For our world with no sound. The concept of opportunism in the Italian context: a methodological evaluation of the lithic assemblages of Pirro Nord, Cà Belvedere di Montepoggiolo, Ciota Ciara cave and Riparo Tagliente.

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Abstract

The opportunistic debitage, originally adapted from Forestier's S.S.D.A. definition, is characterized by a strong adaptability to local raw material morphology and its physical characteristics and it is oriented towards flake production. Its most ancient evidences are related to the first European peopling by *Homo* sp. during Lower Pleistocene starting from 1.6 Ma and gradually increasing around 1 Ma. In these sites a great heterogeneity of the reduction sequences and raw materials employed is highlighted, bringing to the identification of multiple technical behaviours. However, the scientific community does not always agree on associating the concepts of *opportunism* and *method* to describe these lithic complexes. The same methodological issues remain for the Middle Pleistocene where, simultaneously to an increase of the archaeological evidences and the persistence of the opportunistic debitage, the first bifacial complexes are attested. Further implications concerning the increasing complexity highlighted in core technology management are now at the centre of an important debate regarding the genesis of more specialized method (Levallois and Discoid) especially during MIS 12 and MIS 9. We suggest that the opportunistic debitage could be the starting point for this process, carrying within itself a great methodological and cultural potential. Its flexibility and capability to be adopted through different chronological and cultural phases are the principles outlining a flaking method by definition.

Keywords:

Lithic technology

Opportunism

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1. Introduction

The opportunistic debitage refers to a flaking method adapted from Forestier's S.S.D.A. definition (1993) and developed in following works (Arzarello, 2003) from which the term *opportunism* has been originally defined and used for the first time. This method shows a strong adaptability to local raw material morphology and its physical characteristics and it is oriented towards flake production mainly achieved through short reduction sequences. The subordination to morphological criteria comes from a common predetermined operative scheme producing highly flexible and variable technical behavior (unipolar, orthogonal, bipolar, and centripetal). These are constantly influenced by, and adjusted to, raw material volume as far as the flaking activity is carried on. The aim is the production of functional flakes deriving from a mental scheme easily replicable through the technical gesture.

The most ancient evidence of the opportunistic debitage are related to the first European peopling by *Homo* sp. during Lower Pleistocene starting from 1.6 Ma and gradually increasing around 1 Ma (Despriée et al., 2010; 2018; Moncel, 2010; Ollé et al., 2013; Arzarello et al., 2016; Cheheb et al., 2019). In all these sites the lithic industry was obtained exploiting local raw material of different qualities (such as flint, limestone, sandstone, quartzite, and basalt) and morphologies (nodules, cobbles, pebbles). The reduction sequences attested, are mainly short and finalized to non-standardized flake production presenting at least one cutting edge achieved through multiple types of debitage (unipolar, orthogonal, bipolar, and centripetal), arbitrarily chosen depending on (or according to) the raw material's morphology and quality. Tools (usually denticulate and scrapers) are rarely attested (Despriée et al., 2010; Arzarello et al., 2016) and unretouched flakes are predominant. The direct percussion by hard hammer is the most commonly used technique, but the bipolar-on-anvil one is also recognized (de Lombera-Hermida et al., 2016). Since a great heterogeneity of the reduction sequences and raw materials employed is highlighted, the scientific community does not always agree on associating the concepts of *opportunism* (Arzarello, 2003) and *method* (Boëda, 1994) in order to describe the lithic complexes belonging to these sites. This brought to the identification of multiple technical behaviours, still without considering the presence of a possible common methodological substratum for these chronological phases which has only recently started to be considered and regarded as "opportunistic".

During Middle Pleistocene, simultaneously along with an increase of archaeological evidence, a persistence of the opportunistic debitage can be attested throughout Europe. These assemblages are often associated to the first bifacial complexes (Preece and Parfitt, 2012; Barsky et al., 2013; Moncel et al., 2013; 2014; 2018; García-Medrano et al., 2015; Bourguignon et al., 2016; Martínez and Garcia Garriga, 2016; Santagata, 2016) or to small-medium flake ones (Parfitt et al., 2008; Despriée et al., 2010; Preece and Parfitt, 2012; Ollé et al., 2013; Gallotti and Peretto, 2015; Aureli et al., 2016; Rocca et al., 2016), although terminological and methodological issues remain. The reduction sequences are always connoted by strong flexibility and versatility, translating in a constant adaptation to the raw material's morphology and optimization of flake production. Further implications concerning the increasing complexity highlighted in core technology management for this period (especially regarding the length of the reduction sequences and surfaces' centripetal conception) are now at the centre of an important debate regarding the genesis of more specialized method (*i.e.* Levallois and Discoid). We suggest that the opportunistic debitage could be the starting point for this process, carrying within itself a great methodological and cultural potential.

Therefore, the first evidence of Levallois production (*Prepared Core Technology*;(Moncel et al., 2020) and its diffusion during MIS 12 and MIS 9 (Moncel et al., 2016; Pereira et al., 2016; Rocca, 2016) implied a shift towards the identification of this technology throughout Europe at the expense of the "opportunistic" complexes from this chronological phase onwards. Because of this, the contextualization of the opportunistic method within the cultural traditions of Middle and Upper Palaeolithic resulted to be nearly absent, few cases being excluded (Arzarello, 2003; Daffara, 2017; Santagata et al., 2017).

2. Materials and methods

The Italian peninsula provides important archaeological evidences to contextualize the origin and the evolution of the opportunistic debitage during the Lower, Middle and Upper Pleistocene. For this reason, a selection of four sites (Pirro Nord, Cà Belvedere di Montepoggiolo, Ciota Ciara Cave and Riparo Tagliente) from different chronological and environmental contexts was made to better underline this phenomenon through the technological analysis of the lithic assemblages.

The site of Pirro Nord (Foggia, Apulia, Italy) is situated in an active limestone quarry at the north-western margin of the Gargano promontory. It belongs to a karstic complex developed at the top of the Mesozoic limestone formation which is part of the "Apricena horst" (Pavia et al., 2012). In the sedimentary fillings of the Pirro 13 fissure (P13) lithic evidences were found alongside with Late Villafranchian vertebrate fossils of the Pirro Nord Faunal Unit (Gliozzi et al., 1997). The origin of the deposit is the result of several massive processes (such as debris-flow) which gradually filled the fissure from the top in a chaotic way, determining the transportation of artifacts and faunal remains (Giusti and Arzarello, 2016). The age of the site, estimated using biochronological data, falls between 1.3 and 1.6 Ma (López-García et al., 2015; Cheheb et al., 2019).

Cà Belvedere di Montepoggiolo is in North-east Italy near the town of Forlì. The geological succession of the area originated from the Plio-Pleistocenic marine deposits *"argille-grigio-blu"* (grey-blue clay) later covered by the *"sabbie gialle"* (yellow sands) and successively eroded by marine regression (Ricci Lucchi et al., 1982). The yellow sands are absent within the site and a pebble beach in a fluvial sand matrix was instead found, containing lithic assemblage in primary position (Peretto et al., 1998). The chronological range of the context has been set to 0.85 Ma (shortly after the cooling of MIS22), correlating the latest paleomagnetic analysis with the biochronological data from the surrounding area since no faunal remains were found (Muttoni et al., 2011).

Ciota Ciara cave is located on the west slope of Monte Fenera's karst (899 m a. s. l.) at the entrance of the Sesia valley (Vercelli, Piedmont, Italy). It is a still active karstic cave whose archaeological interest has been the object of systematic excavations during the 60s, the

90s and again from 2009 onwards (Fedele, 1966; Busa et al., 2005; Daffara et al., 2019). During the last investigations an important sequence at the entrance of the cave was unearthed and four main stratigraphical units were found, each one attesting a phase of human occupation (Angelucci et al., 2019). The archaeological record is very rich and includes faunal remains, lithic industry and anthropical evidences (hearths and human remains; (Arzarello et al., 2014). According to the chronological data so far gathered the human frequentation of the Ciota Ciara cave can be placed during the second half of the Middle Pleistocene (Berto et al., 2016; Vietti, 2016; Cavicchi, 2018).

Riparo Tagliente is a rock shelter situated on the west slope of Valpantena, one of the main valley bottoms of Monti Lessini (Verona, Veneto, Italy). Systematically investigated since 1967, a complex stratigraphy was unearthed attesting two distinct phases of human occupation: the lower one referred to MIS 4-3 with Mousterian and Aurignacian assemblages and the upper one dated to the Late Glacial with Late Epigravettian evidences. For both sequences a rich faunal record alongside human remains was brought to light (Fontana et al., 2002; Thun Hohenstein and Peretto, 2005; Arnaud et al., 2016). The age of the Mousterian sequence (the one studied in this paper) is estimated to be between 60 and 40 ka based on sedimentological analysis correlated with the faunal assemblages (Bartolomei et al., 1982).

The technological analysis was performed with the intention of reconstructing the knapping sequences and core reduction strategies of exclusively opportunistic assemblages. The aim was to identify the objectives of production, the operative schemes applied to obtain such products and, at the same time, to evaluate how those aspects were influenced by morphology. In order to do so technical criteria are required (Inizan et al., 1995; Boëda, 2013).

For the flakes, several attributes were considered. The knapping technique was identified through the analysis of the stigmata present on the butt and on the ventral face (impact point, ripples, hackles). The scars together with the presence/position of cortex were analysed for defining the knapping method and the different reduction sequences employed. The incidence of debordant flakes and their morphology were used to identify any possible "wanted product" together with the presence and position of the cutting edge (Van Gijn, 1989). Moreover, for each core a diacritical scheme was realized to recognize and interpret the final steps of core reduction. The dimensional analyses were performed on complete pieces.

