AUSTRIAN ACADEMY OF SCIENCES PRESS JOURNAL OF MUSIC ARCHAEOLOGY 1 (2023) 125–141 JMA.ISGMA.INFO

Only Pottery Drums in the Stone Age? Advantages and Disadvantages of Wooden versus Pottery Drums Relating to Production and Sound

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Abstract

Hundreds of possible prehistoric pottery drums made in Central Europe, mainly from the Late Neolithic (especially the TRB culture) have been found. Their forms vary from funnel-shaped, goblet to hourglass. It is not difficult to imagine equivalent or alternative forms of drums made from hard plant tissues, which are missing in the archaeological record during these or even other periods. Aside from a thought experiment based on archaeological knowledge, experimental and experiential research is presented here with three main examples of wooden drums – a simple frame drum from a branch imaginable since the Palaeolithic, a cylindrical double-headed drum made from a log with a rotten inside, and a wooden alternative to a TRB goblet drum that is compared to a ceramic replica of the same type of TRB drum in terms of material characteristics, technology, tools, skill, productions costs, time requirements and durability. The experience and results prove that simple frame drums are the fastest and the easiest option, followed by cylindrical drums made from logs, however production costs of wooden vessel drums greatly exceed those of pottery ones. Thin walls make ceramic drums much worse in terms of manipulation, playing and durability, but fairly better in clear and loud sound production. The presented examples are closely related to Central European prehistory, but they may serve as valuable analogies to other geographical or cultural contexts as well.

Keywords

Drums – Woodworking – Experimental archaeology – Stone Age

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1 Introduction

There are several hundred possible prehistoric vessel drums made exclusively from pottery. The potential oldest known pottery drum dated back to the Lengyel culture was revealed at Großweikersdorf in Lower Austria.[1] Nevertheless, the vast majority of them come mainly from the Late Neolithic or Eneolithic, as it is called in Central European countries. The Funnel Beaker culture (Trichterbecherkultur, TRB) drums might have originated from other pottery vessels, e.g. pedestal bowls.[2] The rich archaeological record is dated to the chronological phases TRB IV and TRB V (i.e. 3350–2700 BCE), which are related to several archaeological cultures in Germany, Austria, the Czech Republic and Poland (e.g. Salzmünde, Walternienburg, Bernburg, Globular Amphorae, Jevišovice, Baden, Řivnáč).[3] Rare archaeological finds are also known from the Bronze Age[4] and the Iron Age.[5]

Extant prehistoric pottery drums vary in form (funnel- or goblet-shaped, hourglass), dimensions (the height ranges from 4.5 to 46 cm[6]), decoration (mostly without any at all, however Salzmünde, Walternienburg or Bernburg drums are richly decorated), or methods for fastening a drumskin (usually knobs, lugs or pierced lugs under the rim). They have been found in graves, but also within the stratigraphy and pits of settlements. Important discussions on their identification, classification, function or meaning have been held since the end of the 19th century.[7] Although they are replicated and presented quite often in open-air museums, (experimental) studies on pottery drum making are published rather rarely.[8]

To answer the question raised in the title of this paper, we would definitely require direct archaeological finds. Until then, we are left with two main possibilities. On one hand, we may use a simple thought experiment to consider available materials, technological knowledge and toolkits based on the archaeological, historical and ethnographic record. On the other hand, we may provide empirical data by conducting an archaeological experiment. Both possibilities are explored here, including three main empirical experiments that follow standard procedures,[9] and aim at comparing the production, durability and sonic characteristics of the drums made from pottery and wood. Although the results cannot provide us with any accurate vision of the past, they definitely allow us to enhance our considerations about prehistoric drums. Further, I hope they might also arouse a stronger interest in exploring the new and already known archaeological contexts

1 Pomberger 2016a: 50, 350.
2 Aiano 2006; Lindahl 1986; Sachs 1940; Stockmann 1986.
3 Behrens 1980; Behrens and Schröter 1980; Chroustovský 2010; Gedigowa-Bukowska 1963; Mašek 1954; Mildenberger 1953; Müller 2001; Pomberger 2018; Wyatt 2008; Wyatt 2020.
4 Lindahl 1986; Pomberger 2011; Pomberger 2016a: 72, 84; Pomberger 2016b.
5 Clodoré-Tissot and Moser 2005.
6 Wyatt 2020.
7 E.g. Fischer 1951; Mašek 1954; Mildenberger 1953; Müller 2001; Seewald 1934; Wyatt 2008.
8 E.g. Aiano 2006; Alebo 1986; Clodoré-Tissot 2010; Lindahl 1986; Pomberger 2011; Seeberger 2003.
9 For experimental standards see e.g. Coles 1973; Reynolds 1999. To the author's knowledge, the experimental production of a Stone Age wooden vessel drum is presented here for the first time.

and searching for potential wooden drums and their fragments. I strongly believe that consideration of the organic materials and their role (practical, social, or symbolic) in prehistory may enrich our debates and lead to a more complex view of past music and sound production.

