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ORIGINAL PAPER

Does knowledge influence visual attention? A comparative analysis between archaeologists and naïve subjects during the exploration of Lower Palaeolithic tools

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Abstract

The role of experience during the exploration of lithic artefacts can be been investigated through multiple approaches. Knowledge can influence visual perception of the environment, whilst action "affordances" can be processed at the first sight of an object. In this study, we used eye tracking to analyse whether and to what extent archaeological knowledge can influence visuospatial attention whilst interacting with stone tools. Archaeologists were found to pay more visual attention to the middle region and the knapped surface. Differences between the visual exploration of choppers and handaxes were also found. Although the general pattern of distribution of the visual attention was similar to naïve subjects, participants with archaeological experience paid more attention to functionally relevant regions. Individuals with archaeological experience directed more attention to the upper region and the knapped surface of the tools, whilst naïve participants spent more time viewing the middle region. We conclude that although both groups could direct their attention to action relevant features in stone tools, functional affordances had a greater effect in subjects with previous experience. Affordances related to manipulation triggered lower attention and showed no differences between participants.

Keywords Eye-tracking · Affordances · Cognitive archaeology · Lithic technology · Visual exploration

Introduction

Stone tools have been part of human culture for over two million years and have influenced our evolutionary history (Semaw et al. 2003). Therefore, they have been generally used to define the genus *Homo* (Ambrose 2001; Federico and Brandimonte 2019). Tools are objects defined by their intrinsic properties that afford manipulability and their interaction with the environment (Rüther et al. 2014). Indeed, tools have been described as problem-solving objects attached to the body, which amplify and enhance the user's abilities (Federico and Brandimonte 2019; Federico et al. 2021a, b; Wagman and Carello 2003). Tool use requires the integration of three types of information, namely technical reasoning, semantic knowledge and sensorimotor processing (Federico et al. 2021a). In this sense, using a tool means being functionally dependent on the cognitive system, sensorimotor integration and reasoning chains (Bruner and Gleeson 2019). Neuroimaging studies also suggest that simply viewing tools activates a specific neural network, including brain areas associated with the motor system (Johnson-Frey 2004; Craighero et al. 1997; Creem-Regehr and Lee 2005; Vingerhoets et al. 2009; Makris et al. 2011). In contrast, other perspectives propose that a tool does not automatically trigger action behaviours and that explicit structural and functional knowledge-based representations of the tool must be elaborated, although evidence for activation of knowledge representations by tools is limited (Osiurak et al. 2020).

Perceiving the environment is thought to automatically provide information regarding how humans can interact with it through affordance mechanisms (Foerster and Goslin 2021).

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Multiple definitions have been offered to describe this phenomenon. Initially, the term *affordance* referred to all action possibilities of the environment (Gibson 1979). At present, the concept refers to a characteristic of an object that informs and allows a subject to perform an action (Vingerhoets et al. 2009; Makris et al. 2011; Turvey and Carello 2011; Borghi 2007; but see also Osiurak et al. 2017). Such affordances might drive the eyes and visuospatial attention towards the regions of the tool that are most relevant to its action, such as the most comfortable grip position or the striking surface (Myachykov et al. 2013; Roberts and Humphreys 2011). From an archaeological point of view, affordances have been defined as opportunities, resources and constraints detected in the materials and the environment through active exploration (Pargeter et al. 2020; Wynn 2020). Following a neuropsychological perspective, affordance has also been described as a link between the perceived visual properties of an object and an action that may be performed with it (Humphreys and Riddoch 2001). This relationship might be based on stored information, but might also be directly guided by the visual features of an object, even if the object has never before been observed. That is, affordance perception depends on the visual processing of the structural properties of objects (Vingerhoets et al. 2009; Proverbio et al. 2011).