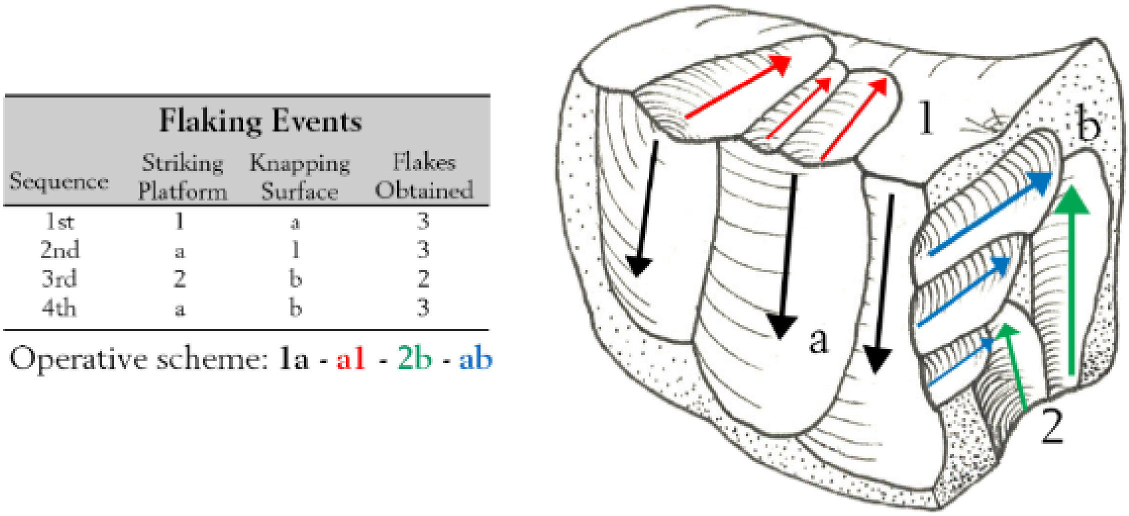
For all sites, a sample of lithic artifacts were considered with the aim of being, at the same time, the most characteristic (concerning raw material exploited and products) but also unintentionally selected (Tables 1-7).

Site	S.U.	N° of studied pieces	Raw material
Pirro Nord	A, B, C, D	101	Flint
Cà Belvedere di Montepoggiolo	101-118	94 (23 refitting)	Flint

Ciota Ciara cave	14	112	Quartz
Riparo Tagliente	52-38	122	Flint

Table 1. Sites, number of pieces and raw materials of the lithic assemblages analysed.

An experimental collection for each site was obtained from the most abundant raw material in each context (Tab. 3). Pirro Nord and Cà Belvedere di Montepoggiolo were conceived together since the raw material morphology exploited in each one is very similar (*i.e.* small pebbles). Since the experimentation focused exclusively on the opportunistic debitage, its purposes revolved around two main aspects to evaluate its stability and versatility as a method: a) the volumetric evolution of each blocks from its initial morphology to its gradual modifications as the knapping activity was carried on and b) the identification of the main strategies and aspects influencing any operative schemes. To accomplish these tasks, the creation of the *knapping-event* concept, similar to the one of *algorithm* defined by Forestier (1993), was necessary (Fig. 1). The *knapping event* can be defined as "the choice of one striking platform and its related knapping surface from which the core will be knapped. The switch or the change of one, or both surfaces previously involved determines the end of that *knapping event* eventually allowing a new one to begin with". Each new striking platform was marked with consecutive numbers while the knapping surface with consecutive letters. The striking platform was always written before the knapping surface so that in case the chosen striking platform was formerly a knapping surface (or vice versa), the letters and the numbers were switched rather than using new ones. Once the core was discarded, an operative scheme was obtained by indicating the sequence of each *knapping event* in chronological order (Fig. 1).



Flaking Events			
Sequence	Striking Platform	Knapping Surface	Flakes Obtained
1st	1	a	3
2nd	a	1	3
3rd	2	b	2
4th	a	b	3

Operative scheme: 1a - a1 - 2b - ab

Fig. 1. Experimental protocol: example of an experimental core with its relative operative scheme. The arrows' colours are related to their respective flaking event. Each arrow indicates a removal and its direction.

Moreover, before the starting of each experimental sequence, specific knapping goals were established to verify if they could have led to different choices regarding core management or if they required specific knapping patterns (Tab. 2). The choice of these goals was set according to the initial morphology and volume of the blocks, always considering the original archaeological context. Besides, to keep track of this process, any time that a *knapping-event's* switch was performed, or the core was discarded, the causes were written down based on knapper's indication (Tab.2).

Experimental Protocol	
Objectives of production	a) maximized flake-production
	b) flake-production achieved through a single technical behaviour (*i.e.* centripetal)
	c) flake production with predetermined functional and/or dimensional criteria (*i.e.* flake presenting a cutting edge of at least 40 mm)
***Knapping-event* change**	1) absence of knapping criteria 2) choice of a new striking platform and/or knapping surfaces on arbitrary base (such as "better convexities available")
	3) raw material quality
	4) dimensional issues 5) impossibility to achieve the objective of production
	6) core management (such as technical flakes)
	7) knapping errors and/or accidents

Table 2. Knapping goals of the experimental protocol.

The study of the experimental collection took place using the same technical criteria applied for the technological analysis of the archaeological material focusing on the direction of scars, incidence of debordant flakes and flake functionality (number and position of cutting edges; (Van Gijn, 1989).

In the end, it is highlighted once again how the experimental knapping activity was applied as a constant analogy to get as close as possible (aware of being far from the absolute certainty) to the identification of a predominant operative scheme (*i.e.* method) by its application through several technical behavior.

Site	N° of blocks collected	N° of flakes obtained	Raw material	Weight (kg)
Pirro Nord	10	302	Flint	2.960
Ciota Ciara cave	10	204	Quartz	4.220
Riparo Tagliente	10	412	Flint	7.430

Table 3. Raw materials, number of blocks collected, and flakes obtained during the experimentation.

3. The opportunistic debitage of Pirro Nord & Cà Belvedere di Montepoggiolo

The raw materials employed in the above-mentioned sites, were locally selected from secondary deposits. The morphology and volume differed within each context, deeply affecting the reduction sequences. In Pirro Nord, small and medium sized pebbles (~30-80 mm), mostly round and oval, were exploited and collected within the range of the site, in riverbeds or slope deposits. The recognized flint types, coming from the Gargano Cretaceous succession, are of good quality. In Montepoggiolo the procurement strategies recall the Pirro Nord ones, both in a qualitative and morphological way. Here, pebbles and cobbles are slightly longer and oval in shape (~30-100 mm).

Each opportunistic assemblage was oriented towards non-standardized flake production presenting at least one cutting edge sometime opposed to a backed margin (cortical or flat) (Fig. 4,5). The technical behaviours applied in each site are deeply related to the locally available morphologies, resulting in different knapping strategies. The presence of natural convexities on the selected blocks is one of the most relevant and more frequently attested features. This allows the production of functional flakes without implying a decortication phase or core preparation.

In Pirro Nord and Cà Belvedere di Montepoggiolo the use of similar morphologies provided an identical technological response, repetitive and deeply assimilated into the method. In both sites the production was oriented towards roughly quadrangular flakes, which sometimes could be elongated depending on the initial morphology and volume of the core, especially for Montepoggiolo (Fig. 5). The flakes were obtained through unipolar, bipolar, and centripetal flaking. The dimensional data available for Pirro Nord, both from the archaeological and the experimental collection, highlights how the cobbles were originally mainly spherical, rarely larger than 60 mm. Concerning Montepoggiolo, mostly large oval pebbles were knapped resulting in longer flakes. All in all, two main reduction strategies were identified: a unidirectional-multifacial flake-production applied on larger volumes and a centripetal exploitation of the surfaces on smaller and more rounded cobbles. Given the original dimensions of the raw material and since the adaption to morphology was constant through the whole knapping process, the reduction sequences were short and arbitrarily applied on the same core (Tab. 4).

Types of core	**Pirro Nord**		**Cà Belvedere di Montepoggiolo**	**Ciota Ciara cave**		**Riparo Tagliente**	
	A.	E.	A.	A.	E.	A.	E.
Unifacial cores							
Unipolar	5	2	5	3	5	1	
Centripetal	1	2	2			1	1
Bipolar		1					
Orthogonal	2	2	1				
Multifacial cores							
Unipolar	3	4	3	3	8	3	7
Unipolar-Bipolar					2	1	
Unipolar-Orthogonal	1	1	1	2		2	2
Centripetal	1						
Centripetal-Unipolar		1	1			2	
Orthogonal			1			1	
Bipolar	2						
Split fracture cores	1						
Cores on flake	3						
Total	**19**	**13**	**14**	**8**	**15**	**11**	**10**

Table 4. Typology of cores analysed in the archaeological (A.) and experimental (E.) record.

Site	**Core ID**	**Knapping events sequence**	**Type of core**	**N° S. P.**	**N° K. S.**	**N° Flakes**
Pirro Nord	n1	1a-ab-bc-2c-cd-dc	Multifacial (Centripetal - Unipolar)	6	5	31
	n2	1a-2a-3a-ab	Multifacial (Unipolar)	2	2	34
	n3	1a-ab-bc-cb	Unifacial (Unipolar)	1	1	42
	n4a	1a-a1	Unifacial (Orthogonal)	2	2	20
	n4b	1a-a1	Unifacial (Centripetal)	2	2	36
	n5a	1a	Unifacial (Centripetal)	1	1	11
	n5b	1a	Unifacial (Unipolar)	1	1	14
	n6	1a-a1-1b-b1	Multifacial (Unipolar - Orthogonal)	3	3	25
	n8	1a	Unifacial (Orthogonal)	2	1	13
	n10	1a-a1	Unifacial (Unipolar)	2	2	10
	n7	1a-ab-2(ab)-a1	Multifacial (Unipolar)	3	3	21
	n9a	1a-a1	Unifacial (Bipolar)	1	1	16
	n9b	1a-ab-bc	Multifacial (Unipolar)	3	3	25

Table 5. Pirro Nord 13. Analysis of the experimental cores. N° S. P. indicates the final number of striking platforms on the abandoned cores. N° K. S. indicated the final number of knapping surfaces on the abandoned cores.

The unipolar production begun with the opening of a flat striking platform by decapping one of the extremities of the pebbles or by exploiting naturally present suitable convexities. The knapping surfaces were initially natural then gradually decorticated by parallel removals. Therefore, knapping surfaces were generally orthogonal, often created by negatives of previous removals. The same scheme is observable on striking platforms. The production was carried on until suitable convexities existed. Usually 3-4 flakes were extracted from each core but when bigger pebbles were present, such as in Montepoggiolo, a succession of three or four generation from the same striking platform is attested (Fig. 2,3,9). Overall, the flake production was achieved while maintaining appropriate convexities. The use of lateral debordant flakes, both for the creation of backed margins and as nervure guides is the technical expedient more frequently adopted to do so (Fig. 8).