Hard plant tissues have been used to make drums extensively in various parts of the world, and thus it is not difficult to imagine equivalent or alternative drum forms in (Central) Europe. In the (Late) Neolithic, stone or bone tools (e.g. axes, adzes, chisels, drills) were usually used for woodworking, and elaborate manufacturing abilities are recognizable in rare archaeological contexts like pile dwellings, well constructions or wooden tools.[10] Very rare wooden vessels copy their ceramic counterparts, or *vice versa*, and wood may have been a popular material for making them not only during the Neolithic.[11] Considering raw materials, tools and technological knowledge in the (Late) Neolithic, we might simply conclude that it should have been possible to make and use a wooden equivalent or other forms of drums.

2 Experimental drum (re)constructions

2.1 Wooden frame drum

A frame drum without a resonator represents the simplest kind of membranophone present in various cultural traditions.[12] Simple frame drums could have been made since the Upper Palaeolithic from a single bent branch covered by a skin or rawhide. There is no direct archaeological record, yet the principle of drumming is recognizable in a percussion set of decorated mammoth bones and two beaters from the Gravettian site at Mezin in Ukraine, or other possible drumsticks.[13] Neolithic contexts provide a debatable iconographic record of drums, e.g. hunting shrine at Çatal Hüyük;[14] more elaborate drum examples are also depicted later in the Near East.[15]

The hypothetical model presented here (Figure 1a) was made many years ago from a fresh alder branch – 163.5 cm long and 8–17 mm thick – that was soaked in water to make it more flexible. The meat and fat was cleaned from a young goat skin (thickness up to 1 mm); it was then left to rot for a while and quite coarsely stripped of its hair. The *châine opératoire* is described in Table 1. The drumhead was fastened by a band cut from the same skin as the drumhead according to North American traditions – a skin band of unassessed length goes through 16 perforations at the edge of the skin; in order to fasten the skin better, the band was twisted. The finished drum is 76.7 cm long and 21.2 cm wide and weighs 226 g. The necessary toolkit involves only a stone blade and a bone awl.

[10] E.g. Elburg et al. 2015; Tegel et al. 2012.
[11] Capelle 1976.
[12] Sachs 1940.
[13] E.g. Jiménez Pasalodos and Rainio 2020; Oliva 1996; Stockmann 1986.
[14] Stockmann 1986.
[15] E.g. Doubleday 1999; Dumbrill 1999.

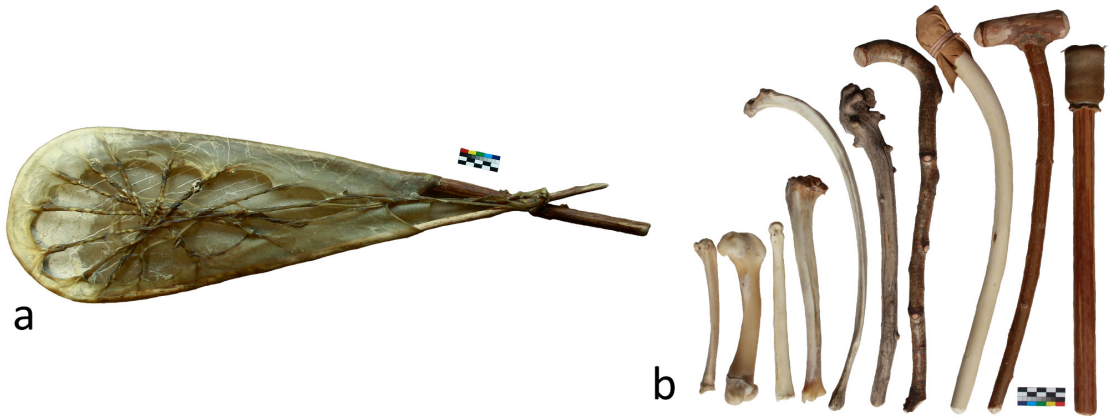

Figure 1: A frame drum from alder wood and a goat skin (a) and various drumsticks (b; from the left: four roe deer bones, a cow rib and five wooden sticks, two of them with leather heads). Photos by the author.

Element	Activity	Tools	Time
frame	cutting a fresh stick to the desired length	stone blade	4 min
frame	removing fresh bark	stone blade	10 min
frame	soaking the stick to make it flexible	(flowing) water	2 days
membrane	removing flesh and fat from skin	stone blades	70 min
membrane	letting skin rot in water	storage vessel	16 days
membrane	removing hair from skin	wooden chippings	90 min
membrane	soaking the goat skin to make it pliable	storage vessel, water, stones	2 days
membrane	cutting a circular drumskin and skin strips (to fasten the drumskin)	stone blade	32 min
drum	bending the stick and fastening the drumskin (fixing both with skin bands)	bone awl	24 min
drum	drying the membrane	—	2 days

Table 1: Main steps in making a frame drum from an alder stick and a goat skin (one person; 2009).