The perception of affordances is an involuntary daily act that can both be perceived at the early sight of an object (Makris et al. 2011; Rüther et al. 2014) or be learned from previous experience (Borghi et al. 2012; Jacquet et al. 2012). There are some aspects to be acquired such as the exact practise of using the tool or the way it is handled (Rüther et al. 2014). There is currently a theoretical debate about the use of tools. Some approaches focus on sensory processing and other perspectives emphasise conceptual reasoning. According to the first viewpoint, there exists two types of tool-related action knowledge, *structural action knowledge* and *functional action knowledge* (Binkofski and Buxbaum 2013). The former concerns the gestures on how to grasp a tool, based in motor information, and is directed to the processing of tool properties such as shape or size; the latter refers to information about how to use a tool for a purpose and commonly associated actions, including stored knowledge (Federico and Brandimonte 2019; Ni et al. 2019). Although these two mechanisms work simultaneously, functional knowledge is dominant during tool interaction (Ni et al. 2019). Nevertheless, functional knowledge of objects may not be a prerequisite for the activation of affordances (Xu and Heike 2017). Other perspectives suggests that structural features or manipulation can be related to sensorimotor processing and embodied theories of cognition, whilst functional knowledge is associated to semantic and abstract information (Osiurak and Federico 2021). Consequently, functional knowledge is a type of semantic knowledge which facilitates mechanical actions (Federico and Brandimonte 2019; Federico et al. 2021a). In a sense, mechanical knowledge (also called technical reasoning) has been proposed to connect the semantic and the sensorimotor information through physical principles (Osiurak et al., 2017; Federico et al. 2021a, b). According to this view, a reasoning process starts with semantic information, moving on to mechanical and finally sensorimotor information (Federico et al. 2021b; Osiurak et al. 2020). In other words, the activation of the sensorimotor pathways includes perceptual and semantic information (Wurm and Caramazza, 2019).

The main kinds of knowledge described can be related to the well-known distinction proposed in tool making between knowledge or *connaissance* and know-how or *savoir-faire* (Pelegrin 1993). The former refers to the abstract knowledge of the procedures necessary to achieve an objective, whilst the latter refers to the concrete knowledge required to implement these procedures (Pargeter et al. 2020). In this sense, the influence of knowledge and expertise has been broadly investigated from an archaeological perspective (e.g. Geribàs et al. 2010; Pargeter et al. 2019; Rivero and Garate 2020; Stout et al. 2011; Williams-Hatala et al. 2020). Experimental studies focusing on knapping have revealed differences between naïve individuals and experts in terms of brain activation, gestures, kinematics, flake size and flake distribution or prediction (Bril et al. 2010; Geribàs et al. 2010; Lombao et al. 2017; Nonaka et al. 2010; Pargeter et al. 2020; Stout et al. 2011; Torres and Preysler 2020; Williams-Hatala et al. 2020; Zorrilla-Revilla et al. 2021). Specifically, neuroscience studies show that naïve individuals relied more on *bottom-up* strategies of visual attention during tool production, whilst experts employed a *top-down* approach associated with parietal activation (Stout et al. 2011). Expert archaeologists can perceive more relevant functional relationships during knapping than novice individuals, who can only identify basic significant parameters (Bril et al. 2010).

Certain key regions in tools can be considered as constituting affordances and their perception is strongly related to vision, because it is the main source of sensory information in humans (Atkinson 2008; Kassuba et al. 2013; Stone and Gonzalez 2015). Indeed, humans are evolutionarily specialised experts in eye-hand coordination and have possibly experienced a specific visuospatial enhancement (Bruner et al. 2018a; Vaesen 2012) . As part of the visuospatial system, affordance processing is associated with the activity of the parietal lobes (Bruner and Iriki 2016; Natraj et al. 2018; Rüther et al. 2014), which show derived evolutionary features in the human brain (Bruner 2018, a, b; Bruner et al. 2018a,b; Pereira-Pedro et al. 2020). In this sense, different visuospatial behaviours have been hypothesised for past human species (Bruner 2021; Bruner and Lozano 2014; Bruner and Iriki 2016; Burke 2012). The exploration of these indirect behavioural traces can be carried out through eye tracking technology and the analysis of the visuospatial attention allocated in different regions of a scene. For instance, visual perception has recently been explored in archaeological artefacts, suggesting that objects influence the way people pay attention to them (Criado-Boado et al. 2019; Silva-Gago et al. 2021a; 2022). In particular, stone tools trigger attention towards those parts that can be interpreted as affordances (Silva-Gago et al. 2022).

