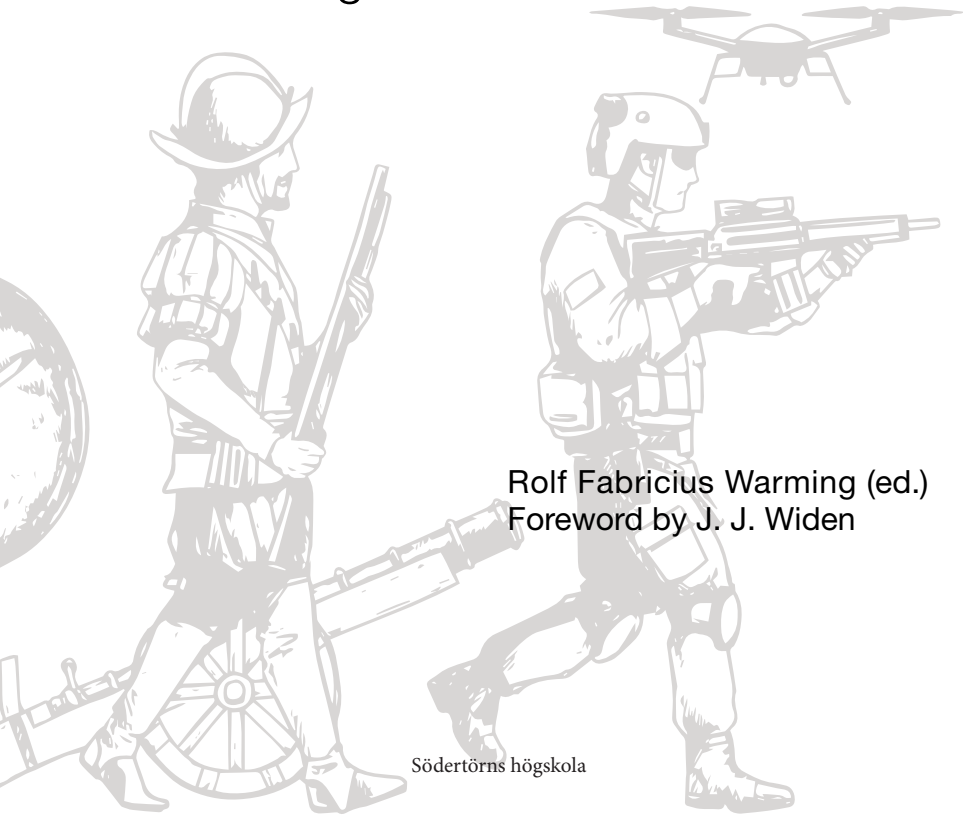
Violence and Warfare in Social Context

Archaeological and Historical Studies



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CHAPTER 4

Beneath the Military Horizon: Measuring Stone Age Hunter Weapon Point Technology at the Ecological Scale

Fredrik Lundström

The main controversies surrounding one of the most famous burials in Sweden, the Mesolithic Barum grave in Scania, revolves around two value imbued activities, hunting and conflict. Since the burial contains a slotted bone point, it was originally assumed that the grave contained a male with his hunting weapon. However, subsequent examinations revealed that the person buried was a woman (Sten et al., 2000). The notion of the person's social role as a hunter, hinging upon the body's relationship to the bone point, has since also come into question. Moreover, the prospect has been raised that the bone point instead indicates that the woman was a victim of inter-human violence, a conflict in which she was shot by the slotted bone point. In that aspect, the burial has been compared with another Mesolithic burial, the grave of a man from Stora Bjers, Gotland, Sweden (Hanlon and Nilsson, 2004). In that example, however, the violent action is less ambiguous since the point was fragmented and found lodged in the hip bone (Gejvall, 1979; Bornfalk Back, 2017; Günther et al., 2018). Regardless of interpretation, the Barum woman's relation to both hunting and conflict is crucial for the discussions surrounding it. Why is this topic ambiguous and difficult to address?

The challenge of interpreting hunting and conflict in cases such as the Barum woman and the Stora Bjers man does not stem from a lack of available material, interest or analytical techniques. Within Stone Age archaeology, no other weapon category exemplifies universalism and temporal depth better than the weapon point, the durable ends of weapon systems, that were once launched as projectiles or thrust as spears. (e.g., Knecht, 1997; Iovita & Sano, 2016; Shott 2020; Pétillon & Cattelain, 2022). Point trauma has been found on Mesolithic human

bone and as evident by several works (e.g., Keeley, 1997; Chapman, 1999; Thorpe, 2003, 2005; Roksandic, 2004; Guilaine & Zammit, 2008; Schulting & Fibiger, 2012; Allen & Jones, 2014; Hutton Estrabrook, 2014; Heath, 2017), interest in Stone Age and hunter-gatherer conflict has grown in recent decades. Simultaneously, there has been a renewed interest in Stone Age weapon functionality and recent developments in geometric analysis, experimental archaeology and digital simulations (e.g., Iovita et al., 2016; Sholts et al., 2017; MacLeod, 2018; Lundström, 2019a; Salili-James et al., 2022) offer techniques that accurately and quantitively measure weapon point properties. Despite growing archaeological interest and new techniques, the study of weapon points as conflict implements is far from straightforward. From an archaeological perspective, two major challenges obstruct research development in this field.

