Sensible dress: the sight, sound, smell and touch of Late Ertebølle, Mesolithic cloth-types.

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This is the final text before it was proof read, formatted and published in the Cambridge Archaeological Journal. The following reference should be used when quoting from this article: "Harris, S. 2014. Sensible Dress: the Sight, Sound, Smell and Touch of Late Ertebølle Mesolithic Cloth Types. *Cambridge Archaeological Journal*, 24, (1) 37-56."

The final publication is available at: DOI: http://dx.doi.org/10.1017/S0959774314000031

Abstract

The aim of this paper is to investigate the sight, sound, smell and touch of different cloth-types in the Late Ertebølle of southern Scandinavia and to argue that such an approach provides stimulating new insights into an area of material culture that has previously been studied by archaeologists in a highly empirical manner. The archaeological evidence drawn together in this paper points to this as a time when furs and skin products were of prime importance and plant fibres were the basis for knotted nets, looped cloth and basketry. In the archaeological literature these cloth-types are usually treated separately and described according to the species of raw materials, such as pine marten fur, or the technology of their production, such as couched button hole stitch. Using an experiment where participants are asked to handle modern cloth-types and answer structured questionnaires, it is possible to create a sensory description of these cloth-types. These descriptive results are then used to reconsider aspects of cloth and clothing in the Late Ertebølle of southern Scandinavia. By moving from the standard technological description to a sensory description, the Mesolithic cloth types investigated in this paper are placed within a sensory and phenomenological theoretical framework. The presentation of these results seeks to provide a new description of these materials and allow archaeologists to revaluate the culturally embedded nature of cloth and clothing at that time.

Introduction

Due to the poor preservation of organic materials, knowledge of Mesolithic cloth and clothing is scarce. Yet pockets of evidence exist and have been successfully incorporated into the general literature. In term of cloth, these envisage a time when furs and skin products were of prime importance but also recognize the role of plant fibre as the basis for looping, twine, basketry and possibly clothing (for example: Bender Jørgensen 1990,2; Mithen 2003,153,185; Spikins 2002, 63-81). Beside the difficult nature of the evidence another factor that makes Mesolithic cloth remote is that the technological descriptions of materials which are reported in the archaeological literature are alien to the present day reader. What type of material, for example, is couched button hole stitch? What is fox fur or pine marten fur actually like? What is tree bast fibre, and what is it like when made into cloth? While this may seem a minor issue in the grand scheme of archaeological thought, owing more to imaginative reconstructions than scientific rigour, recent research has pointed to the importance of the senses as a means to know materials, relevant both to the role of those materials in the past and in our understanding of that past in the present (Edwards et al. 2006; Hurcombe 2007). Perhaps more than this, by refocusing on the sensory perception of materials, in this case cloth, it is possible to gain not only a fresh understanding of the complexity of different cloth-types used in the past, but also question their culturally

embedded nature both in the past and in the present day interpretation of those materials by archaeologists. Certainly the sensory perception, or sensibility, of materials is nowhere more relevant than when investigating those materials that are used to wrap and clothe the human body.

Outside archaeology the sensibility of cloth is taken seriously. The contemporary textile industry has standardized tests to investigate factors such as the "tickle and prickle" of cloth (Saville 1999,232-233) or the lustre of cloth surfaces (Hadjianfar & Semnani 2010). Contemporary textile designers are well aware that sensory perception is essential in the way values and emotions are attached to cloth, and that such responses or preferences may shift and change throughout a lifetime and according to context (Bonapace 2001, DeLong et al 2012). For along with more traditional factors such as style, it is through the sight, sound, smell and feel of this cloth that individuals and groups select and appropriate cloth for clothing and through this communicate aspects of themselves (for example: Becker 2007,72-82;Eicher 1995,1;Welters 2007). As current designers and researchers recognize these factors as significant when developing products, so too may some of this be true in the past. The aim of this paper, therefore, is to investigate the sensory properties of the Mesolithic cloth-types that could have been used for clothing in the Late Ertebølle of southern Scandinavia and to use this perspective to provide a new understanding of these materials and their social context in the past.

In the first part of the paper I break with the archaeological tradition of separating animal skin products from textiles and write about cloth types, including those made from interwoven plant fibres and those made from animal skins products. While this is a small shift in focus, it is based on a deeper philosophical stance on materials, whereby materials are drawn together through shared properties, qualities or use, rather than separated according to source or technology of production. The method of investigating the sensory properties of cloth developed in the second part of the paper then enhances how we understand the relationship between these cloth types, by considering how they are experienced as products, rather than the processes of construction or acquisition. The problem frequently raised within such a sensory approach is that archaeologists cannot claim to understand the unique character of past human experience, as the subjects are not available to answer for themselves; instead such experiments rely on the response of people today and may well be anachronistic (see Brück 2005,45-51,57-9). While acknowledging these shortcomings, the authors view is that a technological description of artefacts can be equally abstract and situational. These issues will be addressed further in the method and discussion. Foremost, this paper is an attempt to take an area of research (mesolithic cloth) which suffers from poor preservation and gain new insights through combining two different research methods: bringing together all cloth types then investigating these according to a sensory criteria. Hopefully at the very least the methods employed in this paper provide a series of descriptions that expands on the current technological classification of separate material groups. At best, it is hoped that the results provide a basis to debate the type and role of cloth and clothing in the past as coexisting materials that would have been understood in relation to one another and the wider society.

As there is no preserved clothing in the Mesolithic, only fragments of cloth, an indirect focus on clothing through cloth is essential and suited to a sensory analysis. It is relevant here to draw the distinction between cloth and clothing. Cloth is the fabric used to make clothing, clothing describes the garments cut from cloth, while costume (or dress) is the combination of clothing, ornaments and dress fittings (Sørensen 1997,96). Cloth is sometimes technically defined to refer only to textiles. However this use is inappropriate when considering the cloth

used for clothing as textiles are not the only source material. Hence I consider cloth-types more broadly to include all those flexible, thin sheets of material that can be wrapped, shaped and folded and used to cover, cloth and contain (Harris 2008b,225-226, Harris 2010). This brings together textiles, furs and skin products due to their shared material properties. As it is generally held that animal skins of this early date would have been cured rather than tanned, they cannot be described as true leather (definition of terms: Thomson 2006,1; Van Driel-Murray, 2000,299; curing process: Groenman-van Waateringe 1995, 67-8; Groenman-van Waateringe *et al.* 1999,885; Harris 2011,57). In this paper the Mesolithic material will be referred to by the general term fur and skin products while only the modern vegetable tanned product will be referred to as leather. The evaluation of these cloth-types as clothing materials on the basis of the results will be considered in the discussion. The paper is structured by first outlining the archaeological evidence for Late Ertebølle cloth-types and considers several gaps in the evidence. This is followed by a presentation of the method and results of the experiment investigating the sensory properties of these cloth-types based on handling modern cloth samples. Through this approach, it is possible to move from the technical classification of archaeological cloth to a description of them as sensible materials. These descriptive results are then used to critically revaluate the knowledge and interpretation of cloth and clothing in the context of the Late Mesolithic.

Theoretical approach

In archaeology, as in related disciplines, cloth and clothing have been investigated through two major theoretical perspectives; a technological approach to the production of cloth, especially textiles, and garments (for example Gleba & Mannering 2012; Anawalt 1981; Wild 1988; Wild 2003) and a semiotic approach to dress as a system of visual signs and related to identity (for example Barnes and Eicher 1993; Sørensen 1997; Wels-Weyrauch 1989; Wobst 1977). As theoretical approaches these have been effective in archaeology as this information can be investigated from the archaeological evidence. Influenced by broader developments in the humanities, in the last couple of decades archaeologists have started to explore the significance of sensory perception in understanding material culture (Hurcombe 2007), whether this is sight and movement (Tilley 1994) or the combination of sight, smell and sound (Hamilton and Whitehouse 2006a,35-43;Hamilton and Whitehouse 2006b). Cloth used to make clothing is laden with sensory experience, from the feel of cloth, to the sound of certain garments (Welters 2007), to the smell of materials or dyes (Hoskins 1993) or their combined effect (Becker 2007). It is now for archaeologists to find methods to investigate these aspects of cloth and clothing and incorporate them into theories of the past.

Method

To develop a method to describe the sensory properties of cloth I looked towards other methods developed by archaeologists. Hamilton and Whitehouse's research method is relevant as it investigates at the sensory experience of smell and sound as well as sight (Hamilton & Whitehouse 2006a;Hamilton & Whitehouse 2006b). Such approaches are based in Merleau-Ponty's theory of the phenomenological of perception, which is explored as embodied human experience (Merleau-Ponty 1989;Merleau-Ponty 2004;Thomas 2006,48;Tilley 1994). Hamilton and Whitehouse's method uses groups of participants who record perceptions of sound, sight and smell using structured recording sheets, which avoided the problem of relying on the unstructured, descriptive results of an individual. The handling experiment used in this paper was developed based on groups of participants examining cloth samples made or bought because of their similarity to Mesolithic cloth types and answering

structure questions on their feel, sound, smell and appearance. This method has been written up in detail elsewhere (Harris 2008a,84-89) and is outlined below.

