerita, an oven was recovered, which presented an access similar to the one in the <i>domus</i> of Torreparedones, consisting of a small passable entrance up to the very mouth of the oven, embedded in a square structure. Similarly, the floor of the oven preserved in Torreparedones is typologically identical to that of the bread oven of the 'Birds' House' and that of the <i>domus</i> of the Planetarium (Itálica, Seville, Spain).	Early Roman Empire	(Bustamante and Salido 2014; Luzón 1975)
2	Oven mouth	It has a diameter of 4 m and it would have been covered by a vault, being embedded, at least in the upper part by a wall, with side openings for putting in and taking out the products to be baked and the fire wood.	Early Roman Empire	(Morena et al. 2019)
1 1	Roman furniture Vegetation	Roman furniture associated with each space. Contemporary vegetation in time and space.		
6	Skewback of the walls of the domus	The walls were built with rammed earth and <i>opus incertum</i> for the plinths, resorting to irregular bonds of limestone, which is the natural local rock, applying plaster as the final layer.	Early Roman Empire	(Morena et al. 2019)
4	Elevation of the walls of the <i>domus</i>	Since the total height of the walls of the <i>domus</i> is not preserved, the work of Vitrubius was selected. It is important to take into account that the ratio relationships established by Vitrubius are approximate.		(Díaz 2014)
3	Access to the western area	Without archaeological evidence, it was decided to create an open door to the <i>hortus</i> , since there must have been an access in the production area to introduce the elements for their use.		(Cáceres-Criado et al. 2022; Cáceres-Criado et al. 2022)
6	Preserved parietal decoration	Ornamental technique in which a mortar coating is repeatedly hit with a mold containing the embossed decoration. Then, the coating is covered with pure line or mortar	Early Roman Empire	(Morena et al. 2016; Morena et al. 2019)
5	Parietal decoration	This type of decoration has also been found in other Roman sites. The archaeological work conducted in Beatas Street (Cartagena, Spain)		(Fernández et al. 2005)

910recovered panels decorated with embossed motifs.(Mezquíriz 2004) motifs.11243WindowsIn the Villa de las Musas (Arellano, Navarra, Spain), a window grill was discovered. The preservation of this type of elements helps in their 3D reconstruction, as well as in the calculation of the size of the hollows.(Mezquíriz 2004) (Mezquíriz 2004)13252Atrium coverComplavium / implavium system(Dfaz 2014; Adam 1996)16262Cover of the southern roomsLarge gabled cover that discharges the rainwater into the atrium and into the street located south of the domus.(Dfaz 2014; Adam 1996)18272Cover of the storage and milling areaSpaces E-37 and E-38 consist of a hip roof that discharges rainwater into the atrium and into the street located south of the domus.(Dfaz 2014; Adam 1996)21282Cover of the tablinum and cubiculumThe tablinum (E-11) and the cubiculum located in the northern area (E-12) consist of a shed roof that also discharges into the atrium, since, otherwise, the rainwater would go to the open corridor of the western area of the domus, where there are no canalisations or storage(Dfaz 2014; Adam 1996)
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18272Cover of the storage and milling areaSpaces E-37 and E-38 consist of a hip roof that discharges rainwater into three areas: the northern area (<i>hortus</i>), the street located south of the <i>domus</i> .(Díaz 2014; Adam 1996)20282Cover of the <i>tablinum</i> and cubiculumThe <i>tablinum</i> (E-11) and the <i>cubiculum</i> located roof that also discharges into the <i>atrium</i> , since, other wise, the rainwater would go to the open corridor of the western area of the <i>domus</i> ,(Díaz 2014; Adam 1996)232425Cover of the <i>tablinum</i> and where there are no canalisations or storage(Díaz 2014; Adam 1996)
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19 northern area (hortus), the street located south 20 28 2 21 28 2 22 28 2 23 23 24 24 25 25
20 28 2 Cover of the tablinum and the street located west of the domus. (Díaz 2014; in the northern area (E-12) consist of a shed roof that also discharges into the atrium, since, otherwise, the rainwater would go to the open corridor of the western area of the domus, where there are no canalisations or storage (Díaz 2014; in the northern area (E-12) consist of a shed roof the atsol discharges into the atrium, since, otherwise, the rainwater would go to the open corridor of the western area of the domus, where there are no canalisations or storage
21282Cover of the tablinum and cubiculumThe tablinum (E-11) and the cubiculum located in the northern area (E-12) consist of a shed roof that also discharges into the atrium, since, otherwise, the rainwater would go to the open corridor of the western area of the domus, where there are no canalisations or storage(Díaz Adam 1996)
22cubiculumin the northern area (E-12) consist of a shed roof that also discharges into the atrium, since, otherwise, the rainwater would go to the open corridor of the western area of the domus, where there are no canalisations or storageAdam 1996)23254
23roof that also discharges into the <i>atrium</i> , since, otherwise, the rainwater would go to the open corridor of the western area of the <i>domus</i> , 2524where there are no canalisations or storage
24otherwise, the rainwater would go to the open corridor of the western area of the <i>domus</i> , where there are no canalisations or storage
25 where there are no canalisations or storage
25 where there are no canadis of storage
structures.
26 29 2 Cover of the service area The other cover is the one that covers spaces E- (Díaz 2014;
27 22, E-23, E-24, E-26, E-28, E-31 and E-46, Adam 1996)
28 with a gable root, which discharges the
2.9 area of the <i>domus</i> .
3 0 30 2 Cover of the woodshed Shed roof proposed for the closing of space E- (Díaz 2014;
32, identified as woodshed. Adam 1996)
3 ± 31 2 Cover of the commercial area, Spaces E-15 and E-16 are composed of a gable (Díaz 2014;
32 redistribution area and faithile western area of the <i>domus</i> , and on the other
hand, into the eastern area. The closing of
34 spaces E-36 and E-13 consists of a shed roof
35 that would be the continuation of the previous
36 'vorch'