In the second above-mentioned case a centripetal conception of the surfaces was applied. A single knapping surface was exploited by different directions (usually orthogonal or bipolar, more rarely centripetal *sensu stricto*) through a peripheral striking platform (Fig. 2,3). This strategy was applied on the rounder cobbles, especially the smallest ones, usually opened by bipolar technique. By doing so, larger knapping surfaces were made available and it was also the best way to enhance the cobbles' volume. Therefore, it is the most efficient behaviour attested in Pirro Nord (Fig. 2). The striking platforms were mainly natural although in Montepoggiolo flat ones are attested by several refits. The latter were realized through one, or more, orthogonal removals to the knapping surface to prepare a peripheral striking platform (Fig. 3). During the reduction sequence each removal would often create new convexities (lateral and or distal) and nervures that allowed the debitage to run around the block until suitable technical criteria existed. As aforementioned, also in this case, the presence of debordant flakes is quite relevant with the aim of maintaining good angles and convexities, and to obtain backed flakes (opposed to a cutting edge; Fig. 8).

All things considered, the raw material's morphology dictates the choice of the best strategy to employ among the two. Nonetheless, both schemes can be attested on the same core. The constant adaptation to the morphology is the scheme laying behind the process for accomplishing the production's goals.

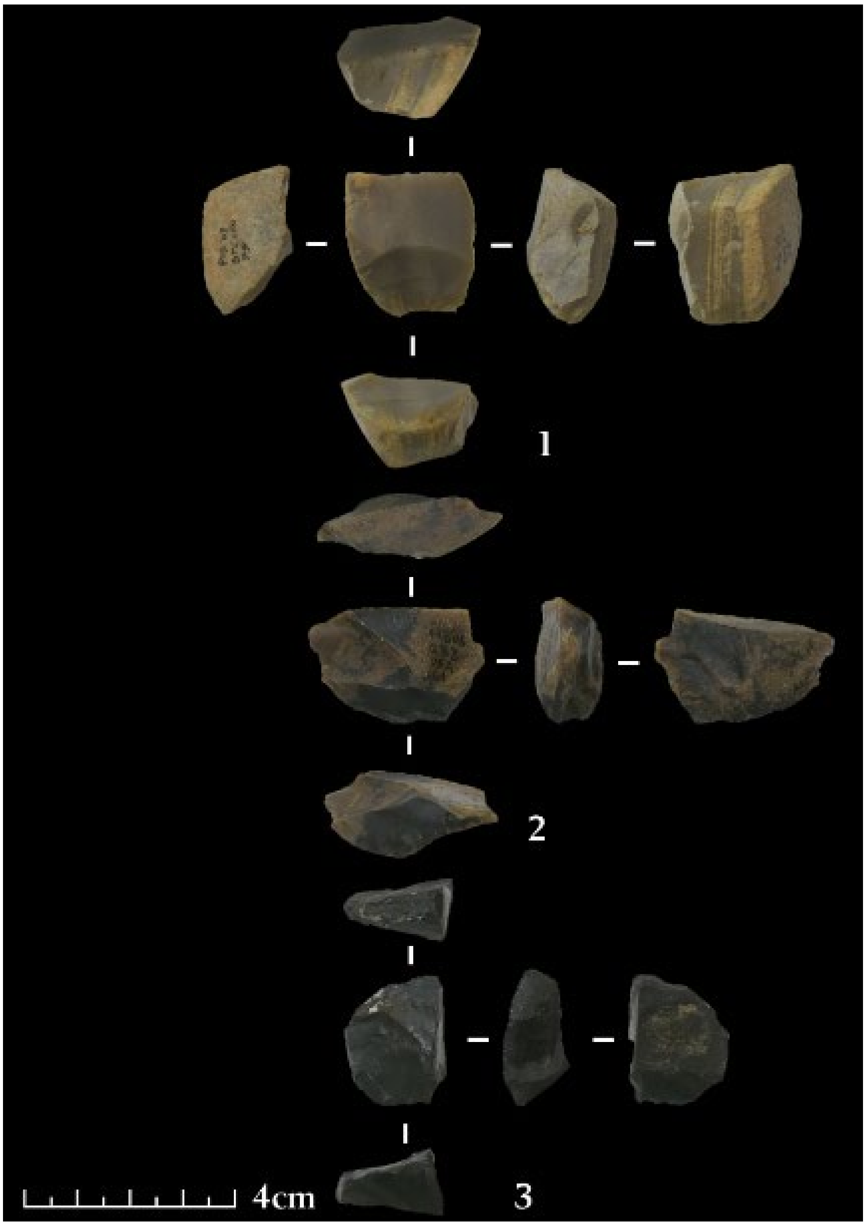


Fig 2. Pirro Nord, archaeological. 1 - orthogonal core; 2 – multifacial orthogonal core; 3 – unipolar core.

Fig. 3. Cà Belvedere di Montepoggiolo, archaeological. 1 – orthogonal multifacial core on small pebble; 2 – unipolar core on large pebble.

Pirro Nord and Cà Belvedere di Montepoggiolo's flakes share common features. Quadrangular non-standardized shapes are widely attested, slightly longer than larger and with at least one cutting edge, usually on the lateral margin (Fig. 4, 5). The dimensional range of the flakes, bearing or not cortex, is quite homogenous, confirming the shortness of the reduction sequences. The cortical flakes, less attested, are related either to the bipolar technique or to the opening of new knapping surfaces (Fig. 6). The frequency of functional flakes (with at least one cutting edge) is constant within each employed reduction sequence, indicating that the adaptation to the morphology led to an efficient production. Moreover, the presence of lateral backed margins (mainly cortical) opposed to the cutting edges can be interpreted as a researched feature for better grasping and as already mentioned, a technical expedient as well (Fig. 4, 5, 6, 8). Several refits from Cà Belvedere di

Montepoggiolo highlight this strategy as an efficient way to maintain technical criteria parallel to flake production. In this case convergent flakes could be obtained through a removal on the lateral edge of the knapping surface, thus preparing a guiding arrise (Fig. 5).

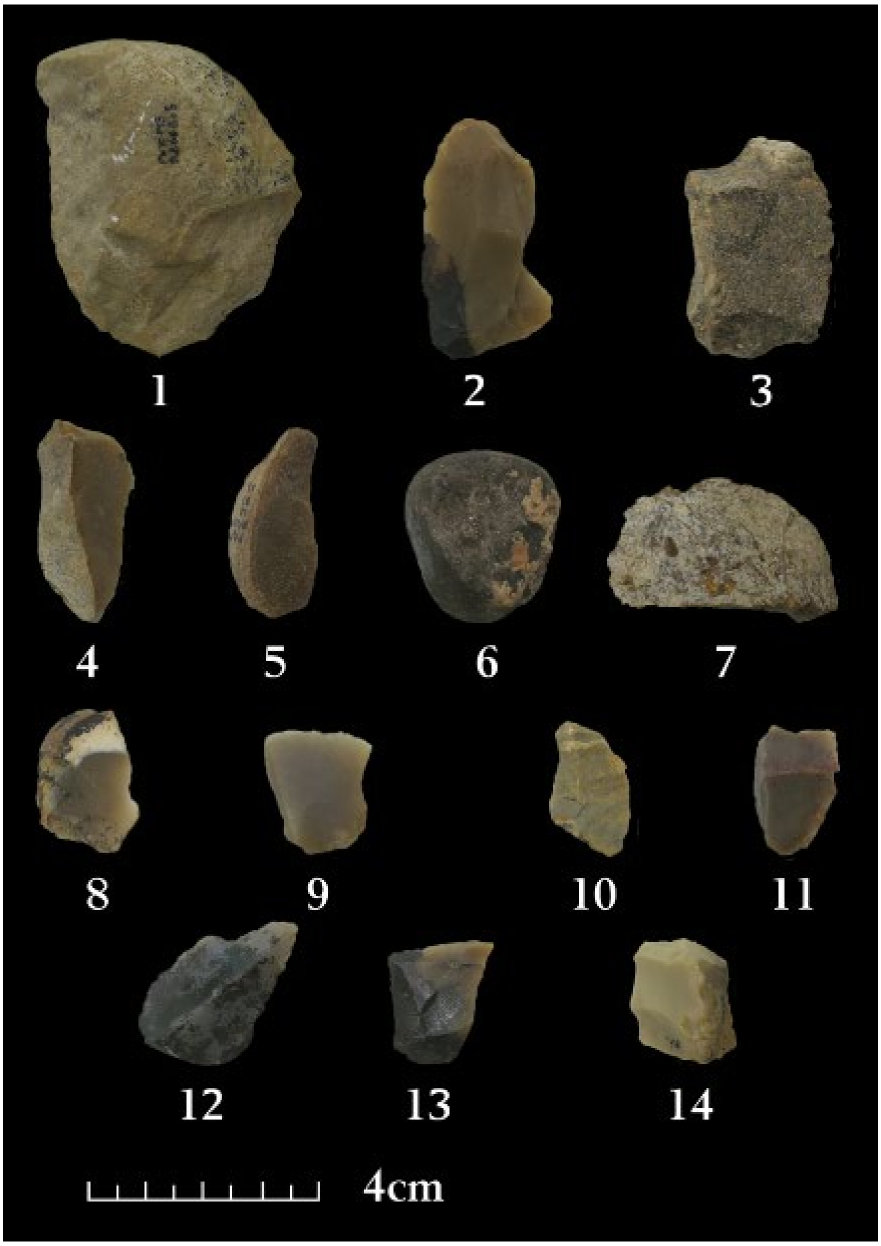


Fig. 4. Pirro Nord, archaeological. 1,3,8,10 – unipolar flakes; 6,11,14 – orthogonal flakes; 2,12,13 – centripetal flakes; 4,5 – bipolar flakes; 7 – cortical flake.

Fig. 5. Cà Belvedere di Montepoggiolo, archaeological. 1,4,6,9,10,11,13 – unipolar flakes; 2,5 – cortical flakes; 3,7,12 – orthogonal flakes; 8,12,14 – centripetal flakes.