In previous studies, we explored visual attention during a free observation of stone tools and during tool physical manipulation, applying eye tracking technology to examine the visual exploration of experimental stone tools in naïve individuals (Silva-Gago et al. 2021a). In these studies, subjects with no archaeological knowledge were selected in order to avoid the influence of expert knowledge of tool functions, and to focus the analysis on spontaneous visual responses only. Knowledge can influence this reaction, involving reasoning on possible functions and planning or executive functioning. Hence, in the present survey, the same explorative behaviour was analysed in expert archaeologists and compared with the results of the previous study (Silva-Gago et al. 2021a). The aim of this survey was to evaluate the experience bias during the exploration of stone tools, by analysing whether the pattern of visuospatial attention was different between naïve participants and subjects with prior archaeological knowledge.

Material and methods

Participants

Thirty-one participants (16 females and 15 males) took part in the experiment. All subjects had normal or corrected-to-normal vision; they were right-handed according to Oldfield Questionnaire (Oldfield 1971) and aged between 26 and 43 years old (mean and s.d.: 34 ± 7). They were archaeologists with at least postgraduate studies in Palaeolithic archaeology or human evolution. The sample included students who had completed the master's degree, PhD candidates and researchers with more than 5 years' experience. All subjects signed an informed consent for their participation in the study, which was approved by the ethical committee of the University of Burgos. All trials were performed under the same environmental and experimental conditions in a laboratory, where the participants were seated 50 cm away in front of a platform where the stone tools were displayed. Subjects were allowed to place their hands on the table without touching the platform.

Experimental design

We employed the same sample and methodology used in a previous study (Silva-Gago et al. 2021a), in order to compare the results. We tested the visual exploration behaviour for the same 40 experimental stone tools (20 choppers and 20 handaxes) used in the preceding analysis (Silva-Gago et al. 2021a). These tools were chosen because they show clear technological differences, can be grasped with the whole hand and are representative of the most iconic elements of earliest technologies, despite the still present debate about whether they were tools or cores (Baena Preysler et al. 2018; Peretto et al. 1998; Shea 2020; Venditti et al. 2021). Stone tool diameters can be found at Silva-Gago et al. (2021a).

The experimental procedure consisted of tracking eye movements whilst participants were visually exploring and manipulating the stone tools. First, each tool was placed on a platform in front of the participants and positioned along its technological axis, showing the more knapped side, for approximately 5 s. Then, participants had to manipulate the stone tool until they reached an ergonomic grip in their right hand. Eye movements were recorded with a portable eye tracker (Pupil Core, Pupil Labs, Berlin, Germany) sampling participants' pupil position at 500 Hz. Eye position was calibrated through the fixation of five predefined dots that were sequentially presented on a screen. Two additional tools were also added before each recording session as a familiarisation procedure and were not included in the analysis.

Data analysis

Video recordings were analysed using Pupil Player software (version 2.0.182). We consider the fixation record for each stone tool and measured the dwell time (DT, in milliseconds) per area of interest (AOI). The same AOI described in the previous study (Silva-Gago et al. 2021a) was defined, namely the upper, the middle region or tool body and the base, as well as cortex and knapped surface. In the manipulation task, we added a new area, called edges, which consist of the sharp border when the tool is oriented in side view (Fig. 1). Then, each fixation was associated with a tool region and surface. We summed the dwell time in each tool region and computed the median duration of the fixation for the different areas as an indirect measure of the amount of visuospatial attention allocated by participants to different parts of the visual scenario (Federico and Brandimonte 2019).