¹37 3²8 4 Conclusions

39 The application of a colour scale in virtual reconstructions **24** 44) a valid tool to show the degree of veracity of the wo215 45 conducted. Therefore, the existing propositions of cargo 46 historical-archaeological evidence scale are considered 47 optimal for such purpose. However, the selection of the 48 evidence levels and colours is key for their easy and 30 optimal for such purpose. However, the selection of the 494 unequivocal understanding. 30

495 Although no negative results were obtained in the 11 14 147 147 questions about the existing propositions of historica2 archaeological evidence scales, the open debate in the Topicas Seminar showed aspects that needed to be addressed. Thus4 **4**48 we decided to create a new proposition that encompasses su35 459 aspects and which can reach the general public, regardless 36 their education with respect to the topic. 37

150 17 18 The achromatic wheel is fundamental to show a scalle where the order of the colours is important. The colourle39 59 scale in this study was used to adjust the degree of value 40**50** each colour and thus obtain a scale of greater to lower visual archaeological sites, in mockups, museums..., etc. Therefore, 214 colour intensity. To increase the understanding of the its use should be encouraged, which is the best way of 55

evidence scale for any type of viewer, regardless of their age or 22 education, it was decided to reduce the evidence levels. It was observed that the presentation of very detailed information in the evidence levels may lead to mistakes in terms of their visual understanding, since the evidence levels increase, with the consequent increase of visual fatigue in the identification of each colour.

As is shown by the results of the questionnaire, there is still a great percentage of people who do not know the historicalarchaeological evidence scale. To solve this issue, it is fundamental to disseminate the scale, highlighting its value in research studies and in the sites of the heritage assets. The historical-archaeological evidence scale for virtual reconstructions is a useful tool to systematise the existing information about the assets, further disseminate them, and finally, assess the virtual reconstruction creation process. In addition to facilitating the correct interpretation of the archaeological work, this scale would help to correctly interpret heritage assets, presenting them in explanatory panels of the

able 2 Duestion	Quantitative study presented in the Topical Seminar held in the University of Córdob.	<u>a.</u>	11/ A	
uestion	s Resp			Formatted: Font: (Default) Times New F Not Bold, Font color: Blue
<u>1.</u>		oonse_Opoptions responses		Formatted: Font: (Default) Times New F
	What is your gender?	• Man:		Formatted: Font color: Blue
		• Woman		Formatted: Space Before: 12 pt
<u>2.</u>	What is your age?	• 20-30 years;		Formatted: Font: (Default) Times New F
		• <u>30-40 years;</u>		Not Bold, English (United Kingdom)
~		• Over 40 years		Formatted: Font: 8.5 pt, Italic, English (L
<u>3.</u>	What is your academic training?	Arts and Humanities;		Formatted: Space After: 8 pt
		• Science;		Formatted. English (Onited Kingdom)
		Heatth Sciences;		
		Social and Legal Science:		
		Engineering and Architecture.		
		• Other		
4.	scale?	• Yes;		
F	When do seen which more did not because about the biotectical contractions			
<u>.</u>	evidence scale?	Virtual reconstructions are not usually accompanied by an evidence scale;		Formatted: English (United Kingdom)
		• I am not interested in this topic;		
		• Lack of training in the Degree of		
		Archaeology		
<u>6.</u>	How many virtual reconstructions do you know?	• <u> </u>		
		• <u>1-5;</u>		
		• <u>5-10;</u>		
-	How money of these vietnal reconstructions are set of the state of the	• <u>Over 10</u>		
<u>7.</u>	now many of these virtual reconstructions are accompanied by a historical- archaeological evidence scale?	• <u> </u>		
		• <u>1-5;</u>		
		• <u>5-10;</u>		
0	In your opinion, what kind of audiance receives the information presents 4 in	Over 10		
<u>ð.</u>	the historical-archaeological evidence scale?	Experts in the field;		
		• General public;		
		• Both		
<u>8.</u>	<u>In your opinion, what kind of audience receives the information presented in</u> the historical-archaeological evidence scale?	 5-10; Over 10 Experts in the field; General public; Both 		