Such phenomenological approaches to archaeology have been part of the archaeologist's tool kit for two decades now and from their inception have been both highly stimulating and the cause of heated debate (reviewed in Bruck 2005). The closely related fields of sensory approaches to archaeological materials and the concept of materiality have been similarly controversial (for example Hurcombe 2007, Ingold 2007, Knappett 2007, Tilley 2007). There are two points from these critiques that are relevant here. The first is the way by which this knowledge is produced and its relevance to understanding the past. Here the fundamental problem with phenomenology in archaeology is that in attempting to describe human experience archaeologists rely on the opinion of modern subjects' and hence face the problem that the qualitative knowledge they hope to gain about the past is tainted by the qualitative knowledge of the present. The counter argument is that through these methods we gain an "entry point" into understanding materials worlds of the past and that these worlds can be interpreted in many different ways (see overview in Brück 2005, 46-50). The second point to ask is, to what extent is the sensory aspects of materials are relevant to archaeological study? Taken from a slightly different angle, this problem is most clearly debated in the discussion of material and materiality published in Archaeological Dialogues 2007. Very broadly, Ingold rejects the vague notion of materiality as unhelpful in archaeology and proposes a biographical approach to materials, where properties are transformed throughout their existence through the interplay of substance, medium and surface as situated in their environment (Ingold 2007,13-4). His separation of properties (as measured through engineering tests) from qualities (as gained by a craftsperson through experience) as different bodies of knowledge is a useful in recognising the many layers of understanding of materials (Ingold 2007, 13-4). Tilley is critical of what he sees as a empirically based approaches which lacks the scope to incorporate the social significance of materials. He is a proponent of materiality as a means to emphasises the contextual relationship between people and materials, their meaning, significance, similarities and differences (Tilley 2007,18). As Knappett's comments in the same issue show, there is validity in both positions and they are potentially less opposed than their proponents argue (Knappett 2007, 20-1). The second part of this paper leans towards the latter approach, recognising what could be called qualities as gained through sensory engagement with cloth and provides a means to discuss the relationship between cloth and the people of in the Late Ertebølle.

The experiment presented in the second part of the paper has two parts. In the first part of the handling experiment, individuals answered questions on a single piece of cloth, repeating this until they had each examined several cloth-types. In the section on the visual appearance of cloth there are questions on whether the cloth is visually flat or uneven, shiny or matt, dense or transparent. There is a section to describe the odour and sound of rubbing you hand across the cloth. In the sections on the sense of touch, there are questions as to whether the cloth is soft or rough, cool or warm, stretchy or stiff. In the second part, the same individuals worked in groups to compare the eight cloth samples according to similar criteria and then answered open-ended questions on their personal preferences. The questionnaires are illustrated in Figure 1 and Figure 2. The purpose of part one was to obtain a description of each individual cloth according to sensory criteria. The purpose of part two was to obtain a second set of results, this time considering the sensory aspects of cloth when examined comparatively. The section on preferences in the second part was to explore the culturally embedded perception of sensory experience. In total 29 people participated in the handling experiment, working in five groups. All participants were undergraduate or masters students at the Institute of

Archaeology, UCL and most completed the experiment in their first week at university as part of an introductory course on experimental archaeology. No data was collected on nationality, age and gender, as this was not recognised as important at the beginning of the experiment. As an estimate most were between 19-25 years of age with a number of older students. Although a range of nationalities were represented the students were predominantly European. The resulting description is presented as sensory properties as experienced by the participants. This is not to suggest that this is the same sensory perception that people in the past would have experienced, as this would be naïve and would ignore the criticisms of this approach in general. Rather, it is intended to add information to the standard archaeological conventions of empirical recording by raw material, such as the animal species used to make furs, or the thread diameter and other technical aspects such as weave structure (way the threads are interwoven) or other features measured in a laboratory. Through this method of approaching groups of cloth types according to sensory properties it is possible to move significantly away from the traditional archaeological conventions of technological analysis. This allows a fresh view of the existing evidence.

Figure 1. (See below)

Figure 2. (See below)

Archaeological evidence

Although preserved Mesolithic cloth is scarce, through a careful examination of the archaeological evidence it is possible to gain a glimpse of some of the cloth-types that were used by these late hunter gatherer societies. The following section examines the evidence for different cloth-type materials known or presumed from the archaeological evidence of the Late Ertebølle of southern Scandinavia c. 4700-4000 BC. For the purpose of the argument presented here I find the classification of hunter-gatherer useful as the economic resource from which the Late Ertebølle produced cloth are from non-domestic resources[1].

Cloth from plant resources

Several fragments of preserved cloth (not necessarily clothing) were excavated from the waterlogged deposits of Tybrind Vig, submerged settlement of the Ertebølle culture on western Fyn, Denmark (Andersen 1985,68). They come from the Dyrholmen II phase, or Late Ertebølle culture c. 4200 cal. BC (Andersen 1985,56; Bender Jørgensen 1990,1). They are all made in a technique referred to as button hole stitch in the finds report (Bender Jørgensen 1990,2) which can also be called as simple looping (Emery 1966,31;Seiler-Baldinger 1994,11-12), 53-54) or variations such as needle netting or knotless netting. Nålebinding is a similar looping technique, but differs in that the thread is carried through two or more adjacent loops (Wild 2003,23). As the finds report refers to these as button hole stitch, I will use this term. Several technical variations were identified: couched button hole stitch, couched button hole stitch with an extra turn in the button hole stitch, and button hole

[1] It should be noted that the usefulness or accuracy of the classification of the Late Ertebølle as hunter-gatherers or Mesolithic is debated on the grounds that they used pottery and were potentially in contact or know of Neolithic farmers and farming practices due to the shared boundaries with farmer traditions to the south (Gheorghiu 2009, 10). However, the assumption that pottery production was a farming practice is contested. The pointed based pottery characteristic of the Ertebølle culture in northern Germany and Denmark is believed to originate from the fisher-hunter-gatheres of East Asia, where pottery is known from the tenth millennium BC and hence is it not a part of a Neolithic package (De Roever 2009, 159-160).

stitch with double couching (Bender Jørgensen 1990,2-4 fig. 1. 1,1. 3 &1. 4) (Fig. 3-5.). All refer to a looping technique made with a single element (yarn or thread) (Emery 1966,31). Button hole stitch explains the technique of looping using a continues thread and which was probably stitched with a needle. The twist refers to an additional twist in the stitch which is formed during the looping, while couching refers to the addition of a base thread to each row of stitching. The spun threads of the Tybrind Vig fragments were made of plant fibres which were identified as originating from willow bast (*Salix*), grass (*Gramineae*) and another bast fibre which could be either willow (*Salix*) or poplar (*Populus*) (analysis by Körber-Grohne in Bender Jørgensen 1990,2). These finds and results are very important as they provide an insight into both the species of plant fibre used to make cloth and the weave structure, neither of which can be securely identified without preserved remains. In addition, the preserved couched button hole stitch of Tybrind Vig shows that the inhabitants were able to produce different versions by varying the density and diameter of the thread and adding twists, couching, and double couching(Bender Jørgensen 1990,2). Couched button hole stitch could have been used for items such as bags or clothing, although the evidence is insufficient to point conclusively to this. Bender-Jørgensen describes the variation in quality as ranging from finer examples that could be considered like coarse knitting, and possibly originating from clothing, to the coarser examples that may be compared with a shopping bag and could have been used as carrier nets (1990,2).

Figure 3. (See below)

Figure 4. (See below)

Figure 5. (See below)

It seems unlikely that these scant remains encompass the full range of fibrous, interwoven cloth types present at Tybrind Vig or more widely in the Ertebølle culture. However, without preserved remains it is all but impossible to do more than suggest which other cloth-types could have once been present. Absent from the Tybrind Vig fragments is simple button hole stitch without couching, three fragments of which were found with two skeletons excavated from a peat bog in Bolkilde, the island of Als, Denmark and dated to the Early Neolithic, 3400 cal. BC (Bender Jørgensen 1990,5, fig. 1. 5). Other examples of button hole stitch without couching made from plant fibre, including examples with an extra turn in the button hole stitch are known from the third settlement period of Friesack near Potsdam in northern Germany, which are dated to ca. 7100-6850 BC (Kernchen & Gramsch 1989, 23-25, taf.7.3, abb.1.3 &1.4). Whether such a types of button hole stitch without couching were used at Tybrind Vig or other Late Ertebølle sites remains unknown.