A frame drum is usually held in one hand and played with the fingers, palm or a drumstick (Figure 1b). As it lacks a resonating chamber, the sound of our model is fairly flat, but using a drumstick considerably increases its volume.

2.2 Wooden cylindrical drum

Another natural way to make a drum is to use an old log, the inner parts of which are preferably entirely rotten, making it easy to clean and providing a cylindrical shell. Cylindrical drums – single

Figure 2: Wooden cylindrical double-headed drum from spruce and cow rawhide. Photo by the author.

or double-headed – have also been a part of many cultural traditions in Eurasia, Africa and both Americas.[16] Several years ago, I used a rotten spruce log for this purpose. First, I simply removed its bark and cleaned the interior with a stone adze, a wedge and a mallet. After the edges were ground down with sandstone, the shell was 50–51 cm in length. Both rims were ground from slightly oval to roughly circular diameters of almost the same size (17–18 cm and 18–19 cm). The walls near the rims were narrowed to 7–9 mm, as were the rims to 3–5 mm (Figure 2a). Before both rims were covered with cow rawhide (up to 2 mm thick, donated by colleagues), they were impregnated with linseed oil.[17] The cordage included a long strand (length 11.20 m, width 1–4 mm) used to fasten both heads (diameters 27 and 29–31 cm), and three other strands (width 2–3 mm, together 215 cm) used to tighten the cordage in the middle of the drum body and near both drumheads (Figure 2b). They all were made from the same piece of hide as the drumheads. The hide was perforated by a solid roe deer antler awl; perforations were started off by a flint blade. To tighten all the knots both ends of straps were held in a linen cloth. The finished drum weighs 2,474 g.

This kind of drum may be played with one hand while held under the other arm, or both hands when it is attached to some kind of support or suspended from a belt (one made by tablet weaving from white and brown sheep wool can be seen in Figure 2c; width 18 mm). Finger techniques may be applied when the rim is quite narrow. However, loud and clean sounds are best achieved when both heads are played with drumsticks – the heads vary slightly in frequency.

[16] Sachs 1940.

[17] This was done to prevent water from the wet hide from soaking into the wood too quickly, as the hides would dry much faster near the rims and the rest of the hide would warp (Figure 7a), preventing it from producing a good sound.

Element	Activity	Tools	Time (min)	Persons
body	removing bark	stone wedge, mallet	5	1
body	removing rotten inside	stone wedge, mallet, stick	10	1
body	grinding the exterior surface	sand stones	140	1
body	grinding the interior surface	sand stones	45	1
body	applying linseed oil on the rims	linen cloth, hand	3	1
membrane	soaking the cow rawhide	vessel, water, stones	2 days	1
membrane	cutting both circles and all the stripes	flint blade	32	2
drum	fastening hides	flint blade, antler awl, linen cloth	48	2
drum	drying hides	—	3 days	x

Table 2: Main steps in making a cylindrical double-headed drum from a spruce log and a cow rawhide (2020–22).

2.3 Wooden goblet drum

Goblet and hourglass drums have been made from various materials, including wood and they have a rich tradition in many cultures, especially in Africa or Eurasia.[18] The oldest examples were found in Neolithic China,[19] and depictions, which are much closer to our European contexts, come from the ancient Near East.[20] Although there is no archaeological evidence of wooden goblet drums in European prehistory, their counterparts in pottery have quite obviously raised questions in archaeologists' minds. The presented reconstruction is based on a well-preserved TRB ceramic drum body found in the Salzmünde settlement pit together with other pottery vessels and two stone arrow-heads in Prague 5 – Řeporyje.[21] It has a typical funnel beaker shape with a rim wider (27 cm) than its height (22 cm) and its base (13.3 cm). The body is 5 mm thick and just above the narrowest part are five simple lugs.

Three different methods of drum body production were deliberately combined during this reconstruction – shaping with bone and stone tools, grinding with sandstone and burning (Table 3). After removing the bark from a pine log (28 cm wide), which had been drying for two years, the log was shortened to almost the desired length by burning at both ends (Figure 3a). The parts of the log intended for use were soaked and protected by clay mixed with water. Both ends were

[18] Sachs 1940.
[19] Lawergren 2006.
[20] Dumbrill 2005.
[21] Kuchařík 2008.