1					
∠ 3					
4					
5					
6					
7					
8					
9 10	<u>9.</u>	In a scale of 1-5, with 1 being Stron	gly Agree and 5 being Strongly Disagree,		
11		do you think that the use of a hist good option to accompany a virtual	reconstruction?	Likert scale*	
12	<u>10.</u>	As is proposed by P. Aparicio and	C. Figueiredo in one of their studies, the		
13		historical-archaeological evidence	scale contributes to the creation of a	Likert scale*	
14	11	In a scale of 1-5 with 1 being Stron	alv A gree and 5 being Strongly Disagree		
15 16	<u></u>	is the name "historical-archaeologic	cal evidence scale" descriptive?	Likert scale*	
17	<u>12.</u>	In a scale of 1-5, with 1 being Stron	gly Agree and 5 being Strongly Disagree,		
18		do you consider that the historica disseminate and correctly interpret	l-archaeological evidence scale helps to not only the heritage asset but also the	Likert scale*	
19		archaeological work conducted?			
20	<u>13.</u>	In a scale of 1-5, with 1 being Stron	gly Agree and 5 being Strongly Disagree,		
21		archaeological evidence scales, do	you think this would help the general	Likert scale*	
22		public to understand the archaeolog	ical remains?		
23 24	<u>14.</u>	In a scale of 1-5, with 1 being Stron do you think it is convenient for t	gly Agree and 5 being Strongly Disagree, he tourist to accompany the information		
25		presented in the explanatory panels	of archaeological sites with the historical-	Likert scale*	
26		archaeological evidence scale of the	<u>virtual reconstruction /</u>		
27	<u>15.</u>	In a scale of 1-5, with 1 being Stron what do you think about the eviden	gly Agree and 5 being Strongly Disagree, ce levels proposed by P. Aparicio?	Likert scale*	
28	<u>16.</u>	In a scale of 1-5, with 1 being Stron	gly Agree and 5 being Strongly Disagree,		
29		what do you think about the eviden	ce levels proposed by R. Ortiz?	Likert scale*	
31	<u>17.</u>	In a scale of 1-5, with 1 being Stron	gly Agree and 5 being Strongly Disagree,	Likert scale*	
32	10	In a cost of 1.5 with 1 hairs Street	ele A erec en d 5 haire Stree ele Diagene		Formatted Table
33	<u>18.</u>	what do you think about the colours	s used in the proposition of R. Ortiz?	Likert scale*	Formatted: Font: 8.5 pt
1 ³⁴	* Like	rt scale composed of the following op	tions: Strongly Agree; Agree; Neither Agree nor	Disagree; Disagree; Strongly Disagree.	Formatted: Font: 8.5 pt
35	Table 3	Oualitative study carried out withcon	ducted to Pablo Aparicio and Rafael Ortiz		Formatted: No bullets or numbering
30 37	Question	e	Demense Della Annicia	Persona Defect Ortiz	Formatted: Font: (Default) Times New Roman, 8.5 m
38.	Questions		Rechance Pania Anaricia		i officiere i offi
		<u>o</u>	Kesponse Pablo Aparicio		Formatted: List Paragraph, Numbered + Level: 1 +
39	1	European dest des mideres	Ecsponse rabio Aparicio Exactly, both. I think it is very important that the scale does not lose its	<u>"From my point of view, I think that the</u> evidence scale is useful for all audiences, and it	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment
39 40	<u>1.</u>	Everyone agrees that the evidence scale, in addition to its scientific	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation	*From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5"
39 40 41	<u>1.</u>	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual	"From my point of view, I think that the "From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions," for both technicians and the general public. In our case, when we started working with the scale, we	Formatted: Forl: (Jertadin) finites rew formali, 0.5 p Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: Font: (Default) Times New Roman
39 40 41 42	<u>1.</u>	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the disaipline accomment viewers	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants-transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we	Formatted: Forla (certain) miles rew remain, o.5 p Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom)
39 40 41 42 43 44	<u>1.</u>	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved".	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom)
39 40 41 42 43 44 45	1.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study",	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved"	Formatted: List Paragraph, Number et et Voltali, 65 p Formatted: List Paragraph, Number et et Voltali, 65 p Formatted: List Paragraph, Number et et Voltali, 65 p Formatted: List Paragraph, Number et et Voltali, 65 p Formatted: List Paragraph, Number et et Voltali, 65 p Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Seat: 9.5 pt
39 40 41 42 43 44 45 46	<u>1.</u> <u>2.</u>	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both? What did you consider for the	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study",	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved".	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt
39 40 41 42 43 44 45 46 47	<u>1.</u> 2.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both? What did you consider for the selection of colours?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study". "In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need	<u>set of the set of th</u>	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment
39 40 41 42 43 44 45 46 47 48	<u>1.</u> 2.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both? What did you consider for the selection of colours?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study", "In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need for standardising the scale, we believed it would be most interesting to keen using colours similar	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved". "Solving the problem related to the work we were doing and also in the colours that were used in geographic information systems. We attempted to create a scale of colours that solved the problem related to the work we made several more than the systems.	Formatted: Fort: (Default) finites rew football, etc.) p Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5"