First, identifying and defining Stone Age violence is particularly difficult. A lack of historical sources, fragmented archaeological remains and uncertainties about which circumstances of making contributed to the production of these remnants make warfare a problematic subject to address (Roksandic, 2004; Waller, 2017; Orschiedt, 2020). In addition, ethnography and ethnohistory reveal that certain violent activities in hunter-gatherer societies defy the modern military theoretical concepts researchers are equipped with. In fact, when first analysed from that perspective, these societies were described as lacking the institutions and the logic that a modern society associate with war, i.e., as having not passed the "military horizon" (Turney-High, 1949:21–38). Later, these were also envisioned as beyond the ethnographically known, that which exists beyond the "tribal zone" (Ferguson & Whitehead, 1992). Irrespective of how these societies have been labelled, it is evident that understanding war therein relates to questions of historicity, as well as historical, cultural and societal specificity, i.e., the historical processes and the specific practices behind the emergence of particular weapon points and violent phenomena. The confusion of the historical perspective in studies of non-Western societies is problematic and has been raised by both anthropologists (e.g., Ferguson & Whitehead, 2000, 1992:xii–xvii; Whitehead, 2000) and Stone Age archaeologists (e.g., Roksandic, 2004). The

goal to address the cultural and societal specificity of warfare through the study of actual practice has also been raised by proponents of the "practice approach to war" (Nielsen and Walker, 2009). In fact, a quick review of primarily South American ethnographical material discloses cultural and societal specificity in the deluge of violent inter-human practices that modern military theory would find difficult to describe and define. Anthropological studies of hunter-gatherers and horticulturalists exemplify how much analysis is required to understand indigenous perspectives and knowledge. These perspectives often rely on dynamic ontogenetic processes that include both how humans interact with their environments and the implements they use (Rival, 1996, 2012; Fausto, 2007:507; González-Ruibal et al., 2011; Bechelany, 2019, for a non-Amazonian comparison see e.g., Evans-Pritchard, 1953). By standard scientific classification, although grounded in physical relations, the notions that emerge because of these processes have psychological, physiological or social aspects. Consequently, classification can be rooted in abilities, for example, "patience" and "accuracy" (Rival, 1996), psychophysiological states, such as "hot" and "cold" (Whitehead, 2002:92f) or low-energy weapon effects, for instance sound (Bechelany, 2019:12f). Such processes may also affect the aspects addressed here, the demarcation between hunting and warfare. Hence, activities may be defined by how they are carried out rather than what is killed (e.g., Rival, 1996, 2012; Fausto, 2007). Additionally, taxonomies may not depend on strong human–animal divisions (Rival, 1996; Solfeldt, this volume), non-humans may turn a hunting episode into conflict, by adopting a reciprocal role (Fausto, 2007:500ff.; cf. Kwon, 1998:119) and important targets may be immaterial (Solfeldt, this volume). Consequently, hunter-warrior behaviour and cognition can be related to weapon effects while military theoretical definitions and modern taxonomy may be a hindrance if the goal of a conflict archaeological research project is to understand the original social world through a fragmented archaeological material (cf. Roksandic, 2004; Waller, 2017; Orschiedt, 2020). Identifying and defining violence, conflict and warfare in Stone Age hunter-gatherer societies hence requires a readiness to relinquish familiar concepts from military theory, i.e., a readiness go beneath the *military horizon*.

Second, the study of weapon point functionality is a separate archaeological sub-field with a particular research history and distinct problems. In effect, identifying the role of weapon points in conflict or warfare relates to the broader challenge of identifying the functional aspects and possibilities of a weapon point and what weapon point morphological variation means from a functional perspective (cf. Iovita & Sano, 2016; Shott, 2020). From a conflict perspective, the functional aspects and specific properties of a weapon point are important since it is through the actual use of the point (i.e., its position in interactions) that acts can be linked to practices in a specific society. In absence of detailed evidence from use-wear, organic residues or find context, the properties of the weapon point, especially its material and its form, are what remain as sources for knowledge. Unlike a double-edged sword, a shield or a morning star, a weapon point cannot unambiguously be regarded as intended for human targets, i.e., for combat use (cf. Chapman, 1999). Instead, weapon points from hunter-gatherer societies can be assumed to be multifunctional (cf. Greaves, 1997) or, at the very least, be crafted based on diverse experiences. As such, they also provide valuable insights into hunting and subsistence strategies (e.g., studies in Peterkin et al., 1993; Knecht, 1997). Developing the analysis beyond ambiguous categories, i.e., identifying specialized war point types or differentiating aspects of war from hunting in weapon points remains a daunting task (cf. Choyke and Bartosiewicz, 2004; Darmangeat, 2019; Lundström, 2019b). Researchers have addressed the issue of war point specialization by using ethnohistorical or historical weapon point form analogies (e.g., Lowrey, 1999; Loendorf et al., 2015; Iversen, 2016) and levels of point standardization (Brill, 2014) as hypotheses. However, such approaches require material to test hypotheses against. Confidently interpreting the possible functions of archaeological point types is very difficult since there are no known universal war or hunting point types made from stone or organic material (Ellis, 1997; Nelson, 1997; Lundström, 2019b). There are ethnographical and historical indications (Ellis, 1997) that a war and hunting point type scheme is more common than other form taxonomies. However, due to representativity issues, especially an underrepresentation of some point types in

the ethnographical material, the link between weapon point form variation and functionality has remained a largely unexplored topic (Shott, 2020:250f). It is unclear how different types of targets and activities affect the properties of a weapon and how those activities are perceived, performed and judged in relation to the properties of the weapon.