Button hole stitch's close cousin knotted netting, also a needle worked looping technique, is preserved at other Mesolithic sites in Scandinavia including, for example, the knotted net made from willow bast from Antrea, Finland (Äyräpää 1950,6; Burov 1998,61; Oshibkina 1983,126;Zaliznyak 1998,49) currently on display in the National Museum, Helsinki or the knotted nets from the second settlement period of Friesack near Potsdam (Kernchen & Gramsch 1989, 24). These knotted nets seem clearly associated with fishing, not clothing and will not be discussed further. Another cloth that should be considered is produced with a twining technique. Twining can be worked to produce solid basketry or fine cloth more akin to textiles. Only the basketry type of twining is preserved in the southern Scandinavian Late Mesolithic, where twining was used for fish traps, as seen in the fish trap from Nidløse on Zealand, Denmark, assigned to the Ertebølle by Clark (Becker 1941,132-133,fig. 1-2;Clark

1952,44, 229; Zaliznyak 1998,50). There is evidence for twining technique in Palaeolithic hunter-gatherer societies (Soffer et al. 2001,36,tab. 20. 1) and Mesolithic hunters and fishers of Vis 1, in the northern Urals (Burov 1998,55,fig. 6. 1), to the Neolithic communities of the late fifth millennium BC circum-alpine settlements (Médard 2010,71-103) and the Neolithic Vinča occupation at Divostin, Central Serbia (Adovasio and Maslowski 1988,346-350). Whether or not the flexible, cloth variation of twining existed in the Late Ertebølle is questionable. Rast-Eicher argues that only the basketry types of twining are known in the Palaeolithic and Mesolithic, with no evidence for flexible twining that could be used for basketry clothing (Rast-Eicher 2005,118). With so little preserved material this remains a moot point as there is too little evidence to argue convincingly either way. Therefore, although examples of twining technique exist, proving that the broader technique was practiced in the Late Mesolithic of southern Scandinavia, flexible twined cloth that would be suitable for clothing is unsubstantiated in the Late Ertebølle. This is part of a larger problem that it is nearly impossible to ascertain the presence of certain cloth types made from fibres without either preserved remains, impressions in pottery or clearly associated tools of production.

Cloth from skins

Although there are no preserved furs or skin products, archaezoologists have noted features in bone assemblages such as cut marks associated with removing the skin, the deposition and kill patterns that suggest animals were exploited for their skins (Charles 1997; Harris 2011; Pignat and Winiger 1998,59,179,206; Richter 2005; Rowley-Conwy 1994;Trolle-Lassen 1986). Specialist animal killing sites where small fur bearing animals appear to be the target species, together with body part representation patterns associated with processing furs also suggest that this was one of the desired resources (for example Romandini et al 2011,188,192). These types of analysis are most successful in identifying small mammals or species noted for their excellent fur, often referred to as traditional fur animals (Richter 2005,1224). Similar techniques have been used to identify a wider range of fur bearing mammals (Charles 1997,253). At the Late Ertebølle seasonal hunting camp of Ringkloster (Jutland, Denmark) the following fur bearing species have been identified from the bone assemblages: pine marten (*Martes martes*), polecat (*Mustela putorius*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), domestic dog (*Canis familiaris*), lynx (*Lynx lynx*), wild cat (*Felis silvestris*), otter (*Lutra lutra*), badger (*Meles meles*) and beaver (*Castor fiber*) (Richter 2005,1224;Rowley-Conwy 1994, 88,fig. 1). The unusually high proportion of pine marten species and the butchery method of these and other fur bear animals (fox, badger, dog, beaver and bear) at Ringkloster has been used to argue that this was a special purpose procurement site for furs (Rowley-Conwy 1994-95, 88, fig. 1, 98). For example the pine marten skulls have cut marks associated with skinning and are found as fully articulated skeletons, which suggests they were not eaten (Rowley-Conwy 1994,95-96; Anderson 1994). Also at Ringkloster the presence of a high proportion of newborn or foetal red and roe deer remains may suggest that their spotted skins were desirable for clothing (U. Møhl pers. comm. in Rowley-Conwy 1994-95, 94-95).

At the Tybrind Vig habitation site (Fyn, Denmark), many of the same traditional fur species were identified as at Ringkloster, excluding wolf, lynx and beaver (Richter 2005, 1224; Trolle-Lassen 1986). Again, there were cut marks on the mandibles and upper parts of the skulls which are most likely associated with skinning with a flint knife, skull fractures possibly associated with trapping, plus many of the bones lay in clusters of single species, suggesting they were not eaten (Andersen 1985,57-58,fig. 9) (Fig. 6). The animal bones of

the Late Ertebølle hunting site Agernæs (Fyn Denmark) also include a large range of fur bearing animals, including most of the species found at Ringkloster with the exception of badger and beaver, plus it seems that neonatal red deer and roe deer were also hunted for fur (Richter 2005,1224).

Figure 6. (See below)

The resource of fur and skin products need not have been limited to small mammals. The skin of nearly all animals including large and small sea or land mammals, birds and fish can be removed, cured and used as cloth for clothing (Krech III 2005;Oakes and Riewe 1996,38-48;Reed 2005); Williams and Hurcombe 2002). Therefore at Ringkloster, Tybrind Vig, and Agernæs we may also consider that the population had access the skins and furs of red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*), even though these are often considered primarily for meat consumption (for example summarized in Richter 2005,1224)[2]. Indeed the full gamut of mammals, birds and fish should be considered as potential cloth resources, and in this, possibly not only their skin was exploited but maybe also their innards. The value of such materials is evident from the coastal regions of Alaska in historic times. Here coats, notably raincoats, were made from fish skins and the intestine and windpipe of bears or sea mammals such as seal (Reed 2005,48;Wilder 1976,16,94-95). In the Late Ertebølle, specialized hunting of marine animals such as seals may also have been important for fur and skin products (Andersen 1995,98). At Tybrind Vig the skin from hunted or captured animals such as elk (*Alces alces*), aurochs (*Bos primigenus*), swan, duck and cod (summarized in Andersen 1985,57) should not be eliminated from the list of potential cloth resources. At Ringkloster we could add other species identified from the bone assemblage including aurochs (*Bos primigenius*), elk (*Alces alces*), horse (*Equus ferus*), and brown bear (*Ursus arctos*) (Rowley-Conwy 1994,88-89 fig. 1). We cannot be certain that all these resources were exploited for their skins or indeed that skins were used for clothing. Some cloth-types were possibly obtained opportunistically, such as lynx or bear (which have a low occurrence in bone assemblages), while other cloth-types may have been mainstay, such as pine marten (with unusually high occurrence in some bone assemblages). Certain taboos and preferences no doubt existed as to which cloth-types were suitable for cloth and clothing and which were not, factors which cannot be understood from bone assemblages alone.

The handling experiment

Eight cloth samples were chosen for the handling experiment. The aim was to represent genres rather than find exact replicas, indeed to suggest these are exact replicas would be misleading. For example, in the Late Ertebølle (as today) a certain amount of variation between furs and skin products made from animals of the same species should be expected on the basis of health, age, markings and through the skinning and curing process (Kellogg 1984,20-30, 73-4;Thomson 2006). In the same way, plant fibre cloths will vary according to the age of the plant, thread processing method as well as subtle effects of individual works. Four of the eight cloths are furs or skin products and four are from plant fibres. The furs were chosen due to their European origin, species (fox and bear) and availability from a reputed supplier. Red fox and brown bear are known from the Late Ertebølle evidence, but silver fox is a modern colour breed[3] (Figs. 7,8,9). The leather is from a domestic species (Fig. 10). The

[2] I have excluded the use of wild boar (*Sus scrofa*) as pig skin is often difficult to cure due to the high fat content and nature of the hair grown.

[3] Although furs such as pine marten are available to buy on line, they are usually the American pine marten and therefore different from the European pine marten, plus I was uncomfortable buying furs from unknown sources.

furs and leather were all tanned using modern processing techniques. This can produce different finished results, most notably for this experiment in the smell of the leathers and furs as will be noted in the comments below. The cloths from tree bast fibre were produced by the author from water retted lime bast using a hand spinning technique. The couched button hole stitch and the sample with core and twist are made to a similar scale to those from Tybrind Vig (Figs. 11 & 12). The simple button hole stitch and twining belongs to those cloth-types that are not known from the Late Ertebølle evidence are based on artefacts from other European sites in the early fourth or fifth millennium cal. BC (Figs. 13 & 14). As these were included in the original handling experiment they are presented in the results of the experiment, but excluded from the discussion and conclusion.

Figures 7 -14. (See below)

Results part I: sensory description of the cloths

The following descriptions of sensory properties were made through the response to the questions in Part I of the handling experiment (Table 1 & 2) (Fig. 15). The questionnaires with the full range of questions are shown in Figures 1 & 2. The participants marked their answer on scale as to how much a statement was true for the cloth in question. For example, can the cloth be described as: very flexible, flexible, neither flexible or inflexible, inflexible or very inflexible. The answers were then processed to find the most common answer. Positive results were taken for those questions where more than half the participants answered in the same way. For example, where more than half respond that a cloth is very flexible, the answer is taken to describe the cloth as very flexible. Where more than half responded that the cloth was either very flexible or flexible, the cloth is described as flexible to very flexible. Where no clear pattern was found, or the most common answer was "neither" the cloth is described as neutral. The number of participants who examined the individual cloth-types was as follows: red fox skin 11, silver fox skin 7, bear skin 9, leather 8, twining 7, simple button hole stitch 8, couched button hole stitch 8, couched button hole stitch with extra turn 7.

Table 1 & 2 (See below)

Figure 15. (See below)

The furs

The furs (red fox, silver fox, bear) have two distinct sides: the fur side and the flesh side. The fur sides were described as visually uneven or neutral, the bear skin and fox skin were described as very shiny or shiny, whereas the silver fox skin was described by some as shiny, while others described it as neutral. All agreed that the flesh side is flat, matt and very dense. The furs have a weak to strong smell: they are described as earthy, like an animal such as a dog, musky, warm, nice, not a bad smell, like old houses. A few disliked the smell. To the touch, the furs were described as very soft or soft, the fox and bear fur were considered warm to the touch whereas the silver fox was split between those participants who thought it was warm to the touch and those who found it cool. Some participants noted that the texture of the fur varied and probably depended on where it originated from on the animal. The flesh side of the fox skins was described as rough or neutral, and cool to the touch or neither warm nor cool. The texture of the bear skin had a wide range of results from very soft to rough and remains ambiguous. The furs were described as likely to be impervious or very impervious to

air or water, very flexible or flexible. The fox skins were considered stiff, whereas the bear skin is stretchy and thick or very thick. The red fox and bear skin were described as thick, whereas the silver fox skin was thin. The sound of the furs was described as like stroking a dog or brushing your hair, like walking on a carpet, quiet, nearly silent, soft, muffled, a slight rustle, silky or soft, and contrasting slightly with the very slightly scratchy, rustling, sandy sound of the grain side.