Results included the tool visual-only exploration and the visual perception whilst the tool is physically manipulated. Then, we compared the current results of archaeologists with the data from the previous study carried out with naïve subjects (Silva-Gago et al. 2021a). A Mann–Whitney test and Kruskal–Wallis test were run between tool regions and between groups in order to test differences. Differences were also tested between males and females. All data were analysed using PAST 3.20 (Hammer et al. 2001).

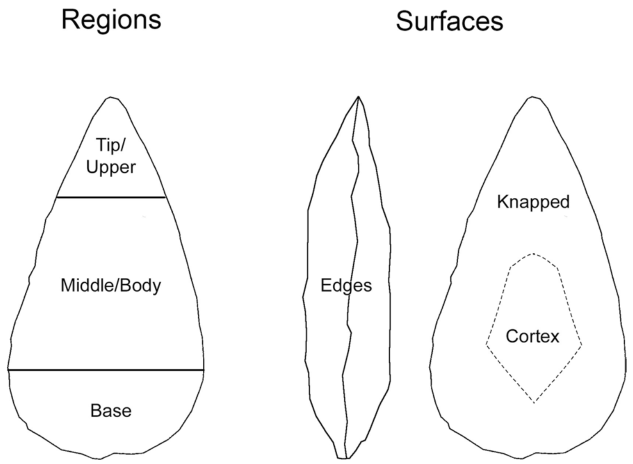

Fig. 1 Areas of interest (AOI) defined in the study. Regions include upper, middle and base; surfaces involve knapped, cortex and edges

Results

When comparing the different tool regions of the complete tool sample (choppers and handaxes) during the archaeologists visual-only exploration (Fig. 2), the middle region triggered more attention than the upper region and the tool base ($H = 49$, $p < 0.0001$). During manipulation, the middle region also attracted more attention than the upper region, followed by the tool base ($H = 61.3$, $p < 0.0001$). Comparing knapped and cortex surfaces of the overall sample, knapped areas elicited more attention than the cortex during visual exploration ($U = 6$, $p < 0.0001$) and also during the manipulation task ($U = 84$, $p < 0.0001$). If we separate choppers and handaxes, all regions showed significant differences between the two stone tools. Handaxes were more observed in the middle region ($U = 374$, $p = 0.01$), tool base ($U = 317$, $p = 0.001$) and knapped surface ($U = 209$, $p < 0.001$), whilst choppers were more explored at the upper region ($U = 299$, $p < 0.001$) and cortex ($U = 390$, $p = 0.02$). Sex differences were not found for any area of interest, neither during visual exploration nor during manipulation ($p > 0.05$).

Figure 3 shows the distribution of the dwell time during visual exploration in archaeologists and naïve subjects. Archaeologists directed their attention more to the upper region and knapped surface, whilst naïve individuals directed more attention to the tool body. Tool base and cortex showed no differences. During the manipulation task, archaeologists also paid more attention to the top and the edges of the tool (Table 1). Other areas showed no statistical differences. If we consider the tool groups separately, we also found differences between archaeologists and naïve subjects (Table 2). Figure 4 shows the percentages of dwell time dedicated to each area of interest. When comparing archaeologists and naïve people together, there were differences in terms of the amount of time allocated to each tool area ($p < 0.05$). During visual exploration, archaeologists spent more time observing the upper and middle region of the tool, as well as the knapped surface in both choppers and handaxes. Naïve individuals directed their attention more to the body of the tool. Base and cortex did not show any statistical differences. During the manipulation task, archaeologists paid more attention to the upper region in both tool types. Moreover, they also spent more time observing the knapped surface in handaxes and the edges in choppers. Other areas did not show any statistical differences.