From a conflict perspective, the challenge of Stone Age weapon point archaeology is: If both Stone Age hunter violence and object classes are a priori indeterminate, how can warfare and conflict – concepts that require historicity, knowledge of actual practice and social relations, i.e., "other programmes of violence" (Armit et al., 2006) be approached through quantitative studies of weapon point properties? The thesis of this paper is that by turning to the "ecological scale", the epistemology and ontology that Ecological Psychology and Dynamic Systems Theory (EP DST) entails, such a project is conceivable. By using EP DST approaches to build models for weapon point research, the paper will reveal that prehistoric hunting, warfare and conflict may be illuminated through the exploratory and empirical research that quantitative studies offer and less related to preconceived classes of weapon points and violence.

The benefits of such an approach will be demonstrated in three steps. First, some basic concepts used by proponents of ecological approaches will be introduced and related to point property measurement techniques. Second, experimental approaches of EP DST to organism(human)-weapon-point-environment interaction is presented as potential principles for experimental archaeology. Finally, the example of the Northern Eurasian inset point will be used to concretize the argumentation.

Ecological Psychology and Dynamic Systems Theory (EP DST)

A quantitative study of weapon points properties in relation to unknown culturally specific concepts of violence and war requires consideration of physical, biological, physiological, psychological and sociological aspects. Furthermore, it is necessary to also address coordination between humans and their surroundings. Preferably, a suit-

able theoretical approach would combine as many of these prerequisites as possible. A framework that considers these criteria is *Ecological Psychology and (Complex) Dynamic Systems Theory* (EP DST). As implied by the name of the approach, EP DST has largely developed through operationalising the ecological psychology of James J. and Eleanor Gibson (Gibson, 1979). Since behavioural organisation is not regarded as centrally controlled in ecological psychology, the behavioural stability and regularity of an organism has come to be viewed as originating from the *dynamism* of the agent-environment system (cf. Warren, 2006). Hence, a general quality of EP DST research is that it is directed towards how behavioural patterns emerge from relational processes, specifically the dynamic coordination between organisms and their environments (Richardson et al., 2008; Chemero, 2009; Lobo et al., 2018; Turvey, 2018). The approaches entail studying the *informational connection* between organism and environment. Besides applying models from other disciplines, such as physics, the direction of this kind of research has involved an approach that integrates ecological psychology with ideas and models from other theoretical frameworks, such as anticipatory systems theory (Latash & Turvey, 1996; Turvey, 2018:16ff., 38ff., 408–418), robotics (Chemero, 2009: 17–44) and enactivism (e.g., Chemero, 2009:183–205; Baggs and Chemero, 2021). Above all, and as implied, modelling and quantitatively studying behaviour in the dynamic way, ecological psychologist envision has required a thorough integration of that theoretical frame with (complex) and dynamic systems theory. Subsequently, it is primarily through that avenue experimental researchers have quantitatively demonstrated emergent, lawful patterns between organism, task and environment (Haken et al., 1985; Kelso, 1994; Kugler et al., 1980; Kugler & Turvey, 1987; cf. Richardson et al., 2014; Warren, 2006). From a physics perspective EP DST is a research tradition that has come to develop "an ontology motivated by nature's *ecological scale*" (Turvey, 2018:341; cf. Smith, 1996; Richardson et al., 2008:167) rather than one motivated by atomic or cosmic scales (cf. Gibson, 1979:4ff.; Baggs & Chemero, 2021). Evidently, the ecological scale is the appropriate level of analysis for both weapon points and the organisms that use them and are targeted by them.

Given the influence of ecological psychology on archaeological and anthropological theory (e.g., Ingold, 2000, 2007; Knappett, 2004; Olsen, 2010; Young-Wolfe, 2015; Jung, 2020) perspectives similar to those found in EP DST have been attractive to archaeology. Furthermore, since EP DST physics is relational and relies on dynamic systems theory, it shares important aspects with relational archaeological schools of thought and those that rely on other dynamic systems theory philosophy (e.g., works inspired by DeLanda, 2016). Indeed, works by EP DST authors have been referenced by archaeologists and anthropologists. Particular EP DST concepts connected to dynamic touch (Turvey, 1996; Turvey & Carello, 2011) have been used in lithic studies with psychological approaches (Fedato et al., 2020; Silva-Gago et al., 2022) and in psychological archaeological studies (Wilson et al., 2016b) and archaeological artefact commentary (Wagman, 2002) by ecological psychologists. Also, embodied approaches to cognitive evolutionary archaeology sometimes reference EP DST scholars (e.g., Garofoli, 2019). However, the specific quality of EP DST approaches, namely the observation and quantification of information detection in organism-environment systems, in particular goal-oriented activities, could be further exploited in archaeology. I will try to demonstrate the benefits of an EP DST approach to illuminate the possible relation between weapon points and violence. This approach is advantageous since:

1. It offers a coherent quantitative approach to investigate weapon point property variation, covariation, hypothetical functional roles and emergent phenomena in human-weapon-point-environmental interaction.
2. It includes a research program for quantitative experiments with tools and sporting equipment that can offer guiding principles for weapon point experimental archaeology.