Leather & skin products

In common with the fur, skin products have two distinct sides; the grain surface with hair removed and the flesh side. Both surfaces were described as visually flat and very dense or dense. The grain side was described as shiny while the flesh side was matt. It was rated as having weak odour which was described as warm, musky, sweet, like shoes or a leather jacket, like tanning products or simply like leather. In this case the tanning products are modern substances which create a characteristic smell. Alternative methods of curing skins produce their own distinctive smell taking after the substances and processes used to tan them, such as types of fat or smoke. The feel of the grain side was described as soft or neither soft nor rough and cool or neutral. The flesh side was described as very soft or soft, and warm to the touch. The leather was described as very flexible or flexible, thin and most described it as stretchy but a few considered the material stiff. The sound of the cloth was described as soft, smooth almost soundless, a little sandy, soft brushing like a hand over paper, whispering or wind blowing.

The button hole stitch

In all three cases, both sides of the button hole stitch cloths are the same. The visual appearance of the button hole stitch cloths was described as uneven or very uneven. Participants brought to attention the difference between the evenness of the stitches and the overall uneven surface. Visually, they were described as matt, or very matt, occasionally described as neither matt nor shiny (neutral) and certainly transparent. The odour was described as mostly weak, several considered it strong and it was described as woody, grassy, sweet, like hay, silage or sap, straw or wicker, that it smelt sharp, acid, or possibly like cedar wood. The button hole stitch was described as rough or very rough to the touch and some considered it neither warm nor cool to the touch while others considered it cool. They were all considered likely to be very porous or porous to air or water. The couched button hole stitch, or with couched button hole stitch with extra turn was described as flexible and stretchy or stretchy to stiff, whereas the button hole stitch cloths were described as very flexible and in all cases, stretchy. The sound of these cloths was described as rustling, grainy, crackling, crunchy, grating, rustling, like dry grass and scratchy.

Twining

As with the button hole stitch, both sides of the twining are the same. The twining was rated as visually both flat and uneven, and both dense or transparent. These mixed results seem to relate to the varied structure of open twining; participants noted that while the fibres themselves are dense, the structure is slightly transparent. Nearly all considered it matt. It has a weak odour which was described as resinous, sharp, woody or plant-like. There was a split between whether it is rough or soft to the touch and most found it neither warm nor cool to the touch. It was considered likely to be porous to air or water, flexible but stiff and either

thin, or neither thick nor thin. The sound of the cloth was described as scratchy, like sweeping with a brush, dry, rustling and crackling.

Results part II: sensory comparison of the cloths

Five groups compared the eight cloth-types. To do this they were asked to place the cloths in a line according to sensory properties. First they were asked to order the cloths from the lightest to the darkest, then rearrange them from the visually flattest to most uneven surface and then according to the sound the cloth made from the noisiest to the least noisy (Fig. 4.). The order of the cloths was written down and positive results were taken as the two cloths chosen as the lightest, darkest, flattest, most uneven, noisiest, or least noisy cloth etc. In several instances the groups rated several cloths as identical, for example if there was no difference between them in terms of density, they were placed together in the relevant position (Table 3). In the following paragraphs the number of groups rating the cloth in their top two (or identical category) for that property is shown in brackets.

Table 3 (See below)

Visual appearance – sense of sight

From the data collected from the five sets of results, the lightest colour cloth was the silver fox (5/5) and red fox (5/5), while the darkest was the bear skin (5/5) followed by the twining (3/5). The flattest was the leather (5/5) followed by the twining (3/5) and the most uneven by visual appearance was the simple button hole stitch (4/5). All five groups considered the bear skin the most shiny (5/5) followed by the red fox (3/5). The most matt cloth surfaces were those made of tree bast including the simple button hole stitch (4/5), couched button hole stitch with extra turn (4/5). The densest were the furs and skin products; the bear skin (5/5), the red fox (4/5) and the silver fox (3/5). The most transparent cloths were the simple button hole stitch (5/5) and couched button hole stitch with extra turn (5/5).

Odour – sense of smell

The weakest smelling cloths were the twining (3/5) and leather (3/5). The rating of the strongest smelling cloths varied between groups. The red fox (2/5), silver fox (2/5), couched button hole stitch (2/5) and couched button hole stitch with extra turn (2/5) were all rated as the strongest smelling by two groups.

Texture – sense of touch

The smoothest cloth to the touch was rated the red fox (5/5) followed by the silver fox (3/5) while two groups rated the grain surface of the leather as smoothest (2/5). All five groups rated the simple button hole stitch (5/5) and couched button hole stitch with extra turn as roughest to the touch (5/5). The coolest to the touch was the simple button hole stitch (3/5) and other tree bast cloths, while the grain surface of the leather was also considered cool to the touch by two groups (2/5). The warmest to the touch were the bear skin (5/5) and red fox (5/5).

Structure – sense of touch

The most flexible cloth was the simple button hole stitch (5/5) followed by the leather (3/5) while the most inflexible was the twining (5/5). In terms of stretch, the simple button hole stitch was rated the most stretchy by all groups (5/5) followed by the two other variations of couched button hole stitch (3/5). The stiffest cloth was the twining (4/5) and silver fox (4/5) followed equally by the brown bear and red fox (3/5). The thickest cloths were undoubtedly the furs with the red fox and brown bear rated thickest by all five groups (5/5). The thinnest cloth was not so clearly distinguished with three groups rating the leather (3/5) and the couched button hole stitch (3/5).

Sound – sense of hearing

The noisiest cloths were those made from tree bast with four out of five groups rating the twining (4/5) or simple button hole stitch (4/5) as the noisiest cloths. By contrast the cloths that made the least sound were the brown bear (4/5) and red fox (4/5).

It must be remembered that the results in this experiment come from modern cloth samples which have been chosen to approximate ancient cloth, which no doubt varied according to the selection of specific raw materials, manner of processing the raw plant fibres or the curing or tanning process.

Results part III: preferences

In all the sessions there was the opportunity to comment on the cloths and express preferences, with sections in both Part I and Part II of the questionnaire. The purpose of these comments is to think through the ways people respond to materials and hence how sensory experiences are culturally embedded. This is not to say this is how the people of the Ertebølle perceived their cloth, indeed such a task cannot be achieved. Through the complex subjectivity of these answers, it is possible to think of the context of these Mesolithic cloth-types anew. While this may seem too subjective, so we should also be aware that the archaeologist's technological and scientific classification is also a current day cultural construction that would not necessarily have been the people of the Ertebølle described cloth. This section sensory investigation raises a whole range of different questions and responses that can be used to question these past cloth-types. Some results seem self-explanatory while others stand out as surprising when seen in this way.

The participants were asked to choose their favourite cloth. The favourite by far was the red fox skin, on the basis that the fur felt very soft, thick and had nice colouring. Several likened the feel of the red or silver fox fur to stroking a soft dog and saw this as a positive sensory experience. One participant commented that the silver fox skin evoked an emotional, cuddly feeling like a beloved pet and that they would have felt safe and secure wearing it. This relationship between sensory experiences is one that came up throughout the whole exercise. Along these lines, it was generally difficult for participants to find the vocabulary to describe odours, but they could easily liken the odour to another. Hence, the tree bast cloths were often described as smelling like hay, grass, wood or silage. In turn, these scents were also associated with emotional memory experiences with good or bad associations. One participant likened the smell of tree bast to an old hay mattress belonging to her grandmother, expressing this as a positive experience. The smell of the red fox skin polarised participants from those who though it smelt nice and those who thought it smelt really bad. In particular one participant, a farmer, said he could instantly smell the fox and associated it with its predatory behaviour on the farm. These sensory connections open up quite a different way of

thinking about cloth in prehistory. The smell of some of these animals would have lingered on the clothes and led to similarly polarised opinions between groups that favoured different materials.