Figure 3: A wooden reconstruction of a TRB goblet drum from Prague 5 – Řeporyje.
a: shortening a pine log by burning; b: burning the upper interior part; c: the polished interior of the upper part (notice the cracks caused by burning). Photos by the author.

levelled by grinding with various pieces of sandstone. Then the upper and lower parts of the interior were burned out and removed with stone wedge and bone wedge. It was very important to maintain just a small fire, intensify and direct it with a blowing tube and to protect the finished parts by applying wet clay to them (Figure 3b). Furthermore, the whole interior surface was ground and polished using various pieces of sandstone (Figure 3c).

The exterior surface was shaped (chopped and chiselled) based on the archaeological model with stone axe and adze, bone and stone wedges and a wooden mallet (Figure 4a-b). Pine wood of this diameter has quite strong fibres and proved to be rather unsuitable for fine woodworking, and therefore the lugs were made much coarser and larger than their originals; the same reasons led to much thicker walls – up to 2 cm. The surface was ground and polished using sandstones of various grain sizes (Figure 4c).

A skin membrane and strands for attaching it were cut from one piece of a goat skin (max. 1 mm thick), which was processed in the same way as in the first example – by removing flash, fat

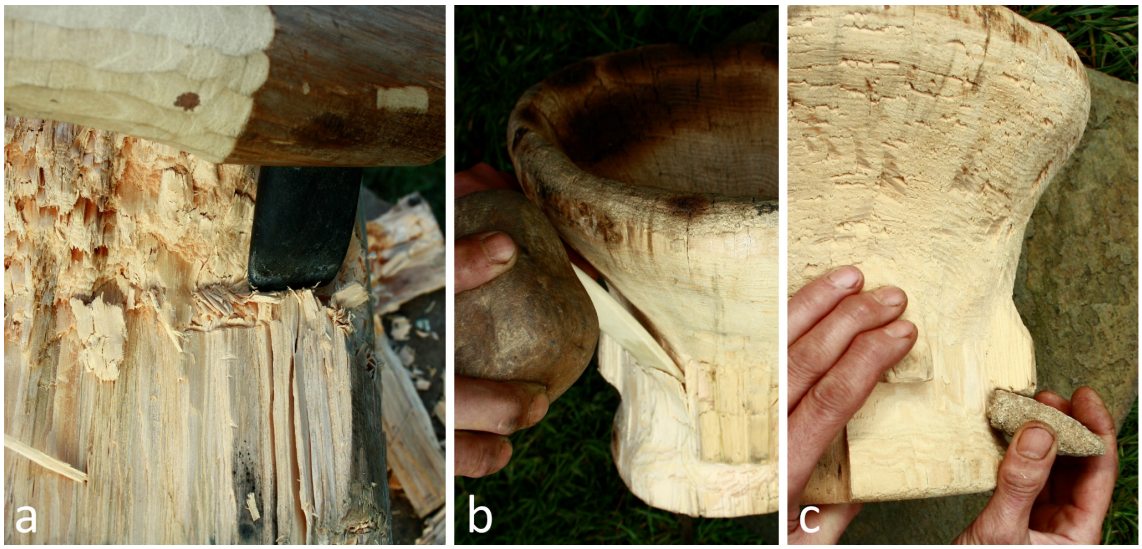

Figure 4: A wooden reconstruction of a TRB goblet drum from Prague 5 – Řeporyje. a/b: shaping of the exterior with a stone axe and bone wedge; c: grinding and polishing a lug with sandstone. Photos by the author.