Discussion

Experience plays an important role during interaction with the environment. Previous studies have shown that activation of action affordances is dependent on the prior visual

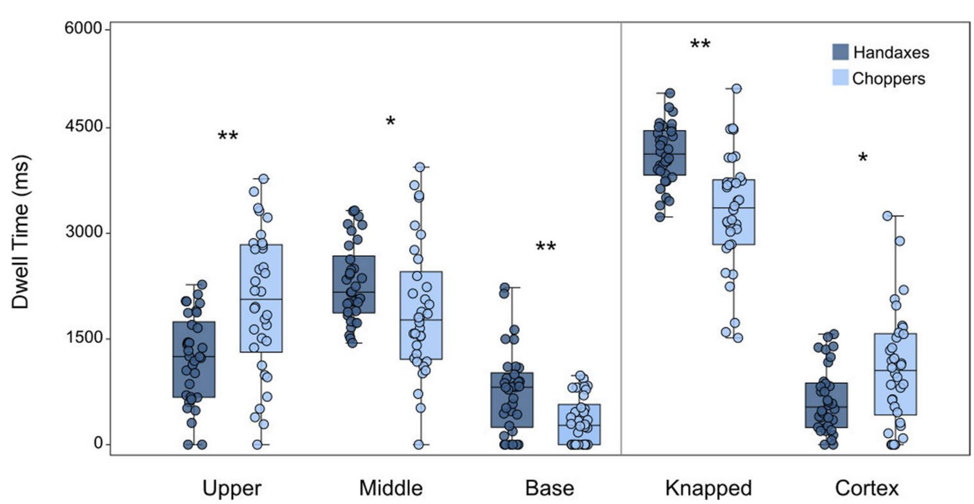

Fig. 2 Dwell time (DT) distribution of archaeologists during visual exploration for each stone tool technology. *$p < 0.05$, **$p < 0.005$

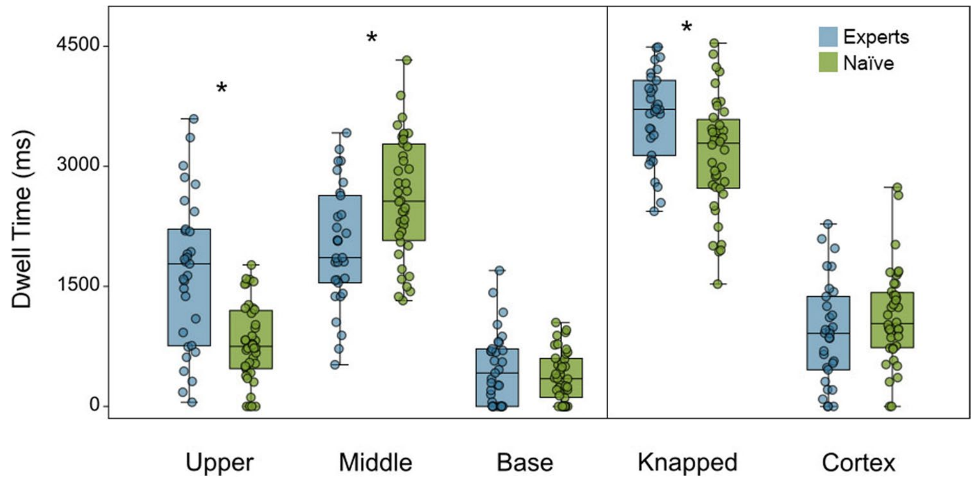

Fig. 3 Dwell time (DT) distribution of archaeologists and naïve individuals during visual exploration. *$p < 0.05$

Table 1 Comparison between archaeologist and naïve individuals. *Median values are shown. Results are considered significant at $p < 0.05$ (in bold)