There were also a few participants who disliked the furs on the basis of ethical grounds, as the animals had been killed for clothing not for food. Again this is an interesting preference, as the tactile and desirable softness of the fur was ignored on the basis of its origin. The same ethical dimension did not seem to apply to the leather, which was generally seen positively, on the basis that it felt nice and would be versatile. One participant described the leather as a "friendly sort of cloth". As mentioned in the introduction this emotional response is important to modern designers who recognise not only the significance of an emotional response to fabrics, but also that this may change through the lifetime of an individual (DeLong et at. 2012 54-7) and hence demonstrate that this is in part contextual. We may imagine this was the case in the past but we need to find avenues into this research. One way may be to consider the longevity of certain cloth-types and their use, or their association with groups or people with different economies. For instance, while both farmers and hunter-gatherers used furs, the species they exploited for this purpose quite possibly varied depending on their economic source of dead animals. However, when used as furs, the visual appearance and smell of these animals would have been quite different. Here there is a contrast between the smell and appearance of domestic cattle skins and deer or pine marten skins. The preference for particular cloth-types and related clothing styles is seen as an important means of inclusion or exclusion and is significant in many historical and present day contexts (Hauser-Schäublin 1996,102-103;Oakes & Riewe 1996,192;Velásquez Nimatuj 2003,201-210). Were the farming communities and hunter-gatherers similar distinguished? Another intriguing comment that came from the questionnaires was that the furs were "manly", due to their connection with hunting. This gendered perception of the material and its origin has been frequently discussed in terms of textiles and women in archaeology. Yet the complexity of how materials become gendered is not always considered thoroughly (for discussion see Owen 2005,7-53). Even a stereotypically gendered scenario such as furs hunted by men, stitched into garments by women, and made into garments which may be women's garments or men's garments shows the complexity of the operational sequence of gendered tasks. Hence, the gender of processes, materials, senses and clothing is complex and multi-facetted.

A number of the participants were intrigued by the stretchiness of the simple looping, a material that few had encountered before. This contrasts with the rather stiff fibre of tree bast cord from which it is made. Possibly this can be compared with Gell's idea of the "Technology of Enchantment" whereby there is a fascination with technical characteristics and technical mastery (Gell 1992,46-49). At the same time, most participants thought the examples of button hole stitch and twining would be scratchy and painful on the skin as clothing but fine for food containers, bags, room screens, shoes or matting. These concepts of the appropriateness of materials can be highly cultural and misleading. In the nineteenth century in British Colombia for example, twined cloth from tree bast fibres was used for capes, socks, bags, mats and tunics (Turner 1998,32,37,68,123,145,170). This use as clothing seems surprising to someone with a modern sensibility of soft, fine, smooth cloth for clothing.

Returning now to the archaeological evidence, what do these sensory results add to knowledge of cloth and clothing in the Late Ertebølle of southern Scandinavia?

Discussion

Before launching into the discussion, a methodological point to iterate is that the cloth-types presented here are known from small fragments or indirect evidence of cloth, not known garments. Consequently, while it seems plausible these cloth-types were used for clothing, indeed some of them must have been, this cannot be categorically proven. Another point to consider is that the results represent a crossover of positive answers from more than half the participants. In some cases, nearly all participants responded equally, in other cases there is variation. This variation is a real effect in how some people perceive or describe materials differently, similar to the problem of Munsell colour charts which unwittingly show how differently colour is perceived by individuals. However, there are crossovers and the method of using multiple responses and working individually as well as in groups has sought to find positive answers but also show ambiguity. Having said that, I believe it is stimulating to put the plant fibre, furs and skin products evidence together as cloth and think through the consequences of this group of cloth-type materials from a sensory perspective.

Taking the visual perspective first, what new information do we find? There are several groupings concerning light and visual perception. The furry side of the furs and the grain side of the leather are the shiniest materials, while the plant fibres and flesh side of the furs and skin products are matt. Industrial textile technologists consider this quality of lustre, shine, gloss or sparkle as an important aspect of visual appearance, although difficult to measure quantitatively (Hadjianfar and Semnani 2010,649). Was shininess a significant sensory aspect of dress in the Late Ertebølle? If so for what purpose? Maybe it shininess was important for during celebrations or group meeting and for festival clothing, but in contexts such as hunting water-repellence could have been more important. There is a question here of which aspects were important to the Late Ertebølle groups of the fifth millennium BC in southern Scandinavia and how aspects combined with other factors. For example, the furs and skin product cloths are also are very dense and the opposite of the button hole stitch which is transparent and can be seen through, a factor has other effects such as allowing substances to pass through. Such factors may have been relevant for weather proof garments where the density of skins is required, and the opposite favoured in the button hole stitch cloth which may be better for letting out drips from fish transported in bags. The lustre may have been of little importance in these situations, but relevant in others.

In terms of colour, there are a range of colours in the cloths, from the variegated hair colour of the foxes with their white fluffy tail end, to the more homologous colour of the button hole stitch and twining which are made from tree bast fibres. There is a data collection issue here that the brown bear skin had been dyed, so despite being a dark fur, it appears even darker and less varied in colour. Similarly, the silver fox is a modern colour breed. However, despite these issues in the furs available for the experiment, the general variation available through markings, species, age and season is inherent in the nature of furs. The selection of particular colours, shades and markings seems likely. The coat of all animals would have offered unique colour and marking opportunities. The European pine marten has a rich dark body colour and contrasting light bib (throat), lynx have flecked grey to light brown coats, seals a wide range of colours and dappled markings together and a distinctive, shiny lustre (Fig. 15). It is suggested that at Ringkloster foetal and neonatal red and roe deer were exploited for their spotted markings (U. Møhl pers. comm. in Rowley-Conwy 1994-95,94-95). How striking indeed would this spotted cloth appear in contrast to the dark, rich brown of pine marten, or the long red hair of fox. In the selection of cloth for clothing today, colour is one of the most important visual factors and there is little reason to doubt its importance in the past. That

relatively small animals such as the pine marten were hunted for their furs suggests that it was not the size of the skin that made them desirable, as one would need many more pine marten to produce a cloth the size of an adult deer. Potentially the light bib and contrasting with the dark coat of pine marten could be used to produce a patchwork effect, much like the dark tipped tail of white ermine still used on special regalia today, which when sewn together creates a regular black-flecked effect against the pure white. These visual resources provide a means to feed the creativity of clothing designers, makers and wearers and it is hard not to imagine this was irrelevant in the past.

When we consider smell, cloth-types of both plant origin and the furs and skin products are classified as cloths with the strongest odour (Table 3). A few months after processing the smells are not pungent (Table 1-2) but they are present, noticeable and some skins smell more than others. When obtaining skins for this project, I was informed by a tanner that the company only tanned young animals for fleeces as adults especially males, really stink and they could never get rid of the smell (pers. comm. Niki Port; Port 2007). Despite this, smells do fade and change, clothing readily picks up new smells such as body odour or smoke from campfires. It must be noted that the modern leather and furs smell of the animal as well as the modern tanning products, in the same way the skin products and furs of Late hunter-gatherers would have smelt of the substances and processes used to cure them, albeit different from the modern tanning products. Leather smells less than the furs and in the handling experiment smelt of tanning products, reminding us the substances applied to the skin affect the smell. One of the questions of this research is whether the smell of raw materials was quickly overwhelmed with wood smoke from camp fires. An account of tanning methods in Alaska of the 1970s notes that for the Rocky Point Eskimo the natural skin smell seems to have endured alongside body odour and campfires rather than been overwhelmed by it: "The smell of natural skins did not bother them because they grew up with the smell. There were many strong odours, especially since they had no soap or detergents. Survival was the important thing. If there was something to smell, it meant food and warmth" (Wilder 1976,13). Tree bast fibres are surprisingly smelly and very distinctive, but unlike the animals, these odours are not like the living plant. The lime bast in this experiment smelt strongly shortly after processing and for about a year after the cloth was made. From processing willow bast and leaving it in my office, I found that it has a medical, astringent odour, presumably as a result of the salicylic acid. As noted in the results, the smell of the cloth is something that people strongly associate with other experiences. This has implications for how we understand these cloth-types and body concepts in the Late Ertebølle. People wearing clothes made of skins would have smelt faintly like the animals they hunted or trapped and later skinned, cured and stitched, or the products used to cure them. People wearing cloth of tree bast fibres would have smelt faintly like the processed tree bast. Children would have grown up surrounded by relatives and friends smelling of these animals and plant processes.

In terms of touch, furs provided the softest, smoothest, warmest surfaces and cannot be mistaken for the roughness and sometimes also coolness of the tree bast cloths. The grain side of leather is a smooth tactile surface, while the flesh side of leather can be very soft (Table 2 & 3). Some participants sat down contentedly and stroked the furs well beyond what was required of the experiment. The usefulness and appreciation of the furs of traditional fur bearing animals is often implied in the literature to explain trapping. I would like to highlight the desirability of lustre of shine and also its desirable softness. In terms of touch and feel all the cloth-types in this experiment are flexible, some to a greater degree than others. The majority have some elastic stretch (Table 1 & 2). When compared together, all three button hole stitch cloths are the most stretchy, of these the simple button hole stitch has the most

stretch of all as the addition of the couching creates a firmer structure. Not surprisingly the furs are the thickest. These aspects could have been important in constructing garments to fit the shape of the body and its movement. These textural factors and many further properties besides are explored in technical textile and clothing manuals (see Saville 1999;Watkins 1984).

The sounds of cloth were split between the quiet, muffled, nearly silent sound made by furs and the gentle rustle, crunch and crackle of tree bast. If these were both materials for clothing, then contrast in outfits in one or the other material would have been obvious. For example, one might wrap a baby in quite, soft, warm fur to lull them to sleep but the rustle of tree bast fibres might have been suitable for a dance costume. From burial it is recognised that ornaments of shells, bead and teeth were sometimes attached to cloth in the Mesolithic(Larsson 2012), adding another dimension to the sensorial qualities of cloth, clothing and costumes.