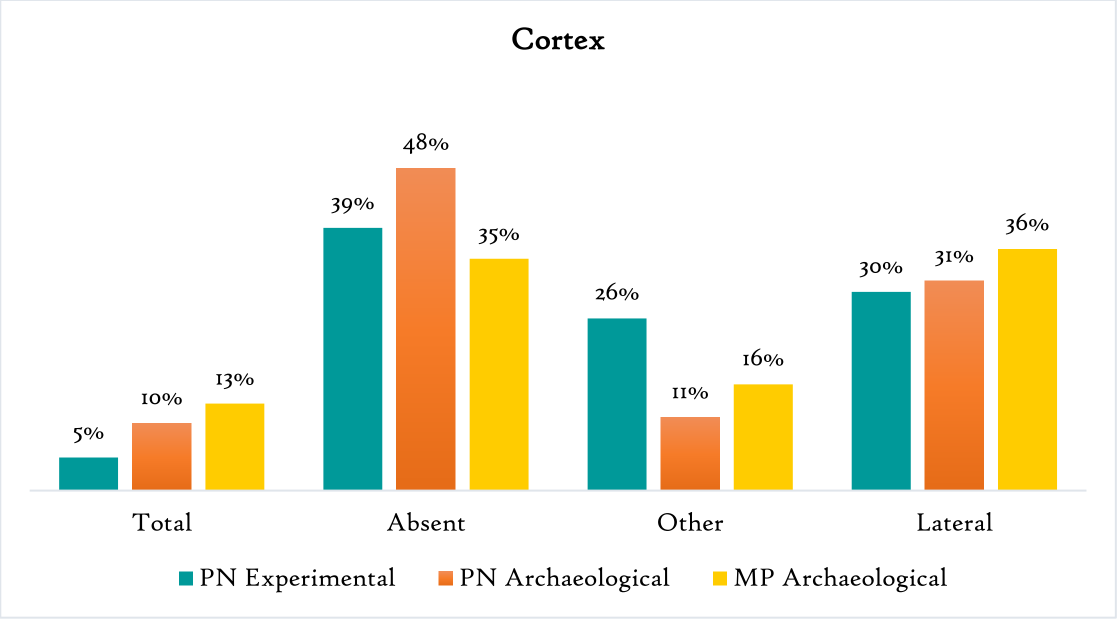


Fig. 6. Pirro Nord and Cà Belvedere di Montepoggiolo. Presence and position of cortex on archaeological and experimental flakes from Pirro Nord (PN) and archaeological flakes from Cà Belvedere di Montepoggiolo (MP).

The experimental collection of Pirro Nord provided a great number of debordant flakes, both from the unipolar and centripetal cores (Fig. 7, 8). These were constant in each *knapping-event*, showing specific behaviours in relations to core's exploitation but often being characterized by a lateral cutting edge opposed to the backed margin. In unipolar productions their function was the knapping surface's management, achieved by lowering the lateral edges of the cores while also creating nervures guide for the subsequent removals. This way, each following flake sets up a lateral convexity and a nervure guide for its consecutive removal, making it possible to easily obtain sustainable flake-lengths and cutting edges without cortex. In the centripetal sequences, cordal-like removals were often performed to maintain good convexities but since the debitage was performed through a peripheral striking platform, lateral and distal convexities were often, unintentionally, created (Fig. 7). This allowed the knapper to effectively run around the block and choose the best surface to eventually control the flake's morphology and its functional features. This pattern is evident especially in the case of small cores (Fig. 10). Therefore, orthogonal removals were performed alternating two distinct directions from the striking platform. The experimental collection also yielded a great number of déjeté points. The frequency of two orthogonal margins (the lateral and the distal one), forming a point, often adjacent to a natural backed edge, turned out to be very high in centripetal exploitation. However, these flakes were not morphologically predetermined, as seen in the archaeological record (Potì, 2012; Arzarello et al., 2016); Fig. 4.). In fact, these proved to be rather an unintentional outcome of centripetal reduction sequences, which likely produced quadrangular flakes (*i.e.* with orthogonal margins; Fig. 7).

Fig. 7. Pirro Nord, experimental. 1,2,5,9,10,12, 13 – unipolar flakes; 3,4,7,8 – orthogonal flakes; 4,6 – centripetal flakes; 11 – bipolar flake.

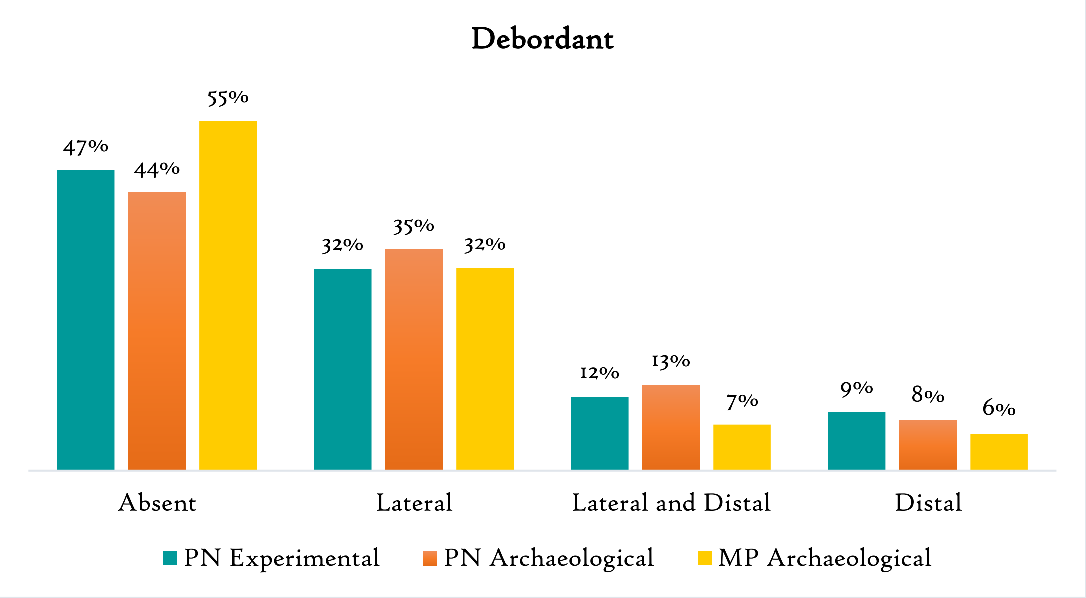


Fig. 8. Pirro Nord and Cà Belvedere di Montepoggiolo. Presence and position of debordant on archaeological and experimental flakes from Pirro Nord (PN) and archaeological flakes from Cà Belvedere di Montepoggiolo (MP).

The analysis of the experimental production from Pirro Nord displayed a greater affinity between the centripetal reduction sequences and the archaeological collection (Tab. 4). As a matter of fact, although unipolar removals are more widely attested in both collections (Fig. 9), their relationship with the orthogonal and bipolar ones is closer when only the centripetal reduction sequences are selected. This is also emphasised by a greater similarity of the flakes thus obtained. The centripetal exploitation of the surfaces resulted to be more efficient and quantitively rewarding when experimenting on smaller volumes and rounder morphologies.

By observing the refitting of the experimental sequences, it appears that, as stressed already, a centripetal conception of the surfaces easily leads to a better control of the flake's morphology. As a result, this gradually generates a greater *awareness* during the knapping activity that could evolve into predeterminated reduction sequences. The presence of déjeté points in Pirro Nord's archaeological record and convergent flakes from the Cà Belvedere di Montepoggiolo's one, may be an example of this. Short reduction sequences intensively and constantly applied on a great number of pebbles could lead to a standardized technical behaviour, modulated on the constantly changing morphology, with a potential of generating predetermined products. In conclusion, to similar morphologies can correspond identical methodological responses.

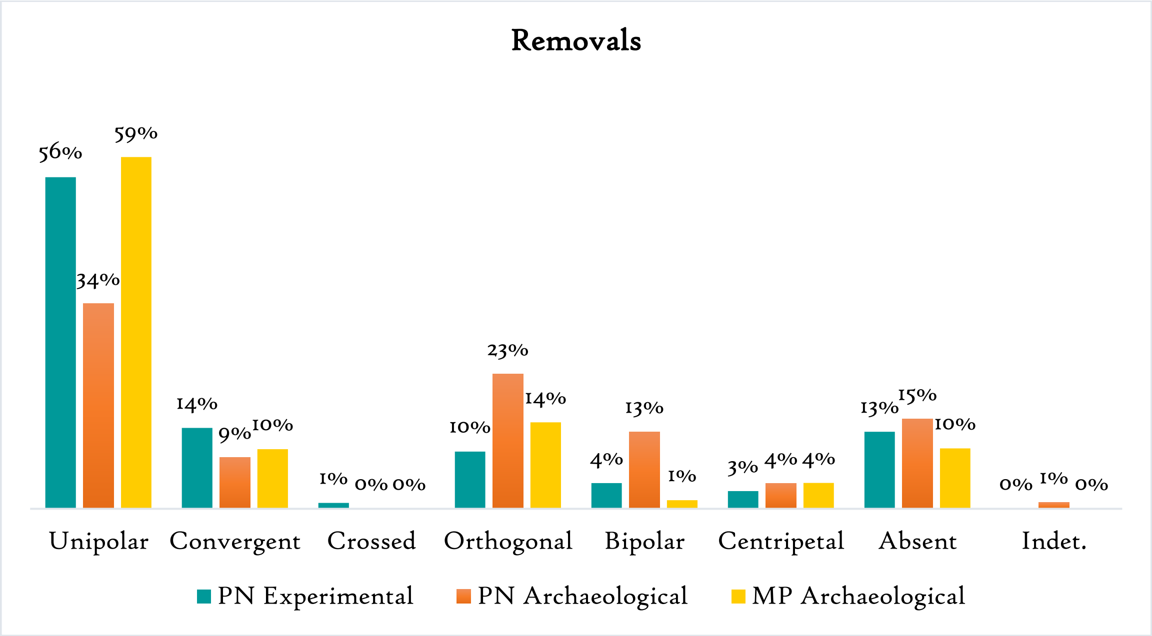


Fig. 9. Pirro Nord and Cà Belvedere di Montepoggiolo. Presence and direction of removal negatives on the upper face from Pirro Nord (PN) and archaeological flakes from Cà Belvedere di Montepoggiolo (MP).

Fig. 10. Pirro Nord, experimental. 1 – bipolar core on small pebble open by split fracture; 2 – unipolar multifacial core on small pebble open by split fracture; 3 orthogonal multifacial core.