Task	Area of interest	Arch	Naive	*U* test	*p* value
Vision-only	Upper	1782	750	267	**< 0.001**
	Middle	1859	2564	356	**0.002**
	Base	418	346	559	0.480
	Knapped	3713	3289	366	**0.003**
	Cortex	913	1035	484	0.116
Manipulation	Upper	1126	501	220	**< 0.001**
	Middle	2053	2235	619	0.995
	Base	216	331	530	0.295
	Knapped	2827	2358	457	0.060
	Cortex	1038	978	615	0.958
	Edges	221	0	360	**0.002**

processing of an object's properties (Xu and Heinke 2017; Makris et al. 2011; Rüther et al. 2014; Vingerhoets et al. 2009; Proverbio et al. 2011), although knowledge can also influence the way subjects perceive objects (Noorman et al. 2018). In fact, theories of tool use involve two distinct approaches: "manipulation-based" models, which emphasise the role of sensorimotor processing, and "reasoning-based" perspectives, which refer to semantic knowledge and technical reasoning (Federico et al. 2021a). According to the former approach, knowledge can be divided into structural action knowledge, associated to how to use a tool, and functional action knowledge, related to the purpose (Binkofski and Buxbaum 2013; Ni et al. 2019). Both functional and manipulation information is part of the artefact concept (Cosentino 2021). In this sense, two main kinds of affordances have been suggested, related to function or manipulation reasoning (Cosentino 2021). Stable or standard affordances, associated to the activation of the parietal and frontal cortex, deal with functions; whilst variable or ad-hoc affordances, whose network is localised in the dorsal stream, deal with manipulation knowledge (Cosentino 2021; Sakreida et al. 2016). On the other hand, technical reasoning focuses on the rationale about the physical properties of tools to solve common tasks, rather than passively perceiving information about how to interact with them (Federico et al. 2021b). According to this point of view, the functional information of the tool involves the conceptual level, whilst the manipulative region is related to the sensorimotor information (Osiurak et al. 2020). Therefore, the activation of action affordances needs the visual processing of both kinds of information.

Our first studies on the visual perception of stone tools suggested that individuals naïve to archaeology identified affordances at first sight and during physical interaction (Silva-Gago et al. 2021a). However, previous experience influenced the way people perform an action, as revealed from different archaeological perspectives (Geribàs et al. 2010; Pargeter et al. 2019; Rivero and Garate 2020; Stout et al. 2011; Williams-Hatala et al. 2020). Hence, the aim of this second study was to analyse whether the pattern of visual attention in stone tools was different between naïve participants and participants with archaeological knowledge.

In the analysis of experienced participants, the central area was the most observed region, followed by the upper regions (tip or cutting edge) and tool base. In addition, the knapped surface also triggered more attention than the cortex. This pattern of visual exploration can be explained by the attention directed to functional regions (Ambrosini and Costantini 2016; Federico and Brandimonte 2019; Land 2006; Natraj et al. 2015), despite the tendency to look at the centre of objects (Ioannidou et al. 2016; Tatler 2007; Tseng et al. 2009). In general, the information needed to process the mechanical action provided by the functional part of the tool is accessed first, and then the information needed to execute the motor action involving the manipulative part can be focused on (Osiurak et al. 2020). Other

Table 2 Comparison between archaeologist and naïve individuals according to tool type. *Median values are shown. Results are considered significant at $p < 0.05$ (in bold)

Task	Tool	Area of interest	Arch	Naive	*U* test	*p* value
Vision-only	Handaxes	Upper	1247	556	284	**< 0.001**
		Middle	2168	2757	418	**0.014**
		Base	813	518	515	0.171
		Knapped	4095	3686	348	**< 0.001**
		Cortex	561	698	492	0.104
	Choppers	Upper	2173	996	342	**< 0.001**
		Middle	1806	2603	441.5	**0.028**
		Base	261	210	575.5	0.490
		Knapped	3390	2565	378	**0.003**
		Cortex	1094	1232	496	0.114
Manipulation	Handaxes	Upper	649	231	195.5	**< 0.001**
		Middle	2881	2563	541	0.285
		Base	459	486	629	0.945
		Knapped	3574	2662	422	**0.015**
		Cortex	605	701	620	0.865
		Edges	396	201	478.5	0.074
	Choppers	Upper	1533	1082	409	**0.010**
		Middle	1722	1850	606	0.742
		Base	133	224	535	0.247
		Knapped	2228	1908	477	0.072
		Cortex	1057	1373	590	0.609
		Edges	56	0	427	**0.010**