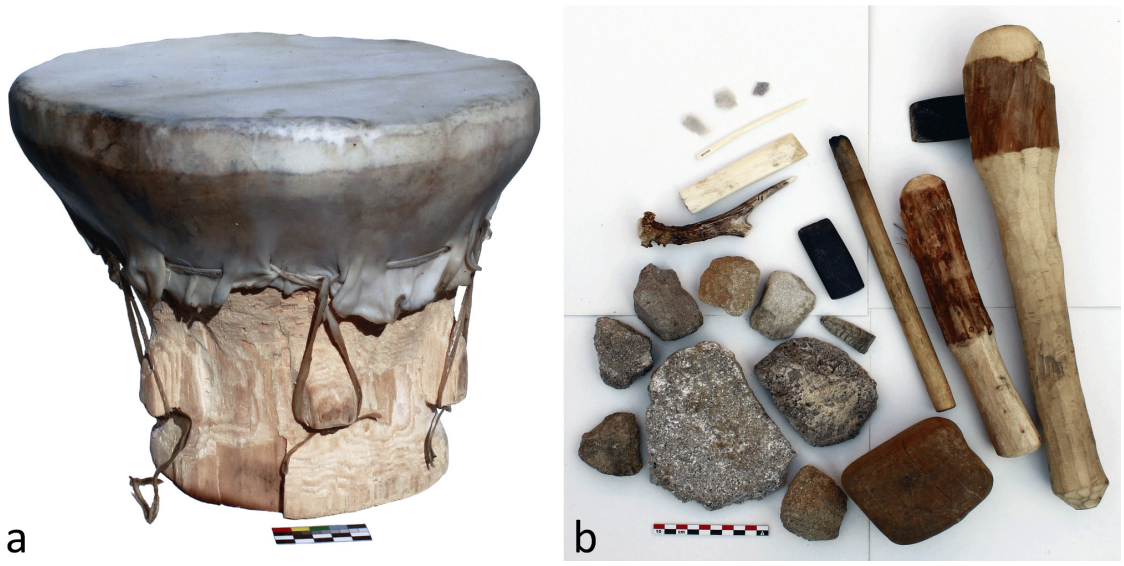

Figure 5: A wooden reconstruction of a TRB goblet drum from Prague 5 – Řeporyje. a: the finished drum with a goat skin; b: replicas of tools from the periods in question used in this reconstruction. Photos by the author.

and hair. The skin was perforated using a bone awl, and a long skin strap (dry length 95.5 cm, wet length 97 cm) was threaded through 23 perforations with a bone needle. With the help of a linen cloth, this strap was fastened with five other straps to the lugs. Two persons were required to stretch and fasten the skin to the drum body. The finished drum (Figure 5a) weighs 1,733 g. Six months later the drum lost its voice, as its body shrunk, therefore the skin had to be slightly soaked, removed (12 min.), attached and fastened again (11 min.). This drum produces quite a low sound.

2.4 Comparison of a pottery and a wooden goblet drum reconstruction

2.4.1 Replication of a pottery vessel drum

The comparison between manufacturing a drum from wood or from clay is relevant when the same type of TRB funnel-shaped drum is considered. Therefore, from a set of replicated Late Neolithic pottery drums, I present the reconstruction of a TRB drum excavated from a settlement layer C2 at the eponymous hilltop site at Jevišovice – Starý Zámek in Moravia.[22] The complete drum is 22.7 cm high, with a 24.8 cm wide rim and 10 cm wide base. It has six eyelets near the waist. The first step in replicating prehistoric pottery is to prepare the potter's clay – in this case two clays were mixed together with a temper (crushed granite, sand) to obtain a material similar to the prehistoric one. Replicating archaeological finds requires adding approx. 12 % to all the dimensions, as the clay shrinks during firing.[23]

This replica was manufactured upside down – starting with the upper part on a board (Figure 6a) – from coils, which is a common technique recognisable in Late Neolithic pottery in Central

[22] Mašek 1954: 652–3, Figure 299.1; Medunová-Benešová 1981: 28, Table 3.6.
[23] Aiano 2006.

Element	Activity	Tools	Time (min.)	Persons
body	removing bark from a log	stone wedge, wooden mallet	5	1
upper part	chopping a groove for burning	stone axe	15	1
upper part	creating the upper side by burning	firewood, charcoals, blowing tube	530	1
upper part	levelling the upper side (rim) by grinding	sandstone	40	1
lower part	chopping a groove for burning	stone axe	12	1
lower part	creating a base by burning	firewood, charcoals, blowing tube	450	1
lower part	levelling the base by grinding	sandstone	136	1
upper part	burning the interior	sticks, charcoals, blowing tube	310	1
upper part	grinding the interior surface	sandstone	210	1
lower part	burning of the interior	firewood, charcoals, blowing tube	355	1
lower part	grinding and polishing the interior surface	sandstone	80	1
body	chopping the exterior surface	stone axe	99	1–2
body	chiselling the exterior surface	stone adze and wedge, wooden mallet	192	2
body	grinding and polishing the exterior surface	sandstone	320	1
membrane	soaking a goat skin	vessel, water, stones	1 day	1
membrane	cutting a circular skin and skin strips	flint blade	17	2
membrane	fastening the drumskin and fixing it with skin bands	bone awl, bone needle, linen cloth	17	2
membrane	drying the drumskin	—	2 days	1

Table 3: Main steps in experimental making of a TRB goblet drum (Prague 5 – Řeporyje) from a pinewood log and a goat skin (2021).

Europe. It is also possible to make two parts and join them together. The body was shaped and smoothed simply by hands, or with a bone or wooden chisel or pebble. Once the body dried to leather-hardness, six eyelets were attached to it. The drum was fired months later in an open fire (Figure 6b).[24] Unexpectedly, during the firing a light cold rain rapidly lowered the temperature of the vessels' surfaces, and some of them cracked, including this drum.