This approach allows us to move on from a technological description of materials by factor such as raw materials and construction technique which emphasises production, into one which by its focus on the product and emphasises the potential of materials as encountered by people. Typically in archaeology these alternate ways to classify and define are attached in different philosophical traditions which we could call empiricist and phenomenological or materials versus materiality. My point in this exercise is not to evaluate which approach is better, but to apply these methods to a body evidence (Late Ertebølle cloth) and gain a new level of knowledge. In this case, I believe we gain a better understanding of these cloth types and are therefore better able to question the role of these cloth types in the past. This is particularly relevant for these ancient cloth types as they are far removed from modern cloth references and technological descriptions often mean little to the average reader. For example, those who may struggle to comprehend anything of the technical description of couched button hole stitch with an extra turn in the button hole stitch or fur from small fur bearing mammals would hopefully be able use the results presented here to gain a better understanding of these materials both alone and in comparison to one another and apply this to a wider understanding of the Late Ertebølle.

Conclusion

Whether the people of the Late Ertebølle would have used the cloth like this or classified sensory perception in the same way are questions for which there is possibly no satisfactory answer with the current evidence. However, the handling exercise throws new light on the technical descriptions usually provided by the archaeological report. It highlights how people use their culturally embedded perception of sensory experience to describe cloth and shows how the same cloth can be described in a totally different manner. In addition, to consider this as simply a lengthy way to describe simple experiences is possibly to miss the importance of the senses in objectifying beliefs. Clothing wraps bodies and makes bodies into cultural beings. From this research, we can propose that the people of the Late Ertebølle archaeological culture grew up and lived surrounded by familiar people smelling faintly of familiar animals and processed plants. They had access to a range of soft, shiny furs as well as transparent, stretchy couched button hole stitch materials. These were not only useful material for dressing for the environment, but also material surfaces with colours, sounds, smells and touch sensations that could be comforting, reminiscent or luxurious. These cognitive responses and classifications are no less part of cultural attitudes to and group identities than technological ones. Those hunter-gatherers that mixed with people following a

farming life way might have recognized the inherent familiarity of cloth made from the skins of domestic animals, but they may also have noted the differences of domestic animal skin products, whether through different smells or animal markings. These animal references may have been fascinating or signalled them as foreigners.

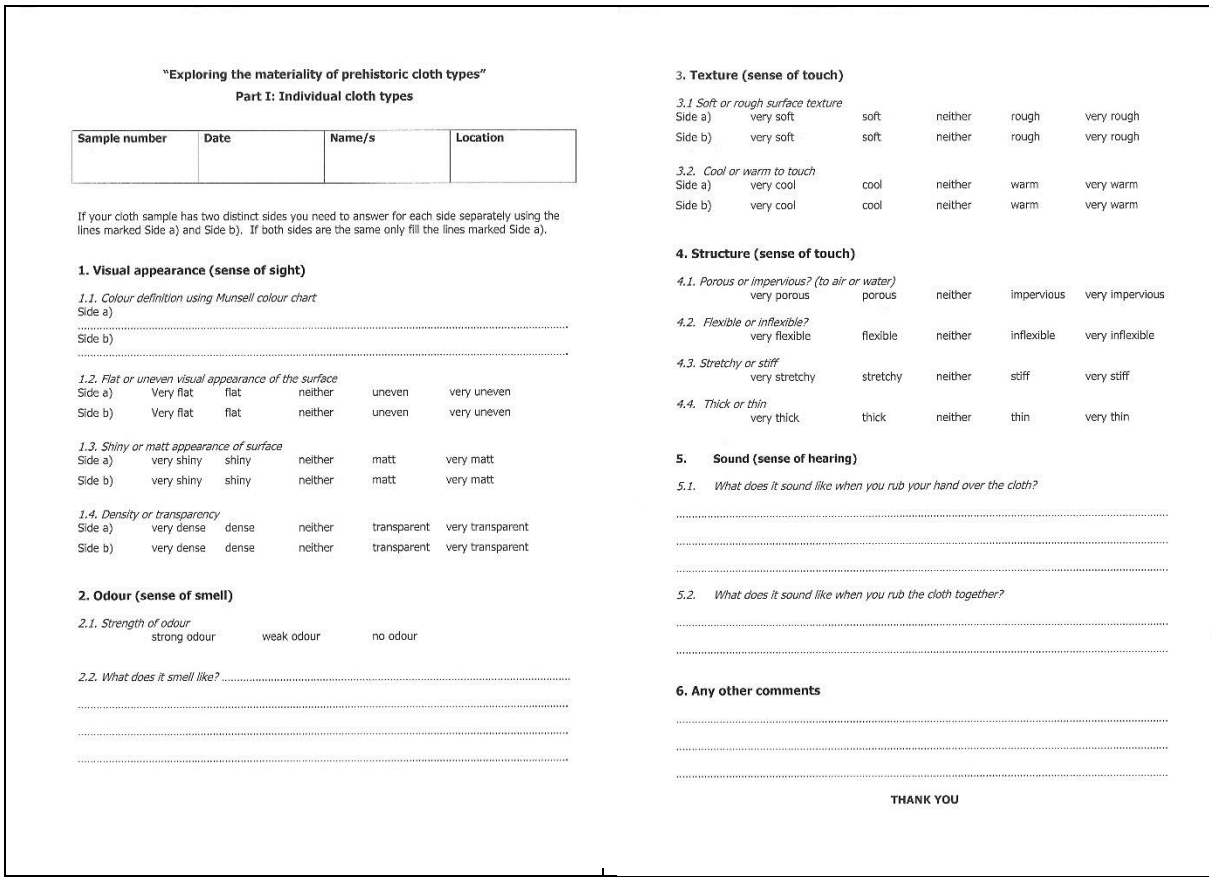
This paper has brought together the current knowledge of cloth in the Mesolithic, Late Ertebølle of southern Scandinavia including both cloth from plant fibres, furs and skin products, as materials that were potentially used as clothing. This in itself is a useful exercise as these technologies are often treated separately. It has then sought to describe these materials using a consistent and coherent experimental method. Using the approach to sensory materials and sensory perception based in Merleau-Ponty's theory of perception these descriptions provide an opportunity for the archaeological evidence of cloth to be explored in a new light. As archaeologists, it is useful find a tool to step back from familiar classification and typological systems and face the evidence from a new perspective.

Acknowledgements

This research was carried out as a British Academy Postdoctoral Fellowship at the Institute of Archaeology, University College London (UCL). I would like to thank all the participants in the experiment for touching, smelling and listening to the cloth samples, especially the undergraduate students at the Institute of Archaeology, UCL on the Experimental Archaeology course run by Bill Sillar. Thanks to: Ulrike Sommer and Linda Hurcombe for their interest in and encouragement of this experiment, Nahum Ben-Yehuda for sharing literature, Tobi Martin and Rosie Weetch for organising the session "Dressing Sensibly: sensory Approaches to Dress for Archaeologists" at Liverpool TAG 2012, Ulrike Sommer for commenting on an earlier draft of the paper, Pippa White for proof reading and the helpful comments from two anonymous reviewers. The furs were sourced from Sagnlandet Lejre Denmark. Thanks to Jesper Laursen for permission to reproduce Orla Svendsen's drawings of textiles from Tybrind Vig and to Lise Bender Jørgensen and Felix Riede for helping trace image copyright. The button hole stitch and twining was made by the author owing much to skills learnt with basket makers Shuna Rendel and Elaine Kingston at the City lit, London, supported by the Worshipful Company of Basketmakers.

Figures & Captions

Figure 1. Questionnaire Part I: Individual cloth types. Individuals selected one of the eight cloths in the experiment and were asked to answer all questions. Where sides of the cloth are different, for example with fur and leather, participants were asked to answer side a) for the fur or grain side and Side b) for the flesh side.



"Exploring the materiality of prehistoric cloth types"

Part I: Individual cloth types

Sample number	Date	Name/s	Location

If your cloth sample has two distinct sides you need to answer for each side separately using the lines marked Side a) and Side b). If both sides are the same only fill the lines marked Side a).

1. Visual appearance (sense of sight)

1.1. Colour definition using Munsell colour chart
Side a)
.....
Side b)
.....

1.2. Flat or uneven visual appearance of the surface

Side a)	Very flat	flat	neither	uneven	very uneven
Side b)	Very flat	flat	neither	uneven	very uneven

1.3. Shiny or matt appearance of surface

Side a)	very shiny	shiny	neither	matt	very matt
Side b)	very shiny	shiny	neither	matt	very matt

1.4. Density or transparency

Side a)	very dense	dense	neither	transparent	very transparent
Side b)	very dense	dense	neither	transparent	very transparent

2. Odour (sense of smell)

2.1. Strength of odour
strong odour weak odour no odour

2.2. What does it smell like? .....
.....
.....
.....

3. Texture (sense of touch)

3.1 Soft or rough surface texture

Side a)	very soft	soft	neither	rough	very rough
Side b)	very soft	soft	neither	rough	very rough

3.2. Cool or warm to touch

Side a)	very cool	cool	neither	warm	very warm
Side b)	very cool	cool	neither	warm	very warm

