

Minimal Rituals in Non-Human Great Apes: Exploring the Emergence of Structured Behavior

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Abstract

The potential for rituals in non-human great apes (apes) is an understudied topic. We derive a minimal definition of ritual, and then examine the currently available evidence for it in untrained and non-enculturated apes. First, we examine whether such apes show evidence for the two main components of our minimal definition of ritual: symbolism and copying. Second, we examine if there are actual cases already identifiable today that may fit all aspects of our minimal definition of ritual – or whether there are at least cases that fit some aspects (proto-ritual). We find that apes are not likely to spontaneously practice minimal ritual, but we claim that the highest expected likelihood of occurrence is in the results-copying domain. Yet, we did not find actual cases of minimal ritual in apes – including those involving environmental results. We did, however, find some cases that may match at least part of our minimal ritual definition – which we termed proto-ritual. At least two out of three potential cases of such proto-rituals that we identified (rain dance, object-in-ear and surplus nest making procedures) do revolve around results. Overall, apes do not show much, or very clear, evidence for even minimal ritual, but may sometimes show proto-ritual. However, dedicated ape ritual studies are currently lacking, and future work may identify ape ritual (or clearer cases of proto-ritual). We discuss the implications of our preliminary finding for inferences of ritual in the last common ancestor of humans and apes.

Keywords

non-human great apes, enculturation, ritual, copying, symbolism

Introduction

How human culture originated is an unresolved question. One approach is to study extant primates as models for early hominin behaviour. Non-human great apes (henceforth: apes) are especially relevant as they can inform us of the potential abilities of the last common ancestor of humans and the genus *Pan* (henceforth LCA). Do apes show ritual?

There are rare, but persistent, claims for ape rituals¹ - mostly in public media but also, more infrequently, in the academic literature (see below). However, the question remains as to whether any of these claims are valid. The first step in examining this issue is to define the term ‘ritual’, in order to have a template against which we can measure ape behaviour. In humans², rituals are said to largely consist of a ritualised *action*, which is “any action that is

¹ In our piece, and for the phylogenetic reasons given above, we will concentrate on non-human great apes. This is not to say that there is no debate of animal ritual outside of apes (there is; e.g. Watanabe & Smuts 1999).

² Here we will be guided by this definition of human ritual taken from developmental/cross-cultural psychology – not only because these fields are traditionally close to comparative cognition research, but also because of

typically causally opaque and goal demoted as a consequence of the repetition, redundancy, formality, and stereotypy of the motor features, and where accurate performance of process is prioritized over outcome” (Kapitány & Nielsen 2019, p 172). Additionally, these actions are said to be performed “for social reasons” (p 173).

We note that there is one large piece potentially missing from the human ritual definition above. It is possible that rituals cannot exist without language, if language is required to transmit the general concept of a ritual. Or, more fundamentally, language might be required because the goal of the ritual is, in essence, symbolic and thus *arbitrarily* linked to the ritual actions (e.g., to pray for happiness only when the sun rises; symbol here defined as “point[ing] arbitrarily to their referents” (Wadley 2001, p. 206).). If full-blown language is necessary for rituals to be maintained, there might be little hope to find spontaneous rituals in apes (and we cannot ask the apes, either). However, single human ritual *performances* themselves can be language-free (imagine a solemn, silent ceremony). Therefore, while language is (at least often) a key component, it may or may not be a *necessary* component of all rituals (we remain somewhat agnostic in this respect). In our preliminary search for ape ritual behaviour, we will therefore intentionally ignore the linguistic component, thus providing apes with a potential to show rituals.

We believe that the definition of human ritual described above is a good starting point applicable to apes. A minimal variant of the definition is necessary because it is possible that some of the features of human rituals are idiosyncratic to our species and that they do not necessarily need to be present in order to constitute ritual in other species (including early hominins and the LCA). In addition, in a first search for ape rituals, we should look primarily for general ability and for every *potential* candidates, and here it is useful to not be too restrictive in terms of definitions. We therefore believe (and hope to make a convincing case) that the ritual definition can and should be both slightly relaxed and somewhat condensed, and thus derive an *ape/animal variant*. We call this the ‘minimal ritual’ definition. Next, we will examine if at least any of the remaining core elements of the minimal ritual definition can be found in apes. Finally, we will assess whether apes show any convincing potential cases of spontaneous rituals (fulfilling all our minimal ritual criteria) or proto-rituals (at least potentially fulfilling at least parts of our minimal definition).

The minimal “ape” definition of ritual

We will *keep* several aspects of the current human ritual definition largely *unchanged* – though we shall distil these arguments to their essence.