Despite this fact, the goat skin (up to 1 mm thick) was stretched and fastened, but one eyelet broke off and the skin was attached using a strand of skin threaded through 22 perforations under the rim (Figure 6c, 7c). This method of attachment can be applied to any vessel with a conical upper

[24] Together with other vessels during experimental firing in the reconstruction of a Late Neolithic hearth situated on a platform formed from clay, stones and old pottery sherds (Boubelová and Chroustovský et al. 2018).

Figure 6: Replicating a TRB goblet drum from Jevišovice in Moravia.
a: fresh clay bodies of drums from Jevišovice and Malemort (France); b: firing of both drums in an open fire; c: the finished drum with goat skin. Photos by the author.

Element	Activity	Tools	Time (min.)	Persons
body	preparation of potter's clay	coarse linen cloth	—	1
body	forming a body from pottery coils (rollers)	stone pebble, bone chisel	420	1
body	forming knobs on the lower part	bone chisel	60	1
body	drying of the clay body	plank	14 days	
body	firing the clay body	open hearth, firewood	360	1
membrane	soaking a deer hide	vessel, water, stones	180	1
membrane	cutting a circular skin and strips	flint blade	15	2
membrane	fastening a drumskin and fixing it with skin bands	bone needle, textile	19	2
membrane	drying of the drumskin	—	2 days	—

Table 4: Main steps in replicating the pottery TRB goblet drum from Jevišovice (2017).

section because after the skin dries and shrinks it cannot come loose. The finished drum weighs 3,300 g. The drum can be played by one or both hands and when dried well the skin produces a nice dry and bright sound.

2.4.2 Comparing replication in clay and in wood

Considering material requirements, simple frame drums are the easiest option,[25] followed by cylindrical drums made from logs that have rotted inside.[26] Standard logs for manufacturing vessel

[25] When a frame is made only from a bent branch in which case the membrane has to be highly strained to produce a satisfactory sound.

[26] Such logs produce resonating idiophonic sounds without any modification when beaten or when some other sound tool or instrument is placed on them (e.g. Lund 1991: 37 Figure 17). They are irreplaceable sources for segments usable as frames for frame drums.

drums should be stored for several years – depending on species, diameter and environmental conditions – to provide a good raw material that will not crack. Potter's clay must also be made in advance and stored in the proper conditions. However, once prepared it can be quite easily modified to fulfil intended tasks, e.g. to add more temper for larger vessels with thin walls like the Late Neolithic drums.

Cleaned raw skins and hides were probably the common raw materials available in prehistoric villages – for drum making, the thinner and stronger the better for vibrations and resonance. Aside from traditional domestic animals (goats, sheep, cattle) and wild species (red, roe and fallow deer), it is possible to use fox, dog, badger, wild boar or even otter or fish skins for smaller drums.[27] The preparation of skins/hides is very simple in the presented examples, but various techniques may be used.[28] It is possible that different skins/hides would need different attachment techniques. The skins/hides used for drumheads serve effectively as sources for cordage, because as they dry they compress in the same way as membranes and can be fixed much better than any other material (leather, or any other plant fibres, including a bast) would do; however sinew would also work well.[29]

Considering the necessary toolkits, skills and time requirements, frame drums are again the fastest to produce. The knowledge and skills for woodworking are documented by the archaeological record (see above). Nevertheless, knowledge of drumming via vibrating membrane must be present. Pottery drums are easily made by skilful potters using only simple tools.[30] Since the Neolithic, people have been able to manufacture various vessels from prepared potter's clay and fire them successfully (in an open fire, a pit, or simple pottery kilns).

When considering the handling of goblet drums and playing techniques, wooden ones are without a doubt more durable during transport, handling and performance, as they can surely survive vigorous use or being dropped on the ground, unlike thin-walled pottery drums. Both materials have to be kept in dry places, however wood absorbs moisture – providing the appropriate conditions for mould – whilst ceramic drums may be fired again to get rid of mould.

Drum making involves many risks, such as hairline or large cracks in the body (Figure 7b), which can prevent a drum from producing a solid sound. For the most part, cracking is caused by rapid changes in temperature while firing a pottery drum or burning the interior of a wooden one.[31] Another major risk lies in the breaking of an important functional feature like lugs, eyelets

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[27] Aiano 2006.

[28] Cf. Aiano 2006; Alebo 1986.

[29] Aiano 2006.

[30] During archaeological workshops for the public held at the open-air museum in the Pilsen ZOO (e.g. Boubelová and Chroustovský 2018), people of any age were able to make usable pottery vessels under the tutelage of a professional potter. However, to manufacture a middle to larger drum body with 5 mm thin walls requires an experienced potter.