4. The opportunistic debitage of Ciota Ciara cave & Riparo Tagliente

As far as it concerns the raw material selection, the same pattern can be highlighted for the opportunistic assemblages of Ciota Ciara cave and Riparo Tagliente. In the Ciota Ciara cave the vein quartz is the most exploited raw material not only for the opportunistic reduction sequences but also for the other knapping methods (such as Levallois and Discoid;(Daffara, 2017). Blocks and nodules of different morphologies and dimensions (40-100 mm) were locally collected along riverbeds and slope deposits (Daffara et al., 2019). Since vein quartz's texture is mainly coarse, implying shorter reduction sequences, a greater importance to the presence of suitable natural convexities was given rather than to the dimensional issues. The same procurement strategies are seen in Riparo Tagliente, where a great abundance of large flint blocks and nodules of extremely good quality were available. As in the previous context, Levallois and Discoid productions are attested on the same raw material alongside with the laminar method.

In the Ciota Ciara cave the flake production started straight from the natural convexities, or arrows, of the blocks without foreseeing any core preparation or surface management. The production, then, proceeded mainly through unipolar removals eventually including new knapping surfaces or just switching them. Orthogonal and bipolar removals are less attested (Fig. 11). The use of the same knapping surface and striking platform until the abandonment of the core was rather common (Tab. 4). The flakes thus obtained were quadrangular in shape, yet morphologically non-standardized and with at least a cutting edge on the lateral margin (Fig. 14). According to the raw material features, a high rate of flaking accidents and the formation of irregular surfaces on the cores are frequent (Daffara, 2017). Therefore, the creation and management of suitable convexities and nervure-guides was related to the initial morphology of the blocks. The reduction sequences' length was proportioned to the initial volume of the block, but above all to its *morphological flaking-predisposition*. This is confirmed by the experimental collection that provided a wide sample of exhausted cores of different morphologies and dimensions. Their analysis emphasizes the absence of a specific tendency in the choice of one, or more, striking platforms and knapping surfaces to exploit (Tab. 6). Instead the objectives of production were modulated considering the pre-existing convexities.

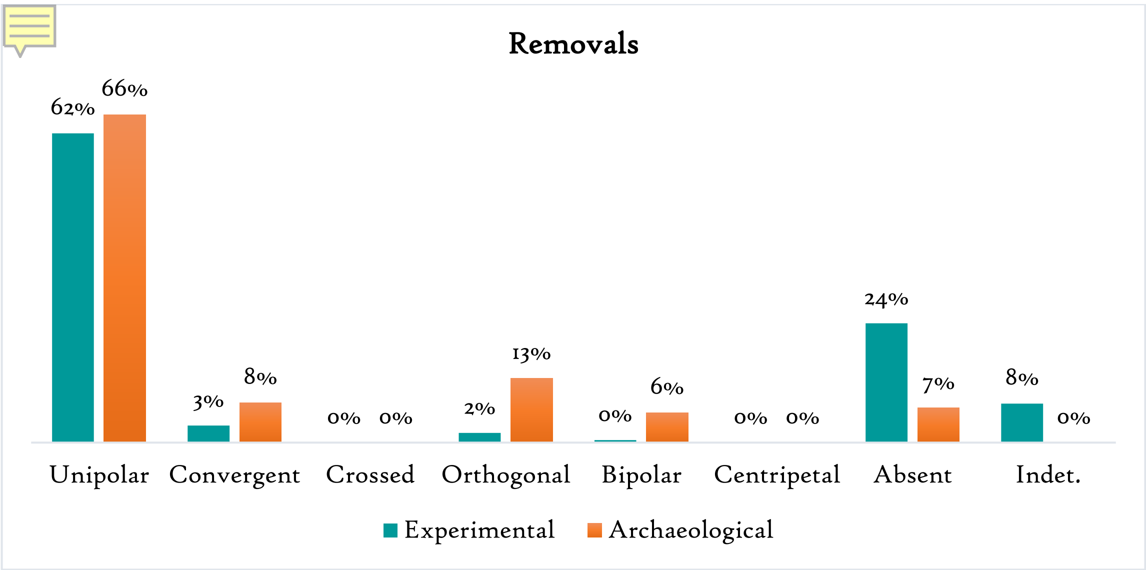


Fig. 11. Ciota Ciara cave. Presence and direction of removal negatives on the upper face of the archaeological and experimental flakes.

No difference was made between natural or flat striking platform since the presence of vein quartz's cortex did not affect the flaking activity. The likelihood of exploiting one single knapping surface until the abandonment of the core was rather high also considering the high percentage of natural butts. This may also prove that the production's phase corresponds to the starting of the flaking process from the natural surfaces.

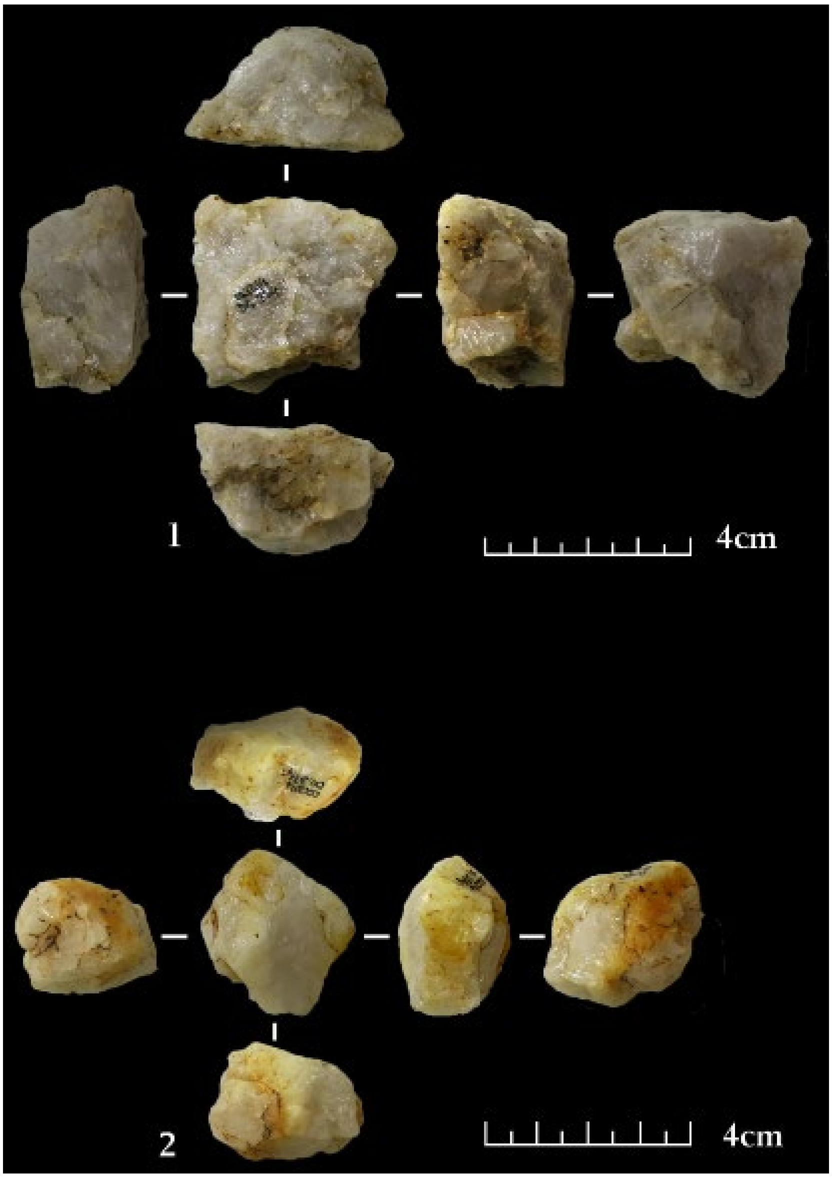


Fig. 12. Ciota Ciara cave, archaeological. 1 – unipolar multifacial core; 2 – orthogonal core.

Site	Core ID	Knapping-events sequence	Type of core	N° S. P.	N° K. S.	N° Flakes
Ciota Ciara cave	CC1N	1a-a1-1b-b1	Multifacial (Unipolar - Bipolar)	3	4	41
	CCN9-1	1a-ab-1c	Multifacial (Unipolar)	2	3	3
	CC3N	1a-a1-1b-b1	Multifacial (Unipolar - Bipolar)	3	3	14
	CCN10	1a-a1	Multifacial (Unipolar)	2	2	4
	CCN5	1a-a1-1a1	Multifacial (Unipolar)	2	2	23
	CCN9	1a-ab-ba	Multifacial (Unipolar)	2	2	23
	CCN7	1a-ab-1a1-a1-1a2	Multifacial (Unipolar)	2	2	27
	CCN4b	1a-ab	Multifacial (Unipolar)	2	2	10
	CCN4a	1a-a1	Multifacial (Unipolar)	2	2	9
	CCN8	1a-21-1aII	Multifacial (Unipolar)	1	1	11
	CCN6	1a	Unifacial (Unipolar)	1	1	18
	CC2Nb	1a	Unifacial (Unipolar)	1	1	3
	CC2Na	1a	Unifacial (Unipolar)	1	1	5
	CC2N	1a-21	Unifacial (Unipolar)	1	1	2
	CCN4b1	1a	Unifacial (Unipolar)	1	1	5

Table 6. Ciota Ciara cave. Analysis of the experimental cores. N° S. P. indicates the final number of striking platforms on the abandoned cores. N° K. S. indicated the final number of knapping surfaces on the abandoned cores.