39 40 41 42 43 44 45 46 47 48 49	<u>1.</u> 2.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study". "In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need for standardising the scale, we believed it would be most interesting to keep using colours similar to those used in the Byzantium project, basically	<u>Acceptionse Rahael Ornz</u> <u>"From my point of view, I think that the</u> evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved". <u>"Solving the problem related to the</u> work we were doing and also in the colours that were used in geographic information systems. We attempted to create a scale of colours that solved the problems regarding the consideration of warm colours – cool colours that existed in the previous	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5"
39 40 41 42 43 44 45 46 47 48 49 50	<u>1.</u> 2.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both? What did you consider for the selection of colours?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study". "In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need for standardising the scale, we believed it would be most interesting to keep using colours similar to those used in the Byzantium project, basically because we understood that they worked very well. We made small changes in the colours, that	<u> ("From my point of view, I think that the</u> ("From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved".	Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: No bullets or numbering
39 40 41 42 43 44 45 46 47 48 49 50 51	<u>1.</u> 2.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study". "In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need for standardising the scale, we believed it would be most interesting to keep using colours similar to those used in the Byzantium project, basically because we understood that they worked very well. We made small changes in the colours, that is, we adjusted the colours in a way that they could be distinguished. However, as was	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved". "Solving the problem related to the work we were doing and also in the colours that were used in geographic information systems. We attempted to create a scale of colours that solved the problems regarding the consideration of warm colours – cool colours that existed in the previous propositions".	Formatted: Forte (betadity) finites reav formation, dots p Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: (Default) Times New Roman Formatted: English (United Kingdom) Formatted: English (United Kingdom) Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: 8.5 pt Formatted: List Paragraph, Numbered + Level: 1 + Numbering Style: 1, 2, 3, + Start at: 1 + Alignment Left + Aligned at: 0.25" + Indent at: 0.5" Formatted: Font: 8.5 pt Formatted: Font: 8.5 pt Formatted: Font: 8.5 pt Formatted: No bullets or numbering Formatted: Font: 8.5 pt Formatted: Font: 8.5 pt Formatted: Font: 8.5 pt Formatted: Font: 8.5 pt Formatted: Font: 10 pefault) Times New Roman, 8.5 p Formatted: Font: (Default) Times New Roman, 8.5 p Formatted: Font: (Default) Times New Roman, 8.5 p English (United Kingdom)
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10	<u>3.</u>	Do you think that your proposition	<u>"It should be.</u> "	The aim is to make this	<u>"Unlike Pablo Aparicio, we always</u>		Formatted: Font: 8.5 pt
11		virtual reconstruction regardless of	reconstruction. I was able	e to apply it to all virtual	that question. Since we always work on the same	$\langle \rangle$	Formatted: List Paragraph, Numbered + Level: 1 +
12		the number of reconstructive units	reconstructions that I ha	we carried out to date.	thing, the Mosque-Cathedral, we cannot export this information to other virtual reconstructions"		Numbering Style: 1, 2, 3, + Start at: 1 + Alignment:
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18			the evidence level of eacl	h area. We must also be			
19			aware that the evidence	scale must be flexible			
20			or scientific team. It is i	mportant to understand			
22			that this is a tool that sh	ows the evidence level			
23			as possible"	<u>e în căch căsc as cicariy</u>			Formatted: English (United Kingdom)
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25		many of the archaeologists who	I see that its use in vir	tual reconstructions is	archaeological evidence scale is increasing, in	\sum	Formatted: List Paragraph Numbered + Lovel: 1 +
26		the historical-archaeological	Virtual Heritage and in	the education platform	Italy, etc., so a greater number of people will		Numbering Style: 1, 2, 3, + Start at: 1 + Alignment:
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33		disadvantage is the scarce training	very good to explain th	is tool in universities,	understand digital technologies, so universities	()	Formatted: Font: (Default) Times New Roman, 8.5 pt
35		given to archaeology students. Greater dissemination and analysis	since, as has been expla not only to virtual recor	ined, it can be applied nstructions, but also to	should start changing some things to highlight the relevance of this scope, which is widespread".	() ()	English (United Kingdom)
36		of this system would considerably	traditional historical dr	awings, and it allows		$\ \ $	Formatted: Font: 8.5 pt
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40		university?	it is a very important tool	that came here to stay".	A		Numbering Style: 1, 2, 3, + Start at: 1 + Alignment:
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Fig. 1. Methodological phases.