Even minimal rituals are and must be symbolic

Although the human definition of ritual above does not specifically use the term ‘symbolic’, we believe that symbolism can be distilled from it, in the following way. According to the human definition above, rituals must be perceived in an extra-ordinary way *and* must be interpreted from a “social or normative point of view” (Kapitány & Nielsen 2019, p 173)³. Ritual actions and/or results must therefore gain “social significance” (Kapitány & Nielsen 2019), and do so through the ritual itself. The significance created must therefore also *extend beyond the actor* (it must be *socially shared*) and must exist at least in part *because* it is so perceived by others (though see below for a case we call private ritual, which would be a conceivable variant of ritual that would lack this aspect). That is, rituals should be **social** (or even normative).

their heavy use of (and expertise in) experimental approaches (and which we hope will be triggered in the case of apes by our piece).

³ Here we will not address normativity. We believe that normativity is adding yet another layer that is not necessary for the minimal definition of ritual.

Part of what makes human rituals “extra-ordinary” is their **causal opacity** (Legare & Souza, 2012; Legare, Wen, Herrmann, & Whitehouse, 2015; Kapitány & Nielsen 2019). For example, if certain actions bring about a causal effect that itself may be the goal of the action (i.e. when the actions are *instrumental*) then they do not qualify as ritual (Watson-Jones et al., 2014). The actions (and/or results) must therefore be *arbitrarily linked to the goal*. Human rituals must also have what might be called *goal opacity* (usually called “goal demotion”; e.g. Schjoedt et al., 2013; Boyer and Liénard 2006; Kapitány & Nielsen 2019), meaning that the goal of the ritual must also not be directly deducible from the actions or results themselves (compare Legare & Souza, 2012).

Consequently, we have to have causally and goal opaque actions and/or results (excluding *ordinary* cases that lead in a *direct* way straight to the goal), and these *also* have to create social significance. This means we would have to a) exclude any direct relationship (and any naturally/sexually evolved or by-product relationship, see below) between behaviour and outcome. Furthermore, b) this would only leave *indirect*, opaque relationships – arbitrary relationships - which also have to create social significance. We interpret all this as a need for the ritual to be symbolic. Therefore, we conclude that one or more of the actions or object constellations or object changes⁴ involved in a ritual must gain a *symbolic feature* – as an effect of the ritual (during or after the ritual). The alternative view, that the ritual merely creates or fosters *social meaning* (directly or indirectly) seems unfeasible, because, if that were the case, all communication would be ritualistic. And so, what would need to be demonstrated in apes is that the ritual creates *some* symbolic feature⁵. Rituals must be symbolic.

Naturally and/or sexually selected actions (and outcomes) and their byproducts are not symbolic and therefore not rituals.

As an example of ordinary behaviour (here, as an adaption in the context of sexual selection), in the courtship display of crested grebes, the grebes engage in complex actions (they can even seem mirrored), and also offer nesting materials (results). Are these actions and results symbolic? We would argue they are not, because if we were to accept courtship displays as rituals, then all displays involving ‘ritualized’ (and any evolved) signals in nature would be rituals. First, most of these cases are presumably not intentional, in the sense that the signaller intends to communicate to the recipient, as shown by a variety of criteria (e.g., Townsend et al. 2017). Second, such actions may be index or handicap signals (signals that reflect quality or ability) or meant to signal conspecificity (species matching) etc. All this makes the signals *non-arbitrary*, since their form must reflect specific qualities. Thus, arguably, naturally and or sexually selected actions and their results should not be equated with rituals. This is not to say that rituals have no *function* (they may, and indeed often do). However, it is to say that biologically evolved, functional forms of actions and/or results are not rituals.

Rituals are and must be copied

Rituals must show stereotypical, accurately executed actions⁶ (Kapitány & Nielsen 2019). *Together* with the requirement that rituals cannot be evolved traits (or their by-products), this strongly implies that these actions and/or resulting object changes must be

⁴ Henceforth all aspects involving objects in rituals will be subsumed under the term “results”.

⁵ We accept that our interpretation towards symbols may be idiosyncratic, but our outcomes below are unaffected by whether we use the term extra-ordinary or symbolic. Alternatively, our use of the term symbolism could be exchanged for “arbitrary, yet socially understood relations”. For brevity and clarity sake, we will keep with the term symbolism.

⁶ This may be different in apes, but we retain this feature for this first paper on topic.

culturally transmitted. In other words, they must have been **copied**, using copying social learning mechanisms. More precisely, rituals must therefore *require* copying. Actions or results must therefore not merely be cultural, they must have been copied, in order to (potentially) be rituals. This difference is important, because copying is not a necessary requirement for culture. Instead, any social learning mechanism (and there are many) can lead to culture (thus, culture is indeed very widespread in the animal kingdom, including in apes: Neadle et al. 2017). But most social learning mechanisms are non-copying social learning mechanisms. They do not produce copies – instead, they lead to “socially mediated reinnovation” (Bandini & Tennie 2017). That is, most social learning variants are merely modulating (and stabilising) the *frequencies* of the expressions of individually derived behavioural forms (Tennie et al. 2009, in press) – but, again, this then counts as culture in each case (Neadle et al. 2017). But, to even potentially count as ritual, copying must be involved. For a possible exception, where ritual might not be copied, see “private ritual” below.