Relational Property Measurements

To demonstrate how organisms and environments affect the properties of an object, a chemical warfare agent (CWA) analogy will be presented as an example. Thereafter, an EP DST perspective to object pro-

perties that corroborates the analogy will be introduced. The example can be compared to and contrasted with the perspectives and analogies in De Landa (2016:68–74).

Historian Edmund Russell's *War and Nature. Fighting Humans and Insects with Chemicals from World War I to Silent Spring* (2001) traces the mid-20th century development of chemical warfare agents and insecticides. In the text, chemical agent properties are described in relation to their historical role. During World War I, industrially manufactured, aerially dispersed chemicals were used widely on the battlefield for the first time (Spiers, 2010:27). Their use prompted an arms race, a search for suitable chemical agents and methods of dispersal that continued throughout the 20th century. Russell (2001) outlines how the search for technological solutions to the challenges of chemical warfare developed in harmony with technical answers to pest control problems. Above all, chemical warfare agent research benefitted from entomology and physiological tests on insects (e.g., Russell, 2001:136, 180, 193). In his analysis, a largely non-lethal laboratory obscurity, chloropicrin, proved successful both on the battlefield and as a fumigant (2001:49, 81), the most lethal nerve agents were developed and synthesized as part of insecticide research (2001:87, 199), CWA and insecticide dispersal systems were interchangeable (2001:154, 167, 176ff.) and an insecticide (DDT), arguably played a more important strategical role than any CWAs in 20th century warfare (2001:233).

Hence, in Russel's text (2001), types are commonly produced and used in one activity, only to be transferred to another and delivery systems are often interchangeable. CWA properties depend on the size and anatomy of the organisms, as well as local and global environmental parameters such as wind, humidity and air-pressure. The deadliness of organophosphates made them undesirable as insectcides since uncontrolled dispersion, especially in confined environments, made the risks to humans too high. Instead, these were considered appropriate for chemical warfare. However, chloropicrin worked well both as CWA and fumigant but for different reasons. It was primarily not the physiological effects on humans that made it an agent of choice during World War I but its ability to penetrate gas masks and cause

vomiting. DDT, on the other hand, was important for success in specific environments where insects were bearers of certain diseases. A CWA analogy to weapon points is suitable as introduction to EP DST perspectives. In that case, organisms and environments are explicit components of the analysis and all properties and measurements are relational. Properties not only specifically guide functional roles, they also explicitly depend on, for example, organismal scale, local environmental conditions, such as wind and humidity, as well as global forces like gravity. Bellow follows how such a perspective is outlined and motivated among EP DST researchers.

From the perspective of EP DST, measurable properties of a thing are impredicative (Turvey, 2018; cf. Rosen, 2012:429–436) and non-linear (Richardson et al., 2008:256f), i.e., they are defined by the entirety of the organism-environment interactions. The impredicativity of a thing can be explained using quantum mechanics as analogy (Turvey, 2018:54; cf. Gomatam, 1999; Barad, 2007:140). Accordingly, a thing does not have a pre-existing state (i.e., qualities outside of a system) and if one intends to measure its qualities the measurement becomes part of that system. This stance is common sense when applied to an action-focused description of reality: a property of an object only exists in relation to an instrument of measurement. Specifically, when a single property is revealed by a measurement, a particular relation must exist between the components involved. Despite appearing ominously relativistic, properties that manifest through these relations are not illusory but lawful (Turvey, 2018:338). In classical scientific experiments, certain properties may appear constant because these are not expressed or actualised in the specific experience of a living organism. Instead, properties are isolated and represented as attributes or predicates, for example, mass and experiments are designed to test how such metrics affect linear causal chains (Turvey 2018:70ff.). That requires both a hypothesis and that the predicates remain predicates throughout the experiments, i.e., all other variables are controlled (cf. Turvey 2018:34). From an EP DST perspective, such weapon point property data lacks a relation to the relevant spatiotemporal configuration, the dynamic environment that produced the archaeological context. A weapon point, although in

isolation hard-assembled, is created to be part of a softly assembled system, like a human or a group of humans. In such a system, these can have surprisingly non-deterministic roles and be flexibly adapted to the circumstances of the complex and dynamic environment in which they are used. In EP DST approaches, recurring patterns, relevant to the original social environment may be revealed through dynamic, nonlinear models (Richardson et al., 2014). That there are underlying patterns in samples of weapon points is for example reflected in size clusters that indicate a relation between specimen clusters and a type of delivery system (e.g., Christenson, 1986; Hughes, 1998; Riede, 2009; Lombard, 2021). Preferably, what is revealed by such an approach is the original intrinsic measurement system, i.e., a physically proper match between delivery system and point that was perceived as appropriate by the original society. The property variation of a sample of archaeological weapon points can be mathematically modelled to suggest the behavioural organisation of the hunting and combat guided system the weapon points were parts of (cf. Richardson et al., 2014:258ff.). To reveal such properties in a dataset of points would involve testing the object's properties in relation to many different variables. Here, archaeological knowledge could be combined with available anatomical and environmental data, such as skin density and temperature, to replicate or simulate how variables covary or vary. Given that the environment is perceived directly, the perceptual variables archaeological replicas reveal in relation to simulated data would also have been like the ones perceived by the original wielders (cf. Gibson, 1979:126). EP DST studies can already demonstrate which intrinsic measurement systems are relevant in particular human–object relations, for example, how a combination of mass and form, rather than mass in isolation is what humans detect (Gibson, 1966:127ff; Amazeen & Turvey, 1996; Wagman et al., 2016) and how the suitability of certain archaeological objects can be evaluated from an EP DST perspective (Wilson et al., 2016b).