[31] Late Neolithic drums in Central Europe were probably fired mainly in open hearths or pits, as there is no evidence of pottery kilns. The most unreliable firing method is in an open fire as it is the most vulnerable to weather changes, including strong winds or precipitations. Of the nine pottery drums made by the author or his colleagues, five cracked during firing. The wooden version of the Prague 5 – Řeporyje drum suffered

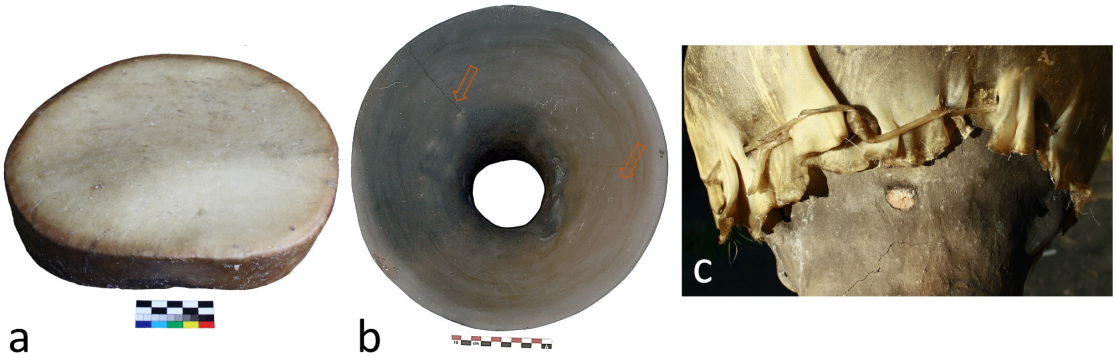

Figure 7: Reconstructions of prehistoric drums involve risks such as warping of drumskin (a), cracks in the shell (b) or breakage of lugs (c). Photos by the author.

or handles (Figure 7c). Based on my experience, this can be prevented by making such elements more robust in wood or by achieving proper firing in clay.[32]

Sound production is influenced by many factors, such as the volume of resonating space – the greater the volume the lower the frequencies –, overall shape – wide shallow bowls on long feet provide higher frequencies than deeper bowls on shorter feet, even if their resonating volumes are equal –, wall thickness – the thinner the walls, the brighter the sounds –, rim diameter – the larger it is, the more playing techniques can be applied and the more pitches produced –,[33] and the material of a body – vibrations caused by oscillation of a membrane transmit to the body. Especially in double headed drums, the ceramic surface is much harder and reflects sounds better than wood, and a ceramic body provides drier, higher and brighter sounds. In addition to the body, the membrane also plays a major role in sound production. In general, the thicker the skin, the shallower and duller the sound. Even though any flexible skin may function as a drumhead, subtle differences are recognisable between various species. The tightness of a membrane also largely impacts the frequency range. If a head is not tightened evenly all around the rim, it produces slightly different tones at different places – the best example is a traditional larger hand-made frame drum. Tuning in drum terminology means achieving equal tension all around a rim, or increasing/decreasing the head tension – traditionally by heating a membrane in the sun or by fire – to get higher/lower frequencies.

Volume is influenced greatly by the resonator (volume, shape, material) as evidenced by the measurements of sound pressure levels of the presented drums (Table 5). The simple frame drum – without a resonator – gives the lowest levels, followed by the cylindrical wooden resonator closed at both sides by the drumheads. Open goblet-shaped resonators of similar size vary slightly

from wall cracking – small parts even separated along the annual rings – while its interior was burned, even though its walls were protected by wetting or clay cover.

32 The breakage of an eyelet of the Jevišovice pottery replica was caused by weak firing in an open hearth caused by situational factors – rapid weather changes.

33 In general, small diameters produce only one tone, while larger diameters make it possible to play up to three different tones (deep bass tone at the centre, middle tone between the centre and rim, and a high tone at/on the rim, cf. 'bass – tone – slap' in djembe playing terms), but actual numeric values depend heavily on rim and membrane thickness.

Drum	One finger		Cupped fingers		Soft beater		Hard beater	
	centre	edge	centre	edge	centre	edge	centre	edge
frame drum	79.2	76.5	78.7	79.4	86.8	85.9	90.2	87.7
cylindrical (17–18 cm head)	89.4	81.8	85.6	88.6	95.6	90.4	95.9	87.9
cylindrical (18–19 cm head)	86	85.9	95.2	90.7	101.3	92.3	95.6	90.1
Prague 5 – Řeporyje (wooden)	90.2	93.7	96.4	99	99.5	97.2	99.1	95.3
Jevišovice (pottery)	95.1	97.3	95	97.3	103.9	98.3	101.3	95.7
Otaslavice (pottery miniature)	95.2	94.1	–	–	91.5	94.6	95.3	90.9

Table 5: Loudness (measured in decibels as maximum sound pressure levels in the measurement period, LAFmax) of the wooden drums (the frame drum – chapter 2.1, the cylindrical drum – chapter 2.2, the Prague 5 – Řeporyje drum – chapter 2.3) and ceramic drums (the Jevišovice drum – chapter 2.4.1, the Otaslavice miniature drum) according to various playing techniques (one finger, cupped fingers, soft beater – wooden stick with a leather head, Figure 1b.8, hard beater – animal bone, Figure 1b.3,5).[35]

according to their material – the hard ceramic one is a bit louder, but this also depends on playing techniques). A smaller resonator usually produces a lower level, as evidenced by the pottery miniature drum.[34] As a matter of fact, the desired character of tone may vary greatly (bright or muddy, loud or quiet, high or low tones) and anyway it is hard to define a drum sound solely on the basis of the characteristics of its body, like in the case of the archaeological finds.