Changes to the human definition of ritual

While *human* rituals do not “typically” (Kapitány & Nielsen 2019) cause physical changes, other species’ rituals might (if they exist). Furthermore, given that ape social learning is already known to be different from humans in that it is *results focused* (including paying attention to and matching object changes/movements: Hopper et al. 2008), for *apes* (and other animals in general) we will allow for the possible presence of *results-based* rituals in addition to action-based rituals. And so, in apes we will look for potential ritual status of **pure actions**, *as well as* potentially ritualized **actions towards and with objects**. Additionally, we will consider **results entirely on their own** (i.e. object constellations and object changes regardless of the actions that brought them about).

Human rituals are said to be **repeated and redundant** (Kapitány & Nielsen 2019). Here we may differentiate between repetition *within* a given ritual event, and repetition *across* ritual events. It is not clear *a priori* whether repetition *within* a ritual event is a necessity for ritual. For instance, the blowing out of candles may be the only ritualistic action (with associated results) at a minimalistic birthday event – yet it only happens once for each instance of these events. We will therefore also leave out this criterion for apes (but will note when/if it occurs). To fulfil the ape ritual definition, for now, a single event is the minimum requirement for our definition of ritual. As reflected in the “maximum” definition of human ritual above, the criterion of redundant repetition within a given ritual event may itself constitute, or add to, the causal opacity (“why repeat an action once its result is achieved?”), and therefore we will not specifically mention it in our minimal definition.

Repetition *across* ritual events may be caused by a link between the ritual and events/occasions/domains, such as, someone’s death or the onset of the rainy season. We agree that finding such a correlation can, in practice, help to detect ritual. Imagine an observer of another group who does not speak their language; she could recognize rituals by this kind of repetition and the link to particular conditions (even though logically, this criterion may not be absolutely required and so we will leave it out of our definition). Even so, we will make use of repetitions below for practical reasons.

The minimal “ape definition of ritual” can now be stated as follows:

Rituals consists of socially shared, symbolic feature(s) that are created via actions and/or results that require copying.

It might be argued that our minimal ritual definition has become too broad, and that it might capture too many things that are not ritual. This is a valid theoretical concern, but as we will show below, empirically (at least in the case of apes), this concern is – at least currently – unfounded: only few potential cases can currently be detected even when using such a broad definition. And arguably, regardless of how many cases may be uncovered, in a first sweep for ape ritual, it is best to use a broad definition so as not to produce false negatives early on. Indeed, given also that we are unaware of even a single study specifically *aimed* at examining the existence of ape ritual (which we encourage all readers to perform), a minimal definition like ours is arguably the kind of liberal approach that is most useful to start any investigation into a new phenomenon. Once ape ritual is found using this minimal definition, further distinctions may then be introduced, but until then, we surmise that a minimal definition serves its purpose, if only to guide the research itself. Of course, our minimal definition may instead also still prove too demanding (but in fact, we will relax our definition even more below, introducing what we call proto-rituals).

Do apes have the necessary abilities for spontaneous ritual?

The goal of our paper is to examine whether apes have ritual – as a phylogenetic proxy for the LCA. Towards this goal, we must ask whether apes have *spontaneous* rituals. We must, in other words, exclude ritual *passed on to apes* by humans, be it directly or indirectly (as humans were also not present to pass these skills to the LCA). Therefore, only data from non-enculturated, untrained apes will be considered here (compare Henrich & Tennie 2017). When we speak of apes below, we therefore exclusively report evidence from non-enculturated, untrained apes (these will be simply referred to as "apes" below).

Before we will look at specific potential cases of ape rituals, we will first – more generally – look for evidence that apes possess the necessary basic abilities to perform the constituent *parts* of the minimal ritual definition. We will start by looking for evidence of symbolism, followed by evidence for copying.

Symbolism in apes?

Human life is drenched in symbols to the extent that Deacon (1997) called humans the “symbolic species”. Although apes can communicate about absent entities (Bohn et al. 2015), they do not seem to produce nor understand iconic gestures (i.e. gestures that resemble their referents, such as the gestures associated with the game rock-paper-scissors), as reviewed in Tomasello & Call 2019). The same is true for iconic *objects*, i.e. objects that resemble the original object⁷: Iconic objects are neither understood, nor produced, by non-enculturated apes (e.g. Herrmann et al. 2006). This is particularly informative because iconic gestures and iconic objects are at least “reality-resembling” and thus should arguably be easier to understand or produce than conventional symbols (which have instead arbitrary relationships, such as the word “symbol” to represent *symbol*). Thus, iconic gestures or objects might be best referred to as proto-symbols and, again, they are not understood (or produced) by apes. This conclusion also seems to hold for ape communication in the wild, despite a few as of yet unclear (but rare) cases (Bohn et al. 2019).