Fig. 2. Application of the evidence scale proposed by P. Aparicio and C. Figueiredo in the Baker's House virtual reconstruction.



Fig. 3. Application of the evidence scale proposed in the Byzantium 1200 project in the Baker's House virtual reconstruction.



Fig. 4. Application of the evidence scale proposed by Ortiz et al. in the Baker's House virtual reconstruction.



Fig. 5. Transformation of the chromatic wheel to achromatism.



Fig. 6. Render with the implementation of the new scale proposition in the Baker's House in colour and in scale of greys.



Fig. 7. Computer graphics of the new proposition of historical-archaeological scale for the digital reconstruction of the domus.

Table 1

Bibliometric study on the implementation of the existing historical-archaeological evidence scales.

Reference	Applied scale	Item	Levels	Chromatic gradation
http://www.byzantium1200.com/ [4]	Byzantium 1200 project	Byzantium city around 1200	10	From warm to cool colours (greater evidence- lower evidence)
Aparicio 2016 [7]	Aparicio & Figueiredo	The crenellated tower of San García, Algeciras (Spain) (17th-18th century). Virtual recovery of a military structure using technology	10	From cool to warm colours (lower evidence- greater evidence)
Aparicio & Figueiredo 2017 [5]	Aparicio & Figueiredo	The historical-archaeological evidence degree of virtual reconstructions: toward a graphic representation scale	10	From cool to warm colours (lower evidence- greater evidence)
De Mota & Valle 2018 [9]	Aparicio & Figueiredo	Archaeology of the military orders in Castilla-La Mancha and the virtual reconstruction of its heritage	10	From cool to warm colours (lower evidence- greater evidence)
Ortiz-Cordero et al., 2018 [6]	COR_16	Proposal for the improvement and modification of the scale of evidence for the virtual reconstruction of cultural heritage: A first approach to the Mosque-Cathedral and the river landscape of Córdoba (Spain)	8	Colour range from greens to browns
Rodríguez-Hernández et al., 2021 [10]	Aparicio & Figueiredo	Virtual 3D reconstruction of the "Fortified tower" of the Ulaca Oppidum (Solosancho, Ávila, Spain): much more than an image	10	From cool to warm colours (lower evidence- greater evidence)
Aparicio-Resco et al., 2021 [8]	Aparicio & Figueiredo	Virtual 3D reconstruction of Gauzón Castle (Castrillón, Principado de Asturias, Spain)	10	From cool to warm colours (lower evidence- greater evidence)
Cáceres-Criado et al., 2022 [19]	Aparicio & Figueiredo	Graphic representation of the degree of historical-archaeological evidence: the 3D reconstruction of the "Baker's House"	10	From cool to warm colours (lower evidence- greater evidence)

 Table 2

 Quantitative study presented in the Topical Seminar held in the University of Córdoba.

estions		Response options	
1.	What is your gender?	•	Man; Woman
2.	What is your age?	•	20-30 years; 30-40 years; Over 40 years
3.	What is your academic training?	• • • •	Arts and Humanities; Science; Heath Sciences; Social and Legal Science; Engineering and Architecture. Other
4.	Is this the first time you heard about the historical-archaeological evidence scale?	•	Yes; No
5.	Why do you think you did not know about the historical-archaeological evidence scale?	:	Its lack of dissemination; Virtual reconstructions are not usually accompanied by an evidence scale; I am not interested in this topic; Lack of training in the Degree of Archaeology
6.	How many virtual reconstructions do you know?	• • •	0; 1-5; 5-10; Over 10
7.	How many of these virtual reconstructions are accompanied by a historical-archaeological evidence scale?	• • •	0; 1-5; 5-10; Over 10
8.	In your opinion, what kind of audience receives the information presented in the historical- archaeological evidence scale?	•	Experts in the field; The general public; Both
9.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, do you think that the use of a historical-archaeological evidence scale is a good option to accompany a virtual reconstruction?	•	Likert scale*
10.	As is proposed by P. Aparicio and C. Figueiredo in one of their studies, the historical- archaeological evidence scale contributes to the creation of a language for all professionals of the field. Do you agree with this?	•	Likert scale*
11.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, is the name "historical-archaeological evidence scale" descriptive?	•	Likert scale*
12.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, do you consider that the historical-archaeological evidence scale helps to disseminate and correctly interpret not only the heritage asset but also the archaeological work conducted?	•	Likert scale*
13.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, if it were compulsory to accompany virtual reconstructions with historical-archaeological evidence scales, do you think this would help the general public to understand the archaeological remains?	•	Likert scale*
14.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, do you think it is convenient for the tourist to accompany the information presented in the explanatory panels of archaeological sites with the historical-archaeological evidence scale of the virtual reconstruction?	•	Likert scale*
15.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, what do you think about the evidence levels proposed by P. Aparicio?	•	Likert scale*
16.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, what do you think about the evidence levels proposed by R. Ortiz?	•	Likert scale*
17.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, what do you think about the colours used in the proposition of P. Aparicio?	•	Likert scale*
18.	In a scale of 1-5, with 1 being Strongly Agree and 5 being Strongly Disagree, what do you think about the colours used in the proposition of R. Ortiz?	•	Likert scale*

* Likert scale composed of the following options: Strongly Agree; Agree; Neither Agree nor Disagree; Disagree; Strongly Disagree.