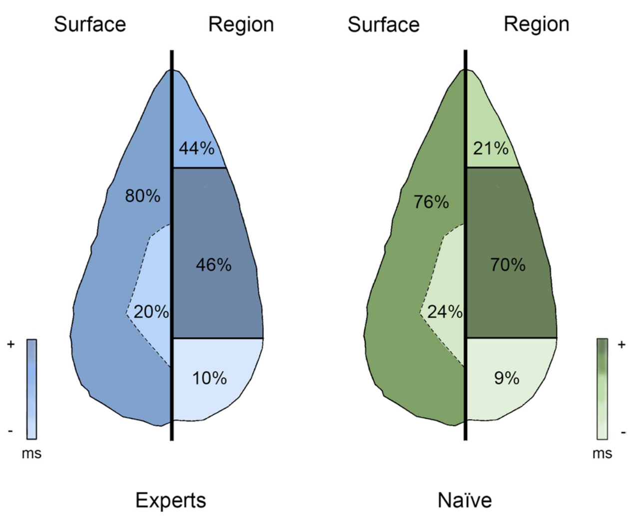

Fig. 4 Comparison between archaeologist and naïve individuals in terms of percentages of dwell time (DT) according to each tool area of interest during visual exploration. Knapped and cortex surfaces are shown on the left of the tool, whilst upper, middle and base regions are shown on the right

reasons may be related to the experts' training of studying knapped areas because they show technological information on tool-related behaviour. Furthermore, differences between choppers and handaxes were also observed. Archaeologists directed more attention to the upper region and cortex in choppers, and to the middle region, base and knapped surfaces in handaxes. Choppers showed a simpler morphology and they may require less attention related with the grasping strategy. In contrast, handaxes had more complex shape and more grasping and use possibilities. Hence, they may need a higher exploration of its base, where they would be grasped (García-Medrano et al. 2014; Gowlett 2006; Key et al. 2016). Additionally, there were no differences in the visual exploration patterns whether or not the tools are physically manipulated, and there were no significant differences between males and females.

Overall, the general pattern of visual attention in individuals with archaeological knowledge is similar to the naïve participants (Silva-Gago et al. 2021a), but with minor local differences. The most observed regions were the same in both groups. Despite the centre bias, functional and action-relevant areas triggered more visual attention instead of handling regions (Ambrosini and Costantini 2016; Federico and Brandimonte 2019; Foerster and Goslin 2021; Xu and Heinke 2017). However, when analysed together, the results from naïve individuals and archaeologists show significant differences in some areas of interest. It is worth noting that, for the manipulation task, we have included an area consisting of dwell time directed to the tools' edges for both participant groups. In general, individuals with archaeological experience directed more attention to the upper region and the knapped surface of the tools during its visual exploration, whilst naïve participants spent more time on the middle region. In the manipulation task, the upper region and the tool's edges attracted more attention for archaeologists. The pattern of visual exploration for choppers and handaxes also showed differences for individuals naïve to archaeology and experts. In the visual-only task, there were significant differences for both tool technologies in the upper, middle region and the knapped surface. In both cases, experienced individuals directed more attention to the upper region and knapped surfaces in handaxes and choppers, whilst naïve individuals spent more time observing the middle region of both tools. In this sense, during passive viewing, participants naïve to archaeology are more affected by the centre bias (Ioannidou et al. 2016; Tatler 2007; Tseng et al. 2009). During the physical manipulation of the tool, archaeologists directed more attention to the upper region and the knapped surface in handaxes, and to the upper region and edges in choppers. Hence, participants with archaeological knowledge paid more attention to the functional regions of stone tools, following a top-down perceptual mechanism (Stout et al. 2011), and were able to identify the most complex significant features (Bril et al. 2010; Nonaka et al. 2010).