4. Structure (sense of touch)

4.1. Porous or impervious? (to air or water)

very porous	porous	neither	impervious	very impervious

4.2. Flexible or inflexible?

very flexible	flexible	neither	inflexible	very inflexible

4.3. Stretchy or stiff

very stretchy	stretchy	neither	stiff	very stiff

4.4. Thick or thin

very thick	thick	neither	thin	very thin

5. Sound (sense of hearing)

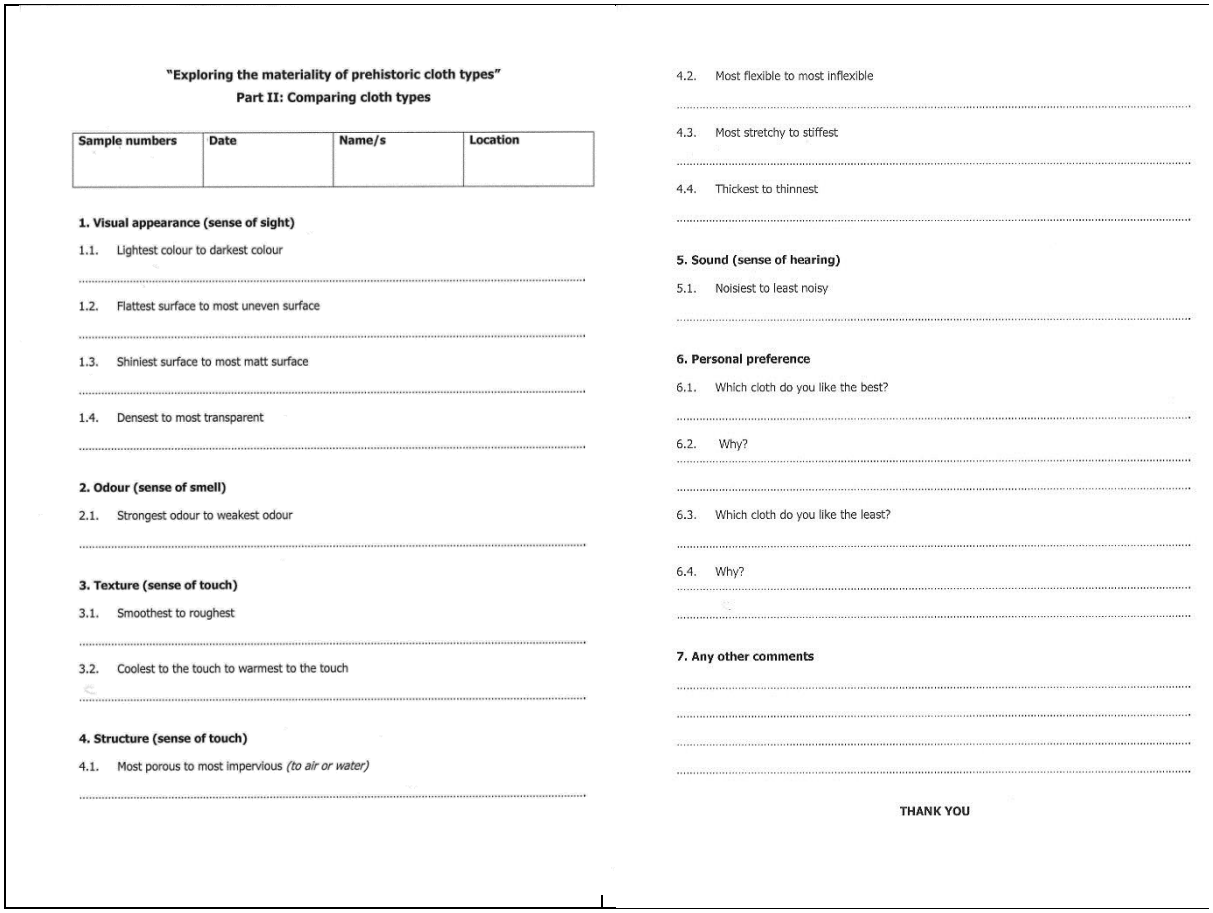
5.1. What does it sound like when you rub your hand over the cloth?
.....
.....
.....

5.2. What does it sound like when you rub the cloth together?
.....
.....

6. Any other comments
.....
.....
.....

THANK YOU

Figure 2. Questionnaire Part II: Comparing cloth types. Groups were asked to arrange the eight cloth types in order according to the statements, for example, from the coolest to the touch to the warmest to the touch. The order of the cloths was recorded on the sheet. In this case, only side a) of the fur and leather was considered.



"Exploring the materiality of prehistoric cloth types"
Part II: Comparing cloth types

Sample numbers	Date	Name/s	Location

1. Visual appearance (sense of sight)

1.1. Lightest colour to darkest colour

1.2. Flattest surface to most uneven surface

1.3. Shiniest surface to most matt surface

1.4. Densest to most transparent

2. Odour (sense of smell)

2.1. Strongest odour to weakest odour

3. Texture (sense of touch)

3.1. Smoothest to roughest

3.2. Coolest to the touch to warmest to the touch

4. Structure (sense of touch)

4.1. Most porous to most impervious *(to air or water)*

4.2. Most flexible to most inflexible

4.3. Most stretchy to stiffest

4.4. Thickest to thinnest

5. Sound (sense of hearing)

5.1. Noisiest to least noisy

6. Personal preference

6.1. Which cloth do you like the best?

6.2. Why?

6.3. Which cloth do you like the least?

6.4. Why?

7. Any other comments

THANK YOU

Figure 3. Drawing of preserved couched button hole stitch excavated from Tybring Vig, habitation site, Fyn, Denmark. (drawing by Orla Svendsen published in Bender Jørgensen 1990, fig. 1. 1).

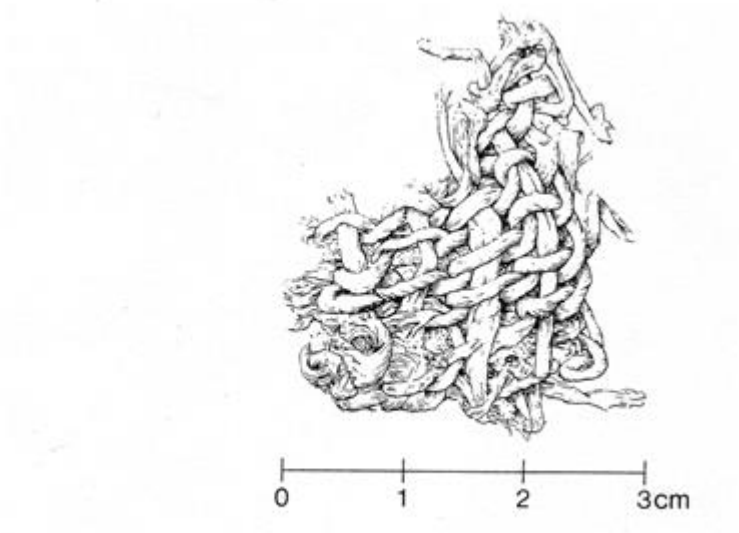


Figure 4. Drawing of preserved couched button hole stitch with double couching excavated from Tybring Vig, habitation site, Fyn, Denmark (drawing by Orla Svendsen published in Bender Jørgensen 1990, fig. 1. 3).

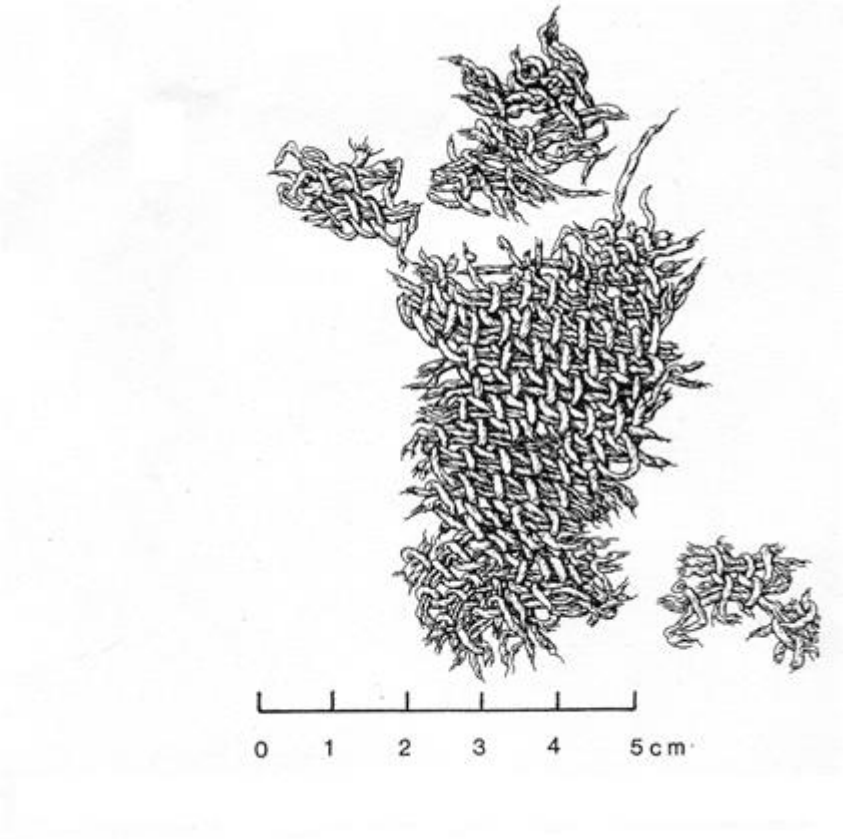


Figure 5. Drawing of preserved couched button hole stitch with extra turn excavated from Tybring Vig, habitation site, Fyn, Denmark (drawing by Orla Svendsen published in Bender Jørgensen 1990, fig. 1. 4).