In this paper we have focused on the practical aspects of drum making, handling, durability, playing techniques, and sound characteristics. Social or symbolic aspects of the different materials also deserve our attention. Nevertheless, with a huge imbalance between the evidence for pottery and wooden artefacts in the European archaeological record we have departed greatly from informed and reliable inference and can only propose general thoughts; we cannot even roughly assess the proportion of pottery and wooden artefacts in the past living culture. Pottery combines earth and fire during its transmutation from natural clay to an intentional expression of cultural knowledge and creativity – the drums forming only a tiny part of ceramic production, which has been a common practice and experience since the Neolithic. We cannot assess the importance of the transforming power of fire during burial practices.[36] On the other hand, wooden artefacts preserve their original material character, which might have been associated with various species of

[34] The miniature drum (9 cm high, 6.4 cm in diameter) was revealed at Otaslavice in Moravia (Behrens 1980: 150–53, Figure 4.2).

[35] The measurements were taken indoors (24 °C) by NTi Audio XL2 handheld audio and acoustic analyser and they were inspired by the works by B. Pomberger (2011; 2016a). The measurement periods for every drum involved 10 beats to eliminate haphazard variations of beats.

[36] Pottery drums usually accompanied inhumated – not cremated – individuals during the Neolithic. In some periods, only selected individuals were buried in burial grounds or monuments, the remains of the others were treated in ways that cannot be verified.

trees, more or less exotic, and thus could support the meaning and significance of the drums. It is also possible that symbolism was not related so much to the material, but more to decoration or other aspects (cf. Wyatt 2010).

In general, both materials being equally available, a potential difference in meaning might have been associated with specific places of their origin, or specific extraction and processing activities, including ritual aspects. Experimental results have proven that the manufacturing process of wooden drums is much more demanding in terms of energy, time, skills as well as tools, but that does not necessarily imply that such instruments would *a priori* have been associated with individuals of special status.

3 Conclusions

This paper serves as a brief contribution to the debate on drums in European prehistory. The presence of wooden drums, especially in the Late Neolithic from which hundreds of pottery drums have been discovered, has been hypothesised explicitly several times (see above). Four main examples of different materials (hard plant tissues, pottery, skins/hides), construction principles, manufacturing, playing techniques and their impacts on sound production are presented here. Considering material requirements, toolkits, skills, and energy/time requirements, simple frame drums are the fastest and the easiest option, followed by cylindrical drums made from logs that have rotted inside. On the other hand, production costs of wooden vessel drums greatly exceed those of pottery as long as we may assume that ceramic drums were manufactured and fired together with other kinds of pottery. Thin walls, which are almost always ready to crack, make ceramic drums much worse in terms of handling, playing and durability, but fairly preferable in terms of the production of clear and loud sound – in a modern ensemble they would recommend themselves for drum solos. Nevertheless, it is not possible to estimate the characteristics of sound production solely on the basis of a drum body, because a membrane (material, attachment, fastening, actual tightness) plays a major role in this regard. The presented examples are closely related to Central European prehistory, but they may serve as empirical analogies to other geographical or cultural contexts.

Acknowledgements

I am grateful to the Revived (Pre)history (non-profit) association which runs an archaeological open-air museum in the Zoological and Botanical Garden in Pilsen for providing me with some materials and manufacturing opportunities (pottery firing). Many thanks go to my friends and colleagues who supported me with their knowledge, help and materials, especially to Drahuše Chroustovská, Eva Míchalová, Lenka Černá, Robert Trnka, Vladimír Karel, Petr Křivánek and František Křivánek. I would also like to thank Oldřich Tureček (Faculty of Electrical Engineering UWB in Pilsen) for lending me NTi Audio XL2 handheld audio and acoustic analyser and for helping me

with interpreting the measures, Sky Kobylak for his kind revision of my English and the two reviewers for their comments and suggestions. Work on this paper was supported by the grant project OP Research, Development and Education: Doctoral school of archaeology: new methods, technologies and historical heritage research (CZ.02.2.69/0.0/0.0/16_018/0002686), which is financed by the European Social Fund and the State Budget of the Czech Republic.

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