Whether we consider that previous experience is related to conceptual or functional information, expert archaeologists have more semantic knowledge about Lower Palaeolithic tools compared to naïve participants (Federico et al. 2021a, b). Additionally, sensorimotor information is associated to manipulation knowledge, which is not affected by experience (Federico and Brandimonte 2019). In this sense, experienced participants have knowledge of stone tools, so they can process the tool faster. They need less effort to solve the motor control question (manipulation), directing a lower number of fixations to the centre and manipulative areas. Therefore, gaze remains more fixed on the functional regions of the stone tools. According to the technical reasoning theories of tool use, the perception of the environment is based on the interaction of sensorimotor, technical and semantic knowledge (Federico et al. 2021a). Subsequently, an action reappraisal mechanism has been proposed, which refers to a "semantic-mechanical-motor cascade system" that first generates the mechanical actions and then imposes constraints on the motor actions selected to perform a task (Federico et al. 2021b). However, familiarity with an object or tool causes functional areas to attract less attention whilst fixations on manipulative areas remain constant (Federico and Brandimonte 2019; Federico et al. 2022). Accordingly, previous experience only affects the amount of visuospatial attention on the functional areas (Federico et al. 2022). Despite the expertise on stone tools, archaeologists directed more visuospatial attention to functional areas although the semantic processing decreased. These evidences can refer to different levels of information or knowledge (i.e. affordances, semantics) which affects the tool visual exploration in an integrative way (Bar et al. 2006; Lambon-Ralph et al. 2017; Wurm and Caramazza 2019).

To summarise, although visual behaviour was similar in expert and naïve subjects, there were differences concerning the proportion of attention directed to specific areas. Therefore, knowledge or experience influences the visual behaviour of stone tools. Archaeologists directed more visuospatial attention to the functional aspects of stone tools (tip, knapped surface or edges). Haptic or sensorimotor interaction (Fedato et al. 2019, 2020; Silva-Gago et al. 2021b) is not affected by experience, and hence is apparently considered less central to the experts' visual exploration. In other words, knowledge causes the visual exploration and processing of the tool to focus on the possible functions to be performed with it. The affordances related to manipulation, and, hence, manual processing can be considered more inherent to the Lower Palaeolithic stone tools.

Conclusion

The differences between expert and novice individuals have been broadly explored during stone tool-making and tool use (e.g. Geribàs et al. 2010; Pargeter et al. 2019; Stout et al. 2011; Williams-Hatala et al. 2020). However, the role of the visual system in stone tool handling has been rarely explored, even though identifying relevant features is a key requirement for making and using a stone tool (Geribàs et al. 2010; Nonaka et al. 2010). Perception is a cognitive activity that is mainly carried out through vision, in order to associate action and body-environment relationships (Atkinson 2008; Kassuba et al. 2013; Stone and Gonzalez 2015). In fact, the main way to identify action affordances in objects is through vision (Makris et al. 2011; Turvey and Carello 2011). This study explored visual behaviour whilst interacting with stone tools. The results suggest the processing of different kinds of affordances according to whether the user did or did not have any archaeological experience. Whilst naïve individuals directed more attention to the tool body due to a centre or centre of gravity bias, archaeologists focused more on functional areas such as edges and upper regions. Grasping affordances triggered lower attention and showed no differences amongst participants. In this sense, functional parameters of tools are more significant for experienced people, whilst the affordances related to manipulation are considered more elementary and therefore easier to identify. Hence, we can speculate that grasping information is more deeply rooted in our relation with stone tools (Key et al. 2018) since it does not depend on previous experience. However, the relatively small differences in the distribution of visual attention might suggest a stronger role for action affordances, rather than experience and knowledge in controlling visual attention.

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Declarations

Ethics approval All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was obtained from all the individual participants included in the study.

Consent for publication Publication consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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