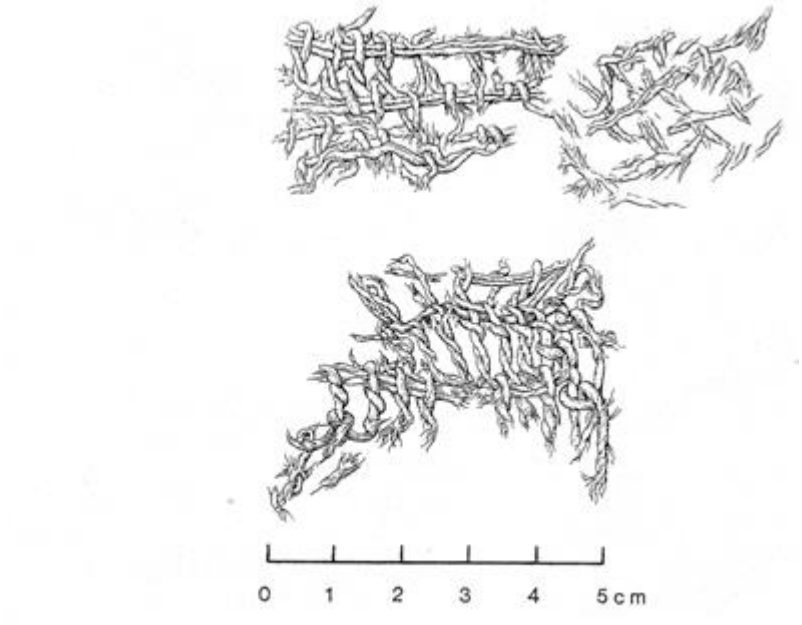


Figure 6. Fox cranium from the in land Ertebølle site of Ringkloser, east Jutland, Denmark. The cranium shows cut marks around the eye sockets and muzzle which were probably the results of using flint knives to remove the skin (drawing by E. Morville del, published in Andersen 1994-1995, 49, fig. 38).

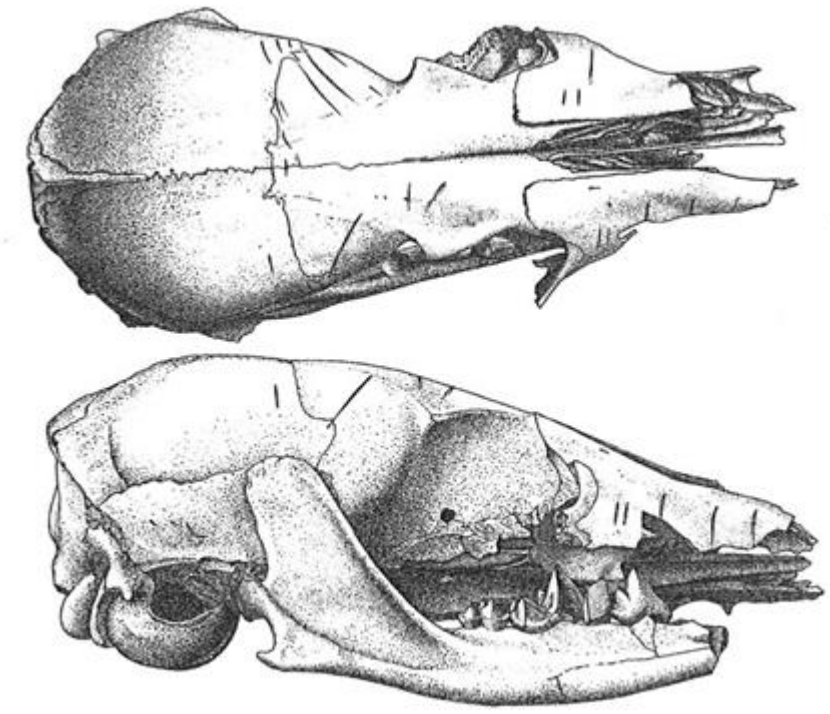


Figure 7. Red fox skin (photograph S. Harris).

Figure 8. Silver fox skin (photograph S. Harris).

Figure 9. Bear skin dyed black (photograph S. Harris).

Figure 10. Leather (photograph S. Harris).

Figure 11. Right: couched button hole stitch. Left: Couched button hole stitch with extra turn. (photograph S. Harris).

Figure 12. Simple button hole stitch (photograph S. Harris).

Figure 13. Twining (photograph S. Harris).

Figure 14. Comparing cloth types during part II of the handling experiment (photograph S. Harris).

Figure 15. Seal skins hanging inside a hut at Sagnlandet Lejre, Land of Legends Lejre, Denmark (photograph S. Harris).

	Red foxskin, fur side	Red foxskin, flesh side	Silver foxskin, fur side	Silver foxskin, flesh side	Bearskin, fur side	Bearskin, flesh side
VISUAL APPEARANCE – SENSE OF SIGHT						
Flat or uneven	uneven	flat	uneven to neutral	flat	uneven	flat
Shiny or matt	shiny	matt to very matt	shiny to neutral	matt	shiny to very shiny	very matt or matt
Dense or transparent	dense to very dense		very dense to dense	very dense	very dense	very dense
ODOUR – SENSE OF SMELL						
Strong or weak	weak		weak to strong		weak	
Description of smell	animal like a dog, musky		animal, like a dog		animal, like a dog or wool	
TEXTURE – SENSE OF TOUCH						
Soft or rough	very soft	rough	very soft	rough to neutral	soft to very soft	very soft to rough
Cool or warm	warm	neutral	warm or cool	cool to neutral	warm	warm to neutral
HANDLE – SENSE OF TOUCH						
Flexible or inflexible	flexible		very flexible		very flexible to flexible	
Stretch or stiff	stiff		stiff		stretchy	
Thick or thin	thick to very thick		think or thin		thick to very thick	
SOUND – SENSE OF HEARING						
Description of sound	muffled, silent	slightly grainy	silky, quiet, nearly silent	slightly scratchy, rustling	silky, quite, slight rustling	

Table 1. Handling experiment results for individual cloth-types including red fox skin, silver fox skin, bear skin.

	Leather, grain side	Leather, flesh side	Twining	Simple button hole stitch	Couched button hole stitch	Couched button hole stitch with extra turn
VISUAL APPEARANCE – SENSE OF SIGHT						
Flat or uneven	flat		flat, uneven	uneven to very uneven	very uneven to even	uneven
Shiny or matt	shiny	matt	matt	matt to very matt	very matt to neutral	matt to very matt
Dense or transparent	very dense to dense		dense to transparent	transparent	transparent	transparent
ODOUR – SENSE OF SMELL						
Strong or weak	weak		weak	weak	weak to strong	weak
Description of smell	warm, sweet, musky, like shoes		resinous, sharp	woody, grassy, sappy	sweet, sharp	sweet, grassy
TEXTURE – SENSE OF TOUCH						
Soft or rough	soft to neutral	very soft to soft	rough, soft	rough to very rough	rough to very rough	rough
Cool or warm	cool to neutral	warm	neutral	neutral to cool	neutral to cool	neutral
HANDLE – SENSE OF TOUCH						
Flexible or inflexible	very flexible to flexible		flexible	very flexible to flexible	flexible	flexible
Stretch or stiff	stretchy		stiff	stretchy	stretchy to stiff	stretchy
Thick or thin	thin		thin to neutral	thin to neutral	thin	thin
SOUND – SENSE OF HEARING						
Description of sound	Almost soundless, soft brushing, whispering		rustling, crackling, scratchy	rustling, crackling, crunchy	crunchy, scratchy rustling	crunchy, crackling, scratchy

Table 2. Handling experiment results for individual cloth-types including leather, twining, simple button hole stitch, couched button hole stitch, couched button hole stitch with extra turn.

VISUAL APPEARANCE – SENSE OF SIGHT	
Flattest Leather, Twining	**Most uneven** Simple button hole stitch
Shiniest Bearskin, Red foxskin	**Most matt** Simple button hole stitch, couched button hole stitch, Couched button hole stitch with extra turn
Densest Bearskin, Red foxskin, Silver foxskin	**Most transparent** Simple button hole stitch, Couched button hole stitch with extra turn
ODOUR – SENSE OF SMELL	
Strongest odour Redfoxskin, Silver foxskin, Couched button hole stitch, Couched button hole stitch with extra turn	**Weakest odour** Leather, Twining
TEXTURE – SENSE OF TOUCH	
Smoothest Redfoxskin, Silver foxskin, Leather	**Roughest** Simple button hole stitch, Couched button hole stitch with extra turn
Coolest Simple button hole stitch, Leather	**Warmest** Bearskin, Red foxskin
HANDLE – SENSE OF TOUCH	
Most flexible Simple button hole stitch, Leather	**Most inflexible** Twining
Most stretchy Simple button hole stitch, Couched button hole stitch with extra turn, Couched button hole stitch	**Most stiff** Twining, Silver foxskin, Bearskin, Red foxskin
Thickest Red foxskin, Bearskin	**Thinnest** Leather, Couched button hole stitch
SOUND – SENSE OF HEARING	
Noisiest Twining, Simple button hole stitch	**Least noisy** Bearskin, Red foxskin

Table 3. Handling experiment for comparing the sensory properties of eight cloth-types.

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