Table 3 Qualitative study conducted to Pablo Aparicio and Rafael Ortiz

Questions		Response - Pablo Aparicio	Response - Rafael Ortiz
1.	Everyone agrees that the evidence scale, in addition to its scientific value, has an educational and informational purpose, but what is the target audience? Experts in the discipline, common viewers or both?	"Exactly, both. I think it is very important that the scale does not lose its educational character and that looking at the caption with the warmer or cooler gradation along with the image of the virtual reconstruction should be enough for anyone to understand which areas have a greater or lower level of evidence. Subsequently, we could expand them with further information for the study".	"From my point of view, I think that the evidence scale is useful for all audiences, and it grants transparency to the virtual reconstructions, for both technicians and the general public. In our case, when we started working with the scale, we saw that it had to be reduced, and the change of colour was due to the work we began, where we made several propositions and talked to all the technicians involved".
2.	What did you consider for the selection of colours?	"In this sense, since we based our work on the proposition developed in the Byzantium 1200 project, considering the need for standardising the scale, we believed it would be most interesting to keep using colours similar to those used in the Byzantium project, basically because we understood that they worked very well. We made small changes in the colours, that is, we adjusted the colours in a way that they could be distinguished. However, as was previously commented, purple may be a bit confusing, and it should be recalculated a little".	"Solving the problem related to the work we were doing and also in the colours that were used in geographic information systems. We attempted to create a scale of colours that solved the problems regarding the consideration of warm colours – cool colours that existed in the previous propositions".
3.	Do you think that your proposition is the most appropriate one for any virtual reconstruction regardless of the number of reconstructive units	"It should be. The aim is to make this proposition useful for any kind of virtual reconstruction. I was able to apply it to all virtual reconstructions that I have carried out to date. There was not one virtual reconstruction in which I said 'it's impossible here'. However, in some cases, it is necessary to reduce a little, such as the number of reconstructive units; otherwise, it can be difficult. In other cases, it is necessary to merge reconstructive units into a single unit. The case of Elephantine City is paradigmatic; it was possible to apply it to the entire city, and I believe that it allows the viewer to clearly see the evidence level of each area. We must also be aware that the evidence scale must be flexible and that its use depends on the excavation team or scientific team. It is important to understand that this is a tool that shows the evidence level and that twe must apply it in each case as clearly as possible".	"Unlike Pablo Aparicio, we always work in the same scope, so I cannot really answer that question. Since we always work on the same thing, the Mosque-Cathedral, we cannot export this information to other virtual reconstructions".
4.	As has been previously mentioned, many of the archaeologists who attended this seminar did not know the historical-archaeological evidence scale. What do you think this is due to?	"I get emails from Italy, UK, etc., and I see that its use in virtual reconstructions is increasing. Moreover, I teach in the MSc of Virtual Heritage and in the education platform of Koré, and there we aim to disseminate the use of the evidence scale, also through seminars like this. It is important to use it in our workplace to increase its dissemination, as well as to modify it if necessary, although it would be good to modify it in a consensual manner in order to achieve its standardisation".	"As Pablo Aparicio says, the use of the historical- archaeological evidence scale is increasing, in Spain and in other countries, such as Portugal, Italy, etc., so a greater number of people will surely know it soon".
5.	One of the attending archaeologists proposed the following: "The main disadvantage is the scarce training given to archaeology students. Greater dissemination and analysis of this system would considerably help in this matter". Do you think that it would be possible, from research, to show the relevance of the evidence scale, even teaching it as part of a subject in the university?	"Education is essential for the application of knowledge. I think it would be very good to explain this tool in universities, since, as has been explained, it can be applied not only to virtual reconstructions, but also to traditional historical drawings, and it allows providing a scientific section. To date, when virtual reconstructions were performed, if you were very lucky you could find an article that explained how it had been done, but their veracity was never addressed. Therefore, I think it is a very important tool that came here to stay".	"Yes, but it is important to highlight that there are still archaeologists who do not understand digital technologies, so universities should start changing some things to highlight the relevance of this scope, which is widespread".

 Table 4

 Identification of the evidence levels, colours and definition of the propositions of historical-archaeological evidence scales.