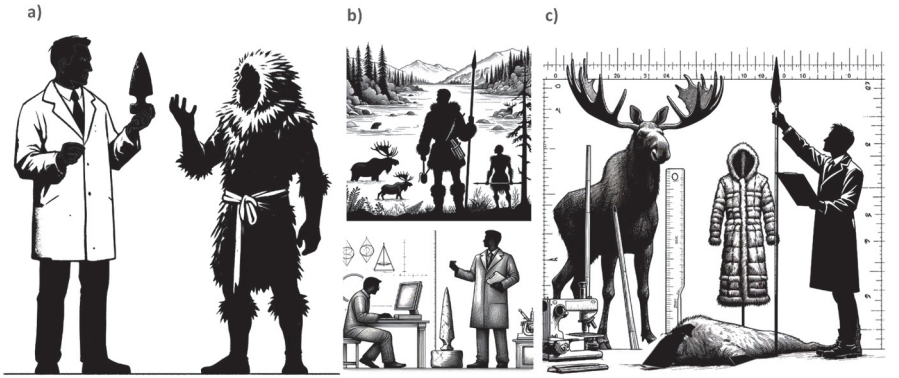


Figure 1: a) The properties of the isolated point are unknown to both researcher and original wielder *a priori* "measurement". b) properties are manifested to researcher and original wielders through different types of "measurements". c) the information the original wielder "measured" is approached by the researcher. AI images generated by Microsoft Designer.

A consequence of adopting the ecological scale, is that the researcher is put on equal footing with the warrior/hunter/maker, in relation to the isolated artefact (Figure 1). Like us, the original wielder of the weapon point did not *know* the properties of the isolated point. Rather, the wielder was aware of, could predict or identify point properties that manifested through interactions with environmental phenomena when accomplishing specific goals (cf. Gibson, 1966:273ff.). In a general sense, the original wielder "measured" impredicative weapon point properties that emerged in complex and dynamic environments and could develop them accordingly (cf. Barad, 2003). Consequently, EP DST approaches, offer ways through which the information the original wielder detected can begin to be revealed to the researcher.

EP DST Approaches as Principles for Experimental Archaeology

The most important benefit of approaching weapon points and violence from an EP DST perspective is that it includes the organism, the human body, as a frame of reference (Gibson, 1979:68; cf. Warren, 1984; Fajen et al., 2011). The anatomy and physiology of the humans who originally interacted with the weapon points, shared basic quali-

ties with us. Thus, the human body has often been used as a point of departure for interpretation in archaeology (e.g., Hamilakis et al., 2002; Malafouris, 2004; Van Dyke, 2015; Jones, 2020). From, the perspective of modern military technology, for example, the CWA case above, the Stone Age world also fundamentally differed in such an embodied respect. Disregarding mere morphological dissimilarities, traditional hunting technology is produced in proximity to usage (e.g., Wiessner, 1983; González-Ruibal et al., 2011) and its handling requires biomechanical proficiency. Even though there are societies with stone and organic technology that rely on specialist or semi-specialists for the creation of objects (e.g., Apel, 2000), most societies with this kind of egalitarian access to raw materials, especially hunter-gatherer societies, do not. Hence, the form of most archaeological stone and organic weapon points are much more directly related to usage and the capacities of those who used them, there is a craft-activity (cf. Elliott, 2019) and body performance-weapon proximity, i.e., the relation entails a very different ontogenetic process. These issues can be addressed by experimental archaeology adopting principles that guide EP DST experiments.

By implementing EP DST methods, approaches and principles, experimental archaeology could introduce a new type of quantitative information: emergent patterns in human-(object)-environment-(task) relations. Here, teleology (task goals) constrains the experimental process rather than variable control, a design that should be understood against the background of how Gibsonian ideas have developed into an experimental program. As an adherent of what has been defined as American naturalism (Chemero, 2009:21), Gibson rejected the key premise of cognitivism, the idea of environmental objects being mediated, mentally represented and processed by sensory organs, the brain or other parts of the nervous system before being perceived. Instead, Gibson conceived perception as unmediated and direct. Hence, it is the structure of the environment, in relation to the properties, goals and needs of the organism that is at the core of perception, the revelation of possible avenues of action, i.e., affordances (Gibson, 1966:285, 1979:119–135). That re-orientation of natural meaning/*affordance*, from a secondary quality to an ontologi-