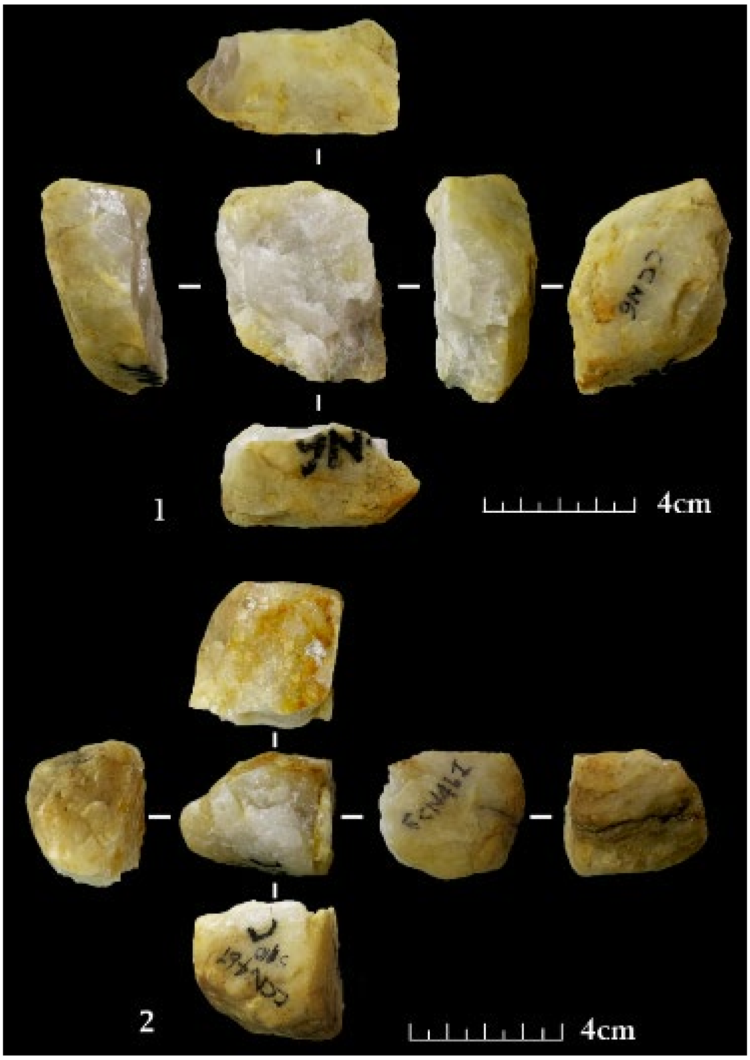


Fig. 13. Ciota Ciara cave, experimental. 1,2 – unipolar multifacial cores.

The flakes are characterized by a lateral cutting edge frequently opposed to a backed margin (Fig. 14). The presence of nervure-guides is usually related to a single unipolar removal or, more rarely, by a portion of cortex (Fig. 14). Generally, most of the flakes show only one negative, suggesting that knapping surfaces were not that large, being exploited through few removals until the exhaustion of the natural convexities. In this way, natural edges were used as a technical expedient to achieve functional flake production and create nervure guides. Therefore, the frequency of debordant flakes is quite high (Fig. 16). Orthogonal and bipolar flaking resulted to be sporadically employed (Fig. 11). The cores and flakes attesting these strategies, however, are not different from the record, fitting well in the same operative scheme of subordination and adaptation to the morphology which comprise the whole opportunistic production of the Ciota Ciara cave. As a sign of this, the experimental's reduction sequences occasionally presented knapping surfaces exploited from several directions, but this was not matched by the flake's removals analysis which, instead, presents the same trend of the archaeological ones (Tab. 4,6; Fig. 13). On experimental basis, the functionality-rate of the flakes proved to be higher on the smallest and thinnest ones. This, however, is not validated by the archaeological sample attesting, on the other hand, a homogeneous distribution of functional flake within the dimensional range. Therefore, the accomplishment of the production's goals was constant along the entire reduction process, without the need for specific morpho-dimensional criteria.

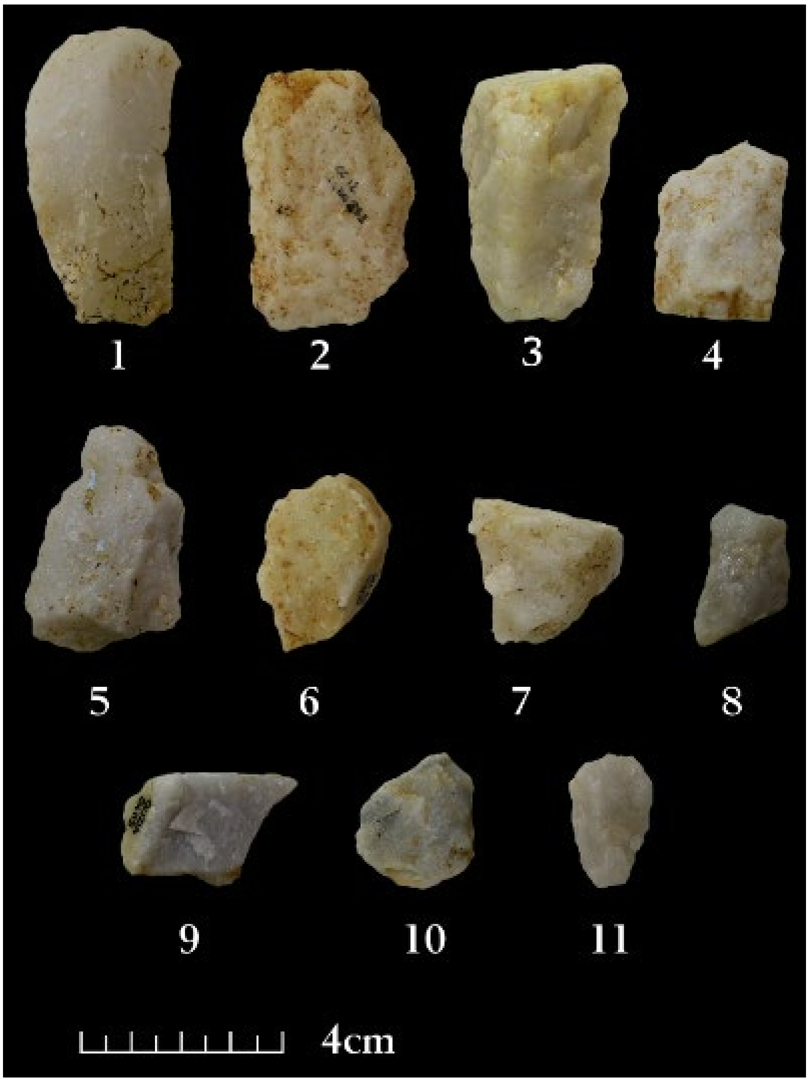


Fig. 14. Ciota Ciara cave, archaeological. 1,2,3,5,6,8,9,10,11 – unipolar flakes; 4 – orthogonal flake; 7 – bipolar flake.

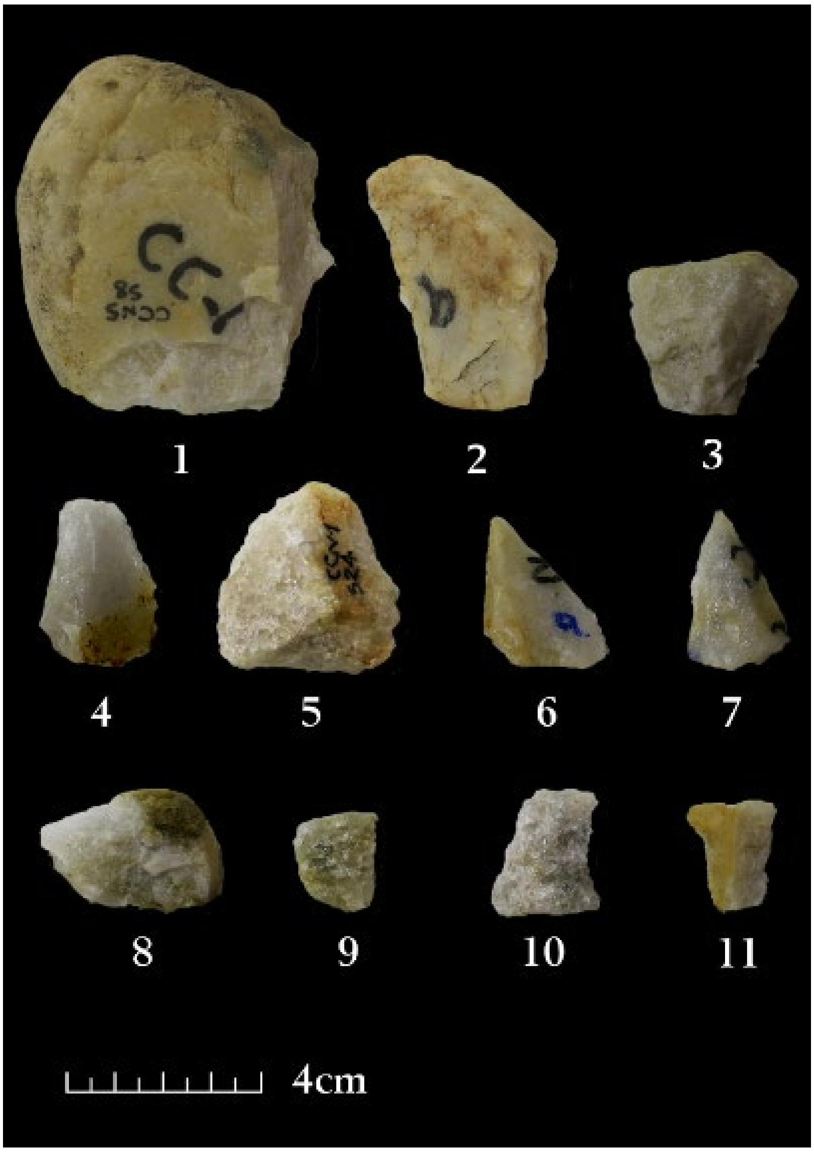


Fig. 15. Ciota Ciara cave, experimental. 1,2 – cortical flakes; 3,4,6,7,8,9,10,11 – unipolar flakes; 5 – orthogonal flake.

Once again, the high flexibility towards morphologies and volumes emerges as the main aspect characterizing the opportunistic assemblages. The presence of Levallois and Discoid productions within the context proves, on one side, that the exploitation of raw materials qualitatively regarded as inferior does not invalidate the possibility of using more complex flaking methods. On the other side, it underlines how the opportunistic debitage persists during these chronological phases resulting in being as much as an efficient and independent method for the manufacturing of functional products.