Level evidence	of Colou Byza	ır ntium	Definition Byzantium	Colour Aparicio and Figueiredo	Definition Aparicio and Figueiredo	Colour Ortiz et al.	Definition Ortiz et al.
1			Exists in its original form		Imagination		Still existing in its original form
2			Partially or with modifications		Conjecture based on similar structures		Still existing with modifications
3			Photographs or plans available		Basic textual reference		Detailed graphical evidence
4			Archaeological information		Descriptive textual reference		Slight graphical evidence
5			Detailed graphical evidence		Simple graphical reference		Archaeological hypothesis
6			Simple graphical evidence		Detailed graphical reference		Textual evidence
7			Textual and comparative evidence		Basic archaeological information or simple base plans		Based on similar structures
8			Textual evidence		Strong archaeological and documental evidence in photographs and detailed plans		Based on historical context, nature and culture
9			Based on similar structures		Still existing (or partially existing) with modifications		
10			Imagination		Still existing in its original form		

 Table 5

 Statistical results obtained from the questionnaire.

Question	Mean	ANOVA ('Gender' variable)	ANOVA ('Age' variable)	ANOVA ('Education' variable)
4	1.37	Pr(>F): 0.271	Pr(>F): 0.74	Pr(>F): 0.0746
5	2.07	Pr(>F): 0.546	Pr(>F): 0.866	Pr(>F): 0.71
6	2.50	Pr(>F): 0.184	Pr(>F): 0.69	Pr(>F): 0.0885
7	1.90	Pr(>F): 0.491	Pr(>F): 0.848	Pr(>F): 0.0757
8	2.27	Pr(>F): 0.64	Pr(>F): 0.118	Pr(>F): 0.854
9	1.73	Pr(>F): 0.101	Pr(>F): 0.236	Pr(>F): 0.298
10	1.90	Pr(>F): 0.00375	Pr(>F): 0.213	Pr(>F): 0.0568
11	1.23	Pr(>F): 0.489	Pr(>F):0.147	Pr(>F): 0.706
12	1.20	Pr(>F): 0.253	Pr(>F): 0.708	Pr(>F): 0.0233
13	1.43	Pr(>F): 0.607	Pr(>F): 0.0361	Pr(>F): 0.705
14	1.20	Pr(>F): 0.346	Pr(>F): 0.119	Pr(>F): 0.959
15	1.83	Pr(>F): 0.345	Pr(>F): 0.466	Pr(>F): 0.00863
16	1.86	Pr(>F): 0.626	Pr(>F): 0.312	Pr(>F): 0.208
17	1.80	Pr(>F): 0.279	Pr(>F): 0.596	Pr(>F): 0.726
18	2.59	Pr(>F):0.412	Pr(>F): 0.0086	Pr(>F): 0.00539

Table 6

Evidence levels and their associated colours of the new proposition of historical-archaeological evidence scale.

Level of evidence for virtual reconstructions	Definition	Colour	RGB	HEX
1	Elements of the historical and natural context		128 0 52	800034
2	Representation through comparative architecture		243 33 47	F3212F
3	Archaeological hypotheses		241 78 37	F14E25
4	Textual references		249 153 33	F99921
5	Graphic references		239 206 4	EFCE04
6	Preserved archaeological remains		255 234 15	FFF30F

Table 7 Scale of greys of the veracity levels of the new proposition of historical-archaeological evidence scale.

Level of evidence for virtual reconstructions	Definition	Colour
1	Elements of the historical and natural context	
2	Representation through comparative architecture	
3	Archaeological hypotheses	
4	Textual references	
5	Graphic references	
6	Preserved archaeological remains	

 Table 8

 Identification of the RUs, evidence levels, name, description, chronology and bibliography of the new proposition of historical-archaeological evidence scale of the virtual reconstruction of the Baker's House of Torreparedones.