cal entity has had consequences for which other entities can be considered objects of inquiry and has impacted studies both within and without of the ecological psychological tradition (cf Chong & Proctor, 2020). The ways in which the affordance concept can be operationalized (e.g., Cutting, 1982; Chemero & Turvey 2007; cf. Shaw et al., 2018) and practically applied (e.g., Chow et al., 2021) alludes to the new perspectives and methods this conceptual re-orientation brings about. This includes perspectives and methods that pertain to object studies as well. Due to perception being direct, they only way things can be perceived as they are is if information or energy patterns are *specific* (Gibson, 1966:186–286; 1979:39–135; Shaw, 1979; Michaels and Carello, 1981; Turvey et al., 1981; Turvey, 2018) to the source and as a consequence grounded in lawful relations (Turvey, 2013, 2018:30; cf. Millikan, 2000:217–237). By combining that perspective with physics, especially thermodynamics and dynamics systems theory, works by EP DST researchers have demonstrated that information in the physical form of lawful energy patterns can be used to explain organismal adjustment (Haken et al., 1985; Kugler & Turvey, 1987:64–105; Kelso, 1994). Hence, EP DST researchers have developed experimental principles that quantitatively reveal how organisms as humans are affected by environmental properties such as objects. These quantitative studies have already been applied to experiments that are analogous to projectile/weapon point archaeology. In fact, emergent patterns in organism-object relationships are studied, constitutes an entire research program within EP DST. Experimental objects include pendulums (Kugler and Turvey, 1987), rods (Turvey & Carello, 2011), balls (e.g., Wilson et al., 2016a; Nordbeck et al., 2019) bows and archery targets (Lee et al., 2012). Furthermore, not only is physical behavioural organisation studied in ecological psychology, phenomena that may be described as psychophysiological – such as the effect of physiological reinforcements (e.g., Turvey, 2018:21ff.) – functional goals affecting behaviour and perception (Turvey et al., 1999; Lee et al, 2012; Zhu et al., 2013) and physiological states (Lee et al., 2017) are explored by examining lawful organism-(object)-environment-(task) relations.

In relation to an archaeological artefact, the EP DST approaches therefore entails a theoretical possibility that emergent patterns in a

weapon point interaction has a quantitative relationship to ontogenetic processes, abilities, low-energy effects and psychophysiological states. The logical outcome of the EP DST approaches is an experimental archaeology where projectile experiments include not only the weapons and targets as independent variables, but also the experimental human subjects (cf. Apel, 2006; Silva-Gago et al., 2022) and other non-conventional variables, for example, weather, sleep, dreams, physical status, time constraints and size relations between experimental subjects and physical objects. Furthermore, not only do EP DST inspired experiments offer a quantitative, embodied alternative to cognitive archaeological experiments, the EP DST principles could be reversed in the archaeological experiments. By varying organism-weapon point-environment configurations and directing the human subject with task constraints or towards a "desired future" (Bernstein, 1966, 1961; cf. Latash, 2015), experiments could reveal how objects are affected by the participants psychophysical properties, social relations and relation to other environmental parameters. Even though such a program is difficult to realise, it demonstrates the potential of the ecological scale. It is an approach that potentially can generate material that pertains to both physical and "less-physical", subtler weapon point properties. Through a program, where natural and cultural meaning is viewed as a continuum (cf. archaeological theory inspired by American pragmatism, see Baron, 2021, for a review, and Tsoraki et al., 2020, for a case relevant to this study), weapon point studies could contribute to an understanding of what constitutes the underlying social relations behind conflict and hunting practices in a chosen context.

Case: The Northern Eurasian Inset Point

An example where an EP DST approach may be adopted concerns the Northern Eurasian inset point, remains of which were found in both the Barum and the Stora Bjers burials discussed in the introduction. Inset points, for example, slotted bone points (Figure 2), were composite weapon points used from the late Paleolithic (c. 11000 cal BP) until the Late Mesolithic (c. 7400 cal BP) (Manninen et al., 2021).



Figure 2: A stray find of a slotted bone point from Vellinge (Scania, Sweden) with some flint micro blades still attached. Swedish History Museum find 362392. Source: Eriksson, Thomas, Historiska museet/SHM (CC-BY 4.0). Edited by the author for the publication.

A brief overview of inset point literature reveals that to understand these as violent phenomena their other social roles cannot be ingnored and that the ecological scale is already an implicit way of addressing multiple roles of the points. An illustrative example is a study by Elston and Brantingham (2008) who have utilized Knecht's organic point experiments (1993, 1997) and Ellis' meta-ethnographical weapon point study (1997) to compare inset points with organic and stone points. In Elston and Brantingham's comparison, organic and stone point performance characteristics and situational use are listed. The lists contain descriptions that relate to impredicative properties since performance characteristics are "self-referenced", i.e., related to, for instance, weather, temperature, targets, other equipment, as well as specific multifactorial arrangements. Elston and Brantingham suggest that inset points were made to combine the best properties of organic and stone points in exchange for a time-consuming and skill demanding crafting process. According to them, inset points were preferred for tasks in specific situations where the costs of failure were high, for example, "when the prey is a key resource" or "when… a dangerous animal or human enemy [is] to be engaged at close quarters" (Elston and Brantingham, 2008:105). From that perspective, the ability of the inset points to penetrate and endure organic material and to damage tissue would have been suitable against dangerous and important animals, as well as the Stora Bjers man and Barum woman, if they were perceived as dangerous enemies or part of such a group. However, such a conclusion is obviously an oversimplification, a consequence of not considering other situational variables. In fact, it prematurely makes impredicative qualities predicates, i.e., situational results become universals. In this example, relatively high tissue penetration depth and more severe tissue displacement effects become "lethal" and better material strength becomes "durable". It also reflects the limitations of a weapon point analysis based on a binary classification, organic stone. Here, more detailed analyses could enable studies that look at minute property variation without making assumptions. Even with little prior knowledge of artefact usage, different object structures can be analysed and modelled with separate data analysis procedures and classification schemes. Distribution patterns revealed by these