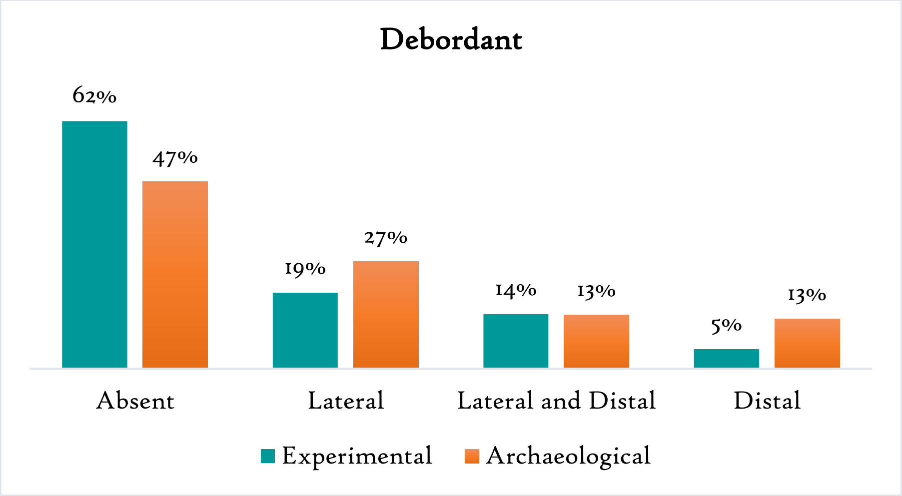


Fig. 16. Ciota Ciara cave. Presence and position of the debordant part on archaeological and experimental flakes.

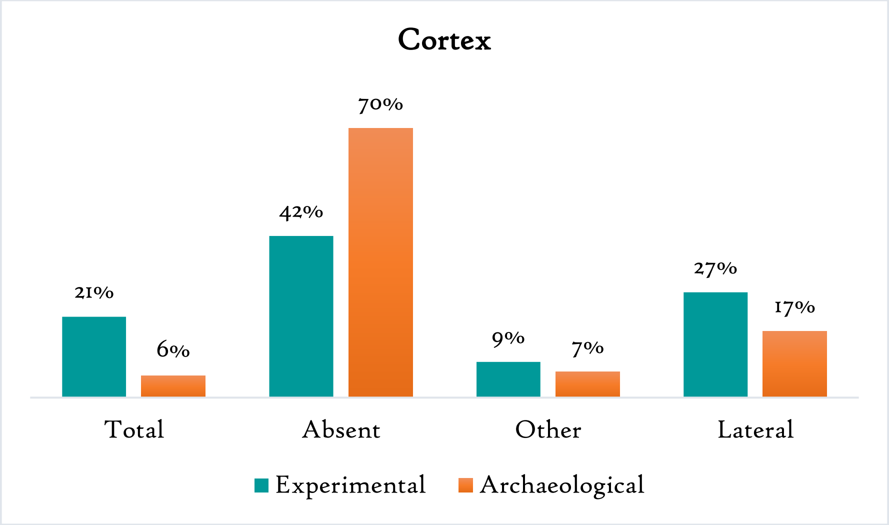


Fig. 17. Ciota Ciara cave. Presence and position of cortex on archaeological and experimental flakes.

Concerning Riparo Tagliente's opportunistic assemblage, the aim was always flake production achieved through a constant adaptation to the morphological criteria. Since better and larger blocks were available (nodules and fluvial cobbles), the reduction sequences were longer and more complex (Tab. 4). As a matter of fact, these aspects enhanced the possibility of exploiting, at the same time or individually, more surfaces through multifacial removals (unipolar, orthogonal, bipolar, and centripetal *s.s.*), until the complete depletion of the existent convexities. This determined, eventually, the abandonment of large dimensions' cores, still presenting suitable surfaces for pursuing the exploitation (Fig. 21). The great abundance of such a good raw material within the site, might explain this behaviour (Arzarello, 2003). Of course, the presence of small massively exploited cores as well suggests that the production could be quantitively remarking despite anything else.

The initial morphology, again, dictated how the production's goals were achieved. This resolved in a dual case scenario to produce non-standardized quadrangular flakes, slightly elongated and with at least one cutting edge (Fig. 22). In the first case, a unipolar-multifacial debitage was set up while in the latter a centripetal one occurred. These two strategies were not separately employed but constantly linked and arbitrarily rotated on the same core according to the evolving morphologies.

The unipolar production (Fig. 20) was carried on larger nodules or on particularly elongated ones, where the longitudinal axis was often employed as the knapping surface. In this case the presence of suitable natural convexities was one of the requirements for the opening of the flaking activity. As a matter fact, most of the nodules presented exposed surfaces due to natural fractures that could speed up the extraction process. Otherwise, a single cortical flake was needed in order to prepare the knapping surfaces and striking platforms. The opening of a flat one was necessary when an already existing one was lacking on the initial morphology of the blocks. Elongated flakes where thus obtained, more frequently presenting a debordant edge on the lateral margin rather than on the distal one (Fig. 18, 22). The cutting edge often corresponded to the scar left by previous removals. The aim was to gradually enlarge the knapping surface, removing the cortex, and thus involving the other core's faces (Fig. 19). The formation of guiding arrises happened simultaneously to the flake's extraction, alongside the exploitation of natural edges. These aspects were functional to the flakes' length, optimizing the knapping surface's productivity in both a quantitative and qualitative way. As stressed above, this strategy resulted, eventually, in semi-tournant behaviours or simply showing edges, initially natural ones then progressively created during the production, recalling the laminar conception. As far as the core's volume decreased a multidirectional flaking could be initiated (Tab. 4; Fig. 21). Therefore, the switching between the striking platforms and knapping surfaces was rather frequent and useful to the preservation of the technical criteria. For this reason, orthogonal and bipolar debitage were likely to happen, leading to a centripetal conception of the core. At this stage, the flakes were gradually smaller and quadrangular in shape bearing no cortex at all. An increase of the cutting edges on the distal margins can be observed. This pattern was then repeated until the core was no further exploitable.

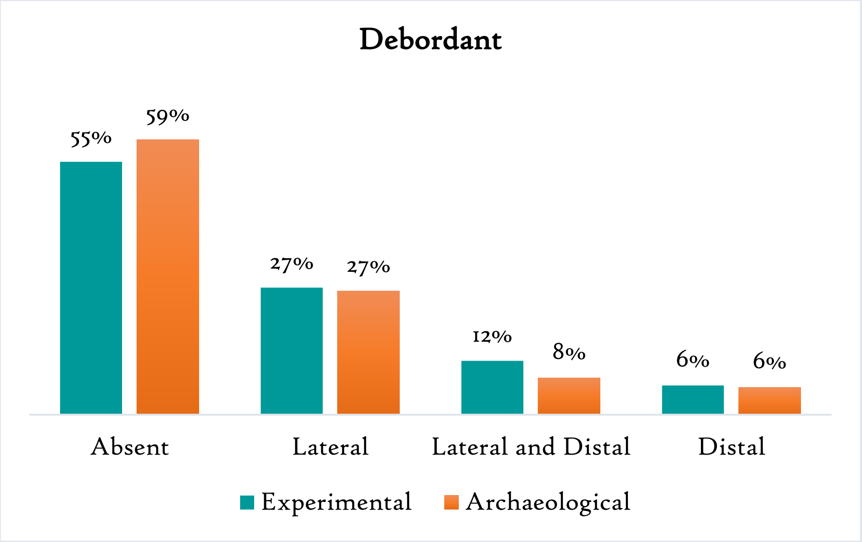


Fig. 18. Riparo Tagliente. Presence and position of the debordant part on archaeological and experimental flakes.

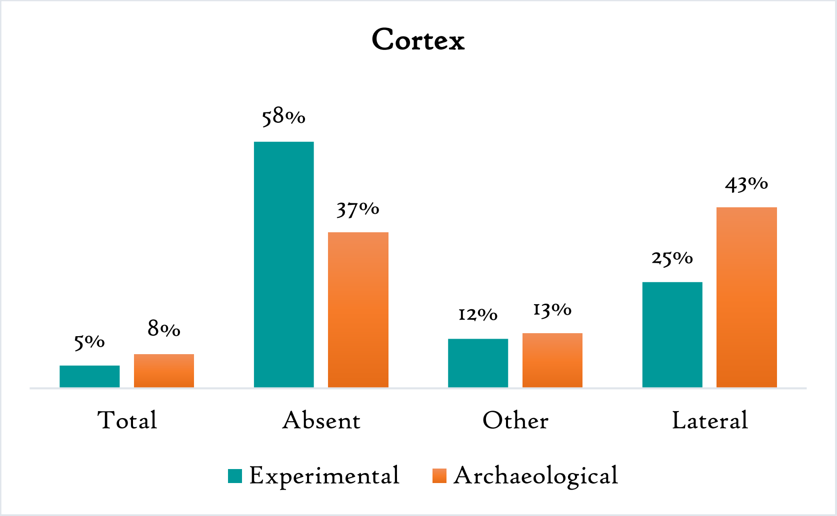


Fig. 19. Riparo Tagliente. Presence and position of cortex on archaeological and experimental flakes.

When large fluvial pebbles were collected and/or flatten and rounder surfaces available, a centripetal flaking was possible for starting the production. In this way a pre-existing peripheral striking platform was available (although a cortical flake may have been required to initiate the debitage) resulting in an optimization of the raw material's economy (Fig. 21). The production focused on parallel removals which gradually involved the entire surface allowing a better control over the flakes' morpho-technical criteria, not to mention an easier handling of the convexities. In this case an orthogonal debitage could be highlighted in the initial stages of the unipolar productions as well, as an expedient to create distal and lateral convexities (Fig. 22). These ones, together with the unipolar nervure-guides guaranteed that each removal would cover the entire knapping surface's length, determining also an elongated and regular cutting edge on the flakes. As previously stated, a centripetal debitage (mainly orthogonal and bipolar) might have occurred during the final phases of the unipolar cores to deal with the unlikelihood of exploiting a surface from one direction. In this way alternated removals were more efficient and productively rewarding.