RU	Evidence	Name	Description	Chronology	Bibliography
1	6	Pavement made of large stone slates	This building technique consisted in extending a bed of <i>opus</i> <i>incertum</i> and irregular flagstone paving, being a parallel technique to the one used in the paving of the streets of the	Early Roman Empire	[31]
2 3	6	Pavement of <i>opus</i> <i>signinum</i> Non-preserved	Pavement of <i>opus</i> signinum in the room identified as <i>cubiculum</i> . Pavements of the <i>domus</i> that are not preserved.	Early Roman Empire	[16, 17]
4	3 6	pavement " <i>A bagnarola</i> " water tank	Supplied with rainwater gathered in the roofs, given its location in one of the corners of the <i>atrium</i>	Late Roman Republic	[16, 17]
5	3	Stairs	Stairs proposed for bridging the different levels of the rooms.	hepublic	
6	2	Latrine	The presence of a limestone slate that stands out in size in all the pavement could be an indication of the location of the latrine hole.		[17]
7	4	Structure designed for the sale of bakery products	Garret made of large 20cm-high slates, located in the southern half of the space.		[17]
8	6	Impluvium	Square pond that gathers rainwater and discharges to the street through a canalisation system connected to a larger canalisation system.	Early Roman Empire	[16, 17]
9	3	Impluvium columns	First building phase of the atrium.		[16, 17]
10	6	Base of the lararium	Square structure that could correspond to the base of the recess that held the figurines for domestic worship.	Early Roman Empire	[17]
11	2	Lararium	Due to its chronology and location, it seems to correspond to a variant of the aediculae type, pseudoaedicular, characterised for being made of walls or a solid block, with an inner recess-like cavity, where domestic worship figurines would be placed, crowned by a gable.		[32, 33]
12	4	Kitchen structure	Masonry structure		[17]
13	6	Circular base associated with the rotatory mill	Circular base of slightly over 1 m in diameter that seems to correspond to the base of a rotatory mill.	Early Roman Empire	[16, 17]
14	2	Roman rotatory mill	Formed by two hollow cones placed upside down, one over the other, with the grain remaining between the two cones and being milled by the friction between the two cones		[34, 35]
15	2	Oven vault	In Augusta Emerita, an over was recovered, which presented an access similar to the one in the <i>domus</i> of Torreparedones, consisting of a small passable entrance up to the very mouth of the oven, embedded in a square structure. Similarly, the floor of the oven preserved in Torreparedones is typologically identical to that of the bread oven of the 'Birds' House' and that of the <i>domus</i> of the Blancterium (Italics Scrills, Saril).	Early Roman Empire	[36, 37]
16	2	Oven mouth	It has a diameter of 4 m and it would have been covered by a vault, being embedded, at least in the upper part by a wall, with side openings for putting in and taking out the products to be baked and the fire wood. Roman furniture associated with each snace	Early Roman Empire	[17]
17	Ż				
18 19	6	Vegetation Skewback of the walls of the <i>domus</i>	Contemporary vegetation in time and space. The walls were built with rammed earth and <i>opus incertum</i> for the plinths, resorting to irregular bonds of limestone, which is the natural local rock, applying plaster as the final laver	Early Roman Empire	[17]
20	4	Elevation of the walls of the <i>domus</i>	Since the total height of the walls of the <i>domus</i> is not preserved, the work of Vitrubius was selected. It is important to take into account that the ratio relationships established by Vitrubius are approximate.		[38]
21	3	Access to the western area	Without archaeological evidence, it was decided to create an open door to the <i>hortus</i> , since there must have been an access in the production area to introduce the elements for their use.		[15, 19]
22	6	Preserved parietal decoration	Ornamental technique in which a mortar coating is repeatedly hit with a mold containing the embossed decoration. Then, the coating is covered with pure lime or mortar.	Early Roman Empire	[16, 17]
23	5	Parietal decoration	This type of decoration has also been found in other Roman sites. The archaeological work conducted in Beatas Street (Cartagena, Spain) recovered panels decorated with embossed motifs.		[39]
24	3	Windows	In the Villa de las Musas (Arellano, Navarra, Spain), a window grill was discovered. The preservation of this type of elements helps in their 3D reconstruction, as well as in the calculation of the size of the hollows.		[40]
25	2	Atrium cover	Compluvium / impluvium system		[38, 41]
26	2	Cover of the southern rooms	Large gabled cover that discharges the rainwater into the <i>atrium</i> and into the street located south of the <i>domus</i> .		[38, 41]
27	2	Cover of the storage and milling area	Spaces E-37 and E-38 consist of a hip roof that discharges rainwater into three areas: the northern area (<i>hortus</i>), the street located south of the <i>domus</i> and the street located west of the <i>domus</i> .		[38, 41]
28	2	Cover of the tablinum and cubiculum	The <i>tablinum</i> (E-11) and the <i>cubiculum</i> located in the northern area (E-12) consist of a shed roof that also discharges into the <i>atrium</i> , since, otherwise, the rainwater		[38, 41]

			would go to the open corridor of the western area of the	
			domus, where there are no canalisations or storage	
			structures.	
29	2	Cover of the service	The other cover is the one that covers spaces E-22, E-23, E-	[38, 41]
		area	24, E-26, E-28, E-31 and E-46, with a gable roof, which	
			discharges the rainwater into the hortus and into the	
			northern area of the domus.	
30	2	Cover of the	Shed roof proposed for the closing of space E-32, identified	[38, 41]
		woodshed	as woodshed.	
31	2	Cover of the	Spaces E-15 and E-16 are composed of a gable roof,	[38, 41]
		commercial area,	discharging, on the one hand, into the western area of the	
		redistribution area	domus, and, on the other hand, into the eastern area. The	
		and latrine	closing of spaces E-36 and E-13 consists of a shed roof that	
			would be the continuation of the previous cover,	
			discharging the rainwater into the 'porch'.	

Supplementary Material

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