analyses could reflect parameters that originally were perceived as important. For the shape of a weapon point, that could, for example, be shaft size or shape, raw material structure or the conventions of a craft tradition (Lundström et al., 2023).

A few studies explore the implications of property variation in composite/inset points. One is Pétillon et al.'s (2011) pilot experiments with Magdalenian antler tips. These experiments indicate how several parameters affect functional variation, for example, cutting-edge length/bladelet numbers effect penetration depth, head bladelet shape affects penetrative ability and point-shaft form compatibility affects durability. In Pétillon et al. (2011) antler composite tips were mounted on dart shafts with a specific diameter and thrown with a spear-thrower at a deer carcass. Changing, for example, point raw materials from antler to bone, flint to quartz, shaft wood species, delivery system and targets to accommodate a Mesolithic setting, where properties would work equally effective, would require point shape and size adjustment. For example, if the wielder used a bow (as likely in the Mesolithic case) and if humans such as the Stora Bjers man and the Barum woman were common targets, points would have been either specifically adjusted or epiphenomenally suitable to support actions in such environments. The suitability of a weapon system for such actions can be assessed through static attributes such as size, shape, or performance characteristics within a dataset of representative weapon points. However, the form of a weapon point would also have been shaped by various external factors, including raw materials, craftsmanship, and contextual circumstances beyond the specific environment under study. For instance, while an arrowhead may have been designed for warfare, the experience of bow hunting certain types of prey could influence the conceptualization of a "war type." Conversely, features of a hunting point might reflect adaptations to specific types of armour used in a particular region.

A perspective on slotted bone point variation, where adaption, in combination with historical specificity and path-dependence is presented in Manninen et al. (2021). In the study, 17 new ^{14}C-dates slotted bone points are presented, and their wide spatiotemporal distribution is discussed. The authors conclude that because the history of the

slotted bone points in Northern Eurasia encompassed varied environments, raw materials, technological organisations and cultural traditions, the sample indicates both situational solutions and path dependence. Adopting such an approach to the Stora Bjers and the Barum individuals, the "inter-human violence technology" therein could thus be analysed as both situational and dependent on historical processes. Hence, from a historical perspective, the impredicative properties at the ecological scale could be considered related to both the specific violent events and a wider set of social interactions outside of the specific environment of the buried individuals. These include both an extensive range of hunting episodes and craft processes accommodated to locally available raw materials and traditions. Simulations can reveal actual functional properties that relate to the original intrinsic measurement system at the ecological scale, for instance how well a specific weapon point, in a specific delivery system, at a specific velocity would penetrate a specific target. With modern digital techniques, it is possible to approach such properties in accurate proxies of original weapon points, for example by simulating 3D-modelled specimens in mechanical programs (Lundström, 2019a). If these points are simulated in collisions with sufficiently varied variables (e.g., shafts, velocities and targets), parameters that are specific to a group of artefacts regardless of, for example, variation in size, shape and material could be revealed and modelled mathematically. Furthermore, complimentary data procedures could be used to identify properties that correlate with certain environmental variables, such as those that would replicate targets, including those within interpersonal violence, such as human tissue or armour.

Weapon points rarely indicate behavioural patterns that emerge from more complex social relations. Recently, however, Jonuks et al. (2023) analysed a mimicry of an Early Mesolithic slotted bone point from Pärnu river, Estonia. The point lacked lithic insets, instead, these were carved out directly from the long bone and the object was in part covered in a red ochre/coniferous resin. The point also had a tip fracture characteristic of projectile use. Therefore, the authors conclude that the mimicked slotted bone point was used practically, while simultaneously being a bearer of extra meaning.