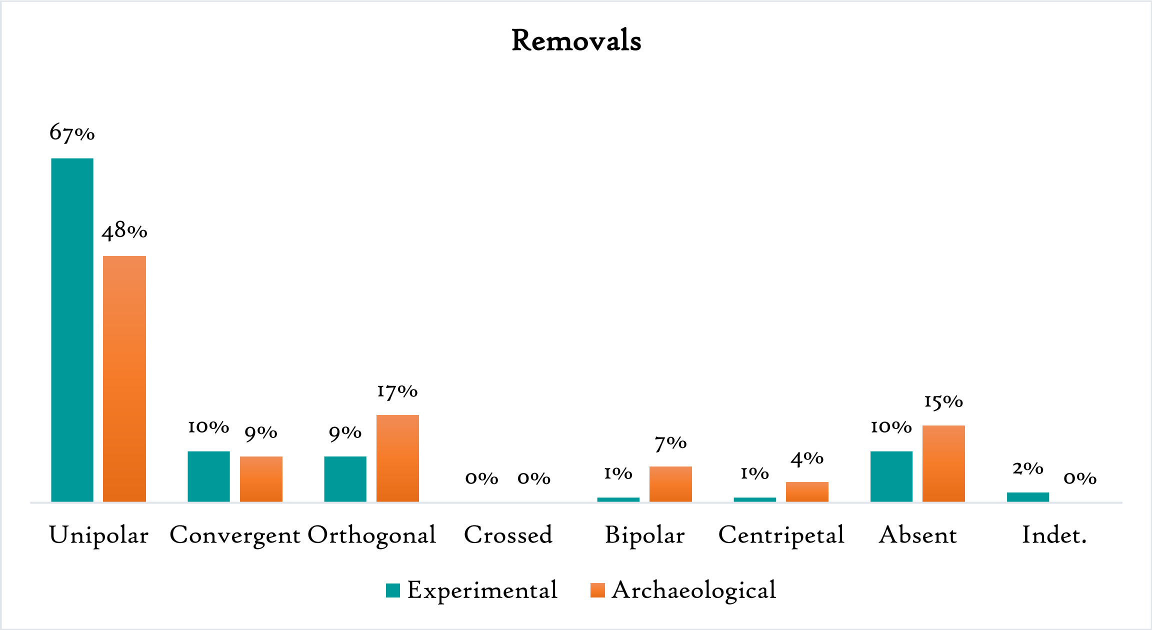


Fig. 20. Riparo Tagliente. Presence and position of removals on archaeological and experimental flakes.

Fig. 21. Riparo Tagliente, archaeological. 1 – multifacial core; 2 – centripetal core.

In conclusion, Riparo Tagliente's strategies proved to be efficient in terms of production of flakes presenting at least one cutting edge. The flakes' functionality rate appeared to be constant within each core, despite the different schemes employed to obtain them. Even with the gradual decrease of the flakes' length the same pattern can be attested confirming, overall, a well-organized production. Both on the archaeological record and the experimental one, a global increase of the cutting edges per flake (especially on the distal margins) was observed simultaneously to a reduction of the whole length and to a decrease of the debordant edges' frequency. However, this was seemingly not a relevant production's goal but still confirms the reliability of the reduction processes even on the final stages of the cores' exploitation. The experimental collection also provided a great number of déjeté points, especially through a centripetal debitage (Fig. 23). Nevertheless, they resulted to be an unintentional outcome of the flaking processes, mainly due to the convexities management and the possibility of obtaining quadrangular flakes rather than to a dedicated flaking scheme. After all, the archaeological record did not provide these kinds of products, if not in negligible percentage.

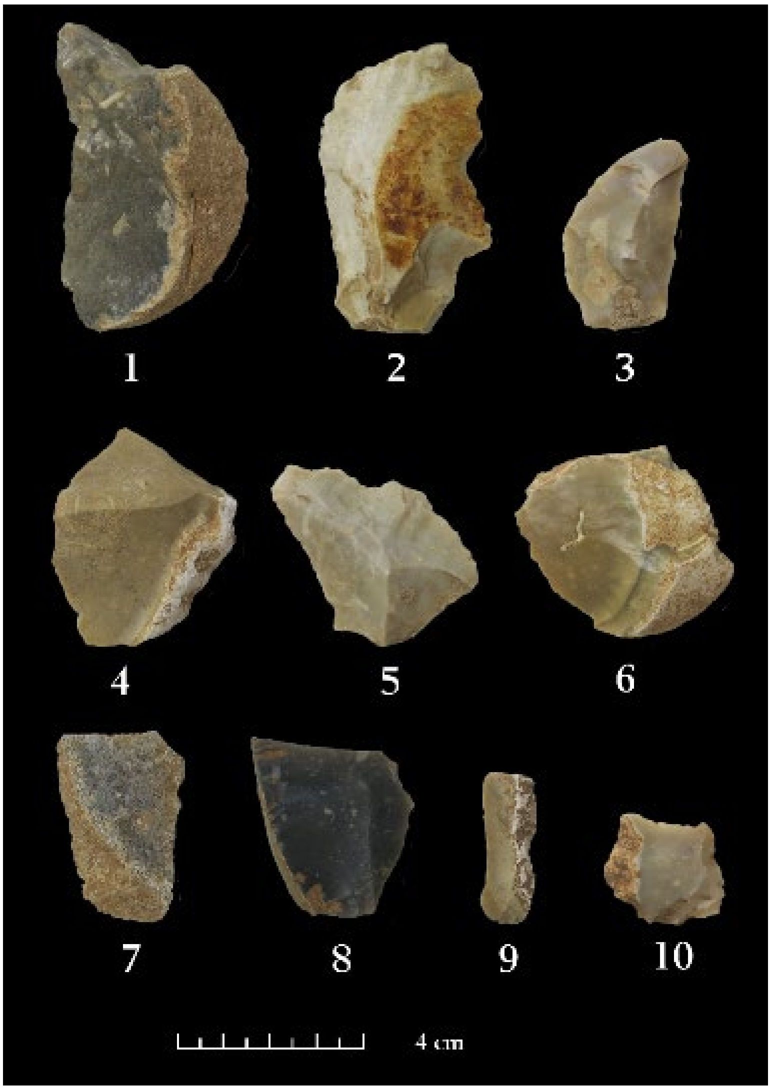


Fig. 22. Riparo Tagliente, archaeological. 1,2,3,8,9,10 – unipolar flakes; 4,6 – orthogonal flakes; 5 – centripetal flake; 7 – bipolar flake.

Fig. 23. Riparo Tagliente, experimental. 1,11 – orthogonal flakes; 2,4,5,6,7,8,9,10 – unipolar flakes; 3 centripetal flake.

The analysis of the experimental reduction sequences matched the archaeological ones (Tab. 7; Fig. 24). Both, massively exhausted cores, and ones of bigger dimensions, still presenting a suitable volume to exploit were present. Multiple *knapping events* involving all block's surfaces or single ones carried on until the core's abandonment were evidenced. The switching between the striking platforms and knapping surfaces was frequent as well (Tab. 7). Moreover, on the same core, when a surface was no longer exploitable that way, a centripetal debitage often developed into a unidirectional one, or vice versa. In this case, it was the experimental work's merit to verify and validate how the morphologies could dictate the objectives of productions, generating a wide number of diversified behaviours still originated from the same mental scheme. For this reason, from a methodological perspective, there is no such difference in a unipolar, centripetal, or multidirectional debitage since the purpose (*i.e.* the operative scheme) they are applied for, remains the same.

Site	Core ID	Knapping-events sequence	Type of core	N° S. P.	N° K. S.	N° Flakes
Riparo Tagliente	RT1N	1a-a1-1b-a1I-1c	Multifacial (Unipolar)	3	3	44
	RT2N	1a-ab-bc-cd	Multifacial (Unipolar - Orthogonal)	3	3	41
	RT3N	1a-a1-1b-1c	Multifacial (Unipolar)	3	3	49
	RT5N	1a-a1-1aI-a1I-1aII	Multifacial (Unipolar - Orthogonal)	4	5	40
	RT6N	1a-a1	Multifacial (Unipolar)	2	2	20
	RT7N	1a-ab-1b-a1-1aI	Multifacial (Unipolar)	2	2	43
	RT8N	1a-a1-1b-b1	Multifacial (Unipolar)	2	2	18
	RT9N	1a-ab	Multifacial (Unipolar)	2	2	25
	RT10N	1a	Unifacial (Centripetal)	1	1	54
	RT11N	1a-ab-ac-ba-abI-baI-abII	Multifacial (Unipolar)	3	3	78

Table 7. Riparo Tagliente. Analysis of the experimental cores. N° S. P. indicates the final number of striking platforms on the abandoned cores. N° K. S. indicated the final number of knapping surfaces on the abandoned cores.

Fig. 24. Riparo Tagliente, experimental. 1 – centripetal core; 2 – multifacial core.

The presence of more complex flaking methods, implying either a surfaces' hierarchization (Levallois) or a strong subordination of the raw material's morphology (such as discoid and laminar), certainly played an influencing role for the opportunistic debitage resulting in a greater technical awareness. As a sign of this, several experimental cores showed a greater affinity both with discoid reduction sequences and the laminar ones. In the first case, the centripetal debitage was addressed, regarding the convexities' management and the use of cordal-like removals (Fig. 24). In the latter, the experimental cores, presenting an elongated morphology together with a low width, were exploited through semi-tournant removals, often implying the presence of central nervure-guide (like a crest).

For these reason, one can assume, in a broader chronological perspective, that it was indeed the great versatility of the opportunistic debitage to represent the groundwork for the rising of such highly specialized flaking method, as the ones above-mentioned. However, their success did not prevent the opportunistic debitage to persist during the whole Pleistocene, both in a qualitative and quantitative way.

5. Conclusions

The delineation of the opportunistic concept interests a wide chronological frame. Being all the way through characterized by a strong adaptation to the morphology and quality of the raw materials locally available, as observed in all the contexts where it was identified. Its flexibility allows the modulation into different technical behaviours, constantly aimed to the extraction of functional products, in a highly efficient perspective. The easily replicability of the operative scheme through the technical gesture, together with an optimization of the block's volume, is the methodological substratum behind the mental process. This, for the oldest contexts, give rise to a methodological and cultural potential that may represent the beginning of more complex flaking methods. The occurrence of predetermined-like products coming from the centripetal reduction sequences of Pirro Nord and Cà Belvedere di Montepoggiolo may be an example of this process. On the other hand, for the most recent periods, the opportunistic debitage persists as a reliable and independent flaking method. In these cases, it often co-exists with Levallois, Discoid and laminar productions, standing as one of the possible behavioural variables of the human groups. Still identifiable on an archaeological basis through its technical criteria, even if subjected to different chronological, environmental, and cultural aspects (this last one always hardly perceived within the analysis of a lithic industry).

In conclusion, the term "opportunism" does not represent just a mere application of flaking criteria along with a great technical skill completely disentangled from any mental scheme. As observed in this work, its flexibility and capability to be adopted through different chronological and cultural phases are the principles outlining a flaking method by definition. Because of this, it must be reminded that it will always be a partial aspect of the human groups' material culture: useful for the identification and interpretation of specific behaviours but far from being its unique constituent.

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