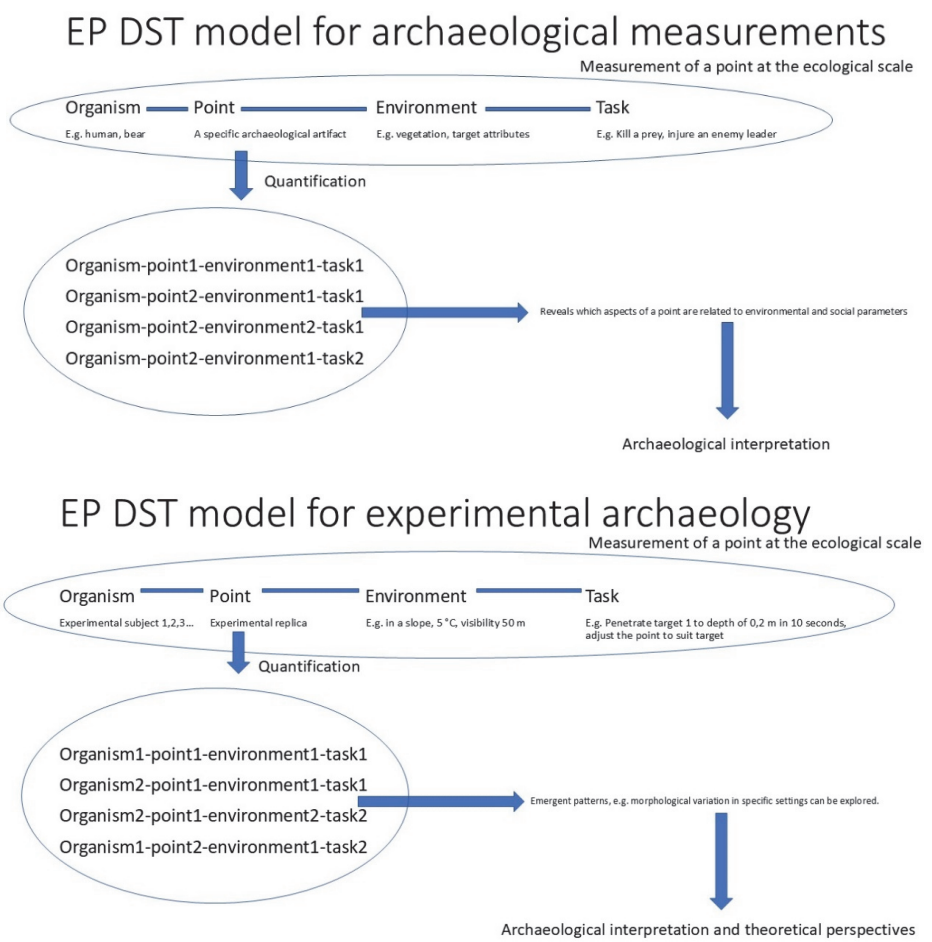


Figure 3: Archaeological models of weapon point measurements at the ecological scale. In these analyses, social relations are inserted through assigning environmental parameters and tasks, including those that may be related to conflict, for example, armour, palisades, non-lethal combat. The measurements can be done exclusively on archaeological data (a) or on data from archaeological experiments (b). The archaeological analyses can contribute information that relates to actual artefacts, while the experimental analyses can explore emergent patterns that relate to very specific organism-environment systems.

Without knowing the ontologies of these Early Mesolithic societies, it is difficult to appreciate how these mimicries and the slotted bone

points from Stora Bjers and Barum were understood or appreciate all other social relationships that affected their form. Although a daunting task to explore, the ecological scale and EP DST offer a way to approach such objects through the "less-material", for example, psychophysiological patterns, via a theory that establishes a continuum to the physical, a continuum between the "cultural", "social" and "natural". By designing archaeological experiments in line with EP DST studies – specifically, by testing replicated weapon points with diverse human participants, environments, and task constraints – emergent behavioural patterns in human-weapon point-environment-task interactions can be explored. For example, researchers could examine whether a group of participants shows a tendency to craft points using a smaller or wider range of materials and colours when exposed to new environmental parameters or task constraints. Additionally, they could investigate how recorded sleep and dream patterns influence the execution of specific tasks involving particular objects. The behavioural patterns revealed through these analyses would open new interpretative possibilities for weapon point and conflict studies.

Conclusion

The functional role of a weapon point is important if warfare is to be viewed as a social or cultural phenomenon, given that it is through the practical role of the weapon point that it relates to both violence and other types of interaction. However, categorizing archaeological artefacts – and here specifically Mesolithic weapon points as warfare-related – is difficult since these could also have been used in other types of activities, especially violent activities that cannot be classified as war. Even with the advent of multiple precise measuring techniques and analytical protocols, there are no methods to relate the form and material of a particular point to a specific activity.

The study outlines the way Ecological Psychology and Dynamic Systems Theory has the potential to re-invigorate or re-socialize these long since silent weapon points (Figure 3). The approach quantitatively exploits that properties of a weapon point in both hunting and conflict depend on environmental and organismal relations, i.e., properties and

emergent behavioural patterns can be related to specific human-weapon point-environment-task configurations. By extension, experimental archaeology can be designed with these principles. Such experiments would reveal what societal influences, psychophysiological states, experiences and anatomies and other environmental parameters could be related to a small hard-assembled component. The importance of such functional relations can be illuminated by the inset point remains that are associated with two Mesolithic persons who were possible victims of conflict, the Stora Bjers man and the Barum woman. Inset point research already reveal the importance of functional properties and environmental factors for such studies, but the role(s) of weapon points – and cases like Barum and Stora Bjers – could also be addressed by extending that work with EP DST approaches.

In general, Stone Age societies are also uniquely suitable objects of study for such an approach. In such societies, the locus between organism, environment, weapon and craft is particularly direct and dynamic since craft-usage and body performance-object proximity transcends generations and societal boundaries. Hence, studying and replicating the conditions of these kinds of societies could provide information about the ways in which humans relate to weapon technology that other studies cannot. Therein lies the well of information, the deep exploration space that Stone Age technology could bestow students of war.

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