In the case of conventional symbols (arbitrarily connected to their meanings), it is generally understood that ape usage and production is not spontaneous, and that it requires very long human training and/or enculturation. Overall, then, the seeming lack of spontaneous pre-symbolic and symbolic skills in both comprehension and production make it unlikely that apes can spontaneously have ritual.

⁷ i.e. object *cues*, often referred to as replicas. Replicas: objects representing/resembling other objects, e.g., photographs of objects or physical replicas.

Copying in apes?

It has been established in recent years that many, or possibly all, ape communication forms do not require copying (Byrne et al. 2017), and similar conclusions were drawn for ape tool-use and subsistence forms (Tennie et al. 2009, in press). True, when experimentally tested, apes do spontaneously *match* what they see demonstrated in two-action, two-results experiments (e.g., Whiten et al. 1996). But, firstly, this match is likely based on their registration of results, not of actions (Tennie et al. in press; compare data in Hopper et al. 2008). Secondly, apes' matching abilities most likely do not move beyond skills that are part of the natural innovative repertoire: these abilities do not move beyond the individual level (also called "latent solutions"; Tennie et al. 2009, in press). Supporting this conclusion, *all* demonstrated options ("targets") of past experiments also occur spontaneously (individually) outside demonstrations, showing that these tasks did not *require* copying (reviewed in Tennie et al. in press). When experiments make copying a *requirement* to succeed, apes do not copy actions (Tomasello et al. 1997, Tennie et al. 2012, Clay & Tennie 2017)⁸ or even results (Tennie et al. 2009). Overall then, apes do not seem to copy when copying is required.

In theory, specific *variants of teaching* (namely those that produce copies) could also lead to copies of form. However, there is very little evidence for *any* variant of teaching in apes (the most complete case being Musgrave et al. [2016], and even here no copies were produced). Importantly, apes do not actively *make* each other copy actions (action-based teaching) and they also do not mould others' actions (teaching by moulding). They do not teach by punishment for wrong actions either (what we may call "teaching by honing").

The apparent lack (or extreme rarity) of action-copying skills (both passive and active: the latter would be a variant of teaching), likely means that apes cannot produce or maintain action-based rituals. The picture looks a little brighter when it comes to results copying. While, again, apes do not seem to match results demonstrations beyond what they could do on their own even, at least here they frequently *do* match such results (reviewed in Tennie et al. in press). Consequently, if apes have rituals at all, they are perhaps *more likely* to have rituals when these revolve around results rather than actions⁹.

Selection of potential examples of ape rituals

The above analysis of the potential presence or absence of the *constituent core elements* of our ape ritual definition in apes has led to the conclusion that apes are rather unlikely to spontaneously have even minimal ritual. This is because they do not spontaneously produce symbols (or even proto-symbols), and they do not show copying when it is *required*. The most likely possible exception is results-based ritual. In our search for examples, we looked especially for cases whose form (~design) may *appear* copied and/or where the behaviour may *appear* to be symbolic (e.g. by seeming extra-ordinary). These foci directly follow from the two main components of ritual (copying and symbolism) examined above. Nevertheless, in line with the experimental evidence we highlight above, the vast majority of cases turn out to be best explained *without* reference to copying and/or symbolism. That is, the vast majority of cases do not fulfil even the minimal definition of ritual.

Generally, we must note that the topic of ape ritual is not often academically discussed. A google scholar search of "ape ritual" on 2nd September 2019 produced a meagre total of three results (none of them actually about apes). Likewise, searching for "apes ritual"

⁸ Only one single ape (with a somewhat unclear background) ever clearly matched an observed action in one of these controlled action copying tasks – but even he merely matched an action that was already in his repertoire (Tennie et al. 2012).

⁹ Note that a lack of copying would not affect the case of possible "private rituals" in apes (see below).

on the same day produced zero results¹⁰. The list of potential cases below was therefore primarily created by the authors, in conjunction with discussions with other primate researchers. Note also that, where other authors might have claimed for ape rituals, they have used ape ritual definitions different from the one we apply here.

Cases that do not require copying and also do not require symbolism

Culturally unconnected populations effectively represent different cultural paths. A presence of copying would lead to path-dependent forms, whose effects cumulate over time. This is unavoidable, given that every variant of copying comes with *copy error* (Eerkens & Lipo 2005). This implies that, if any ape behaviour is really based on copying, it will by now necessarily have to show population differences in form (at least in a subtle way). And given that we established that even minimal ritual must be based on copying, ape behaviour that is ritual according to this minimal definition *must* differ in form *between populations*. Or to put it differently, ape behaviour that is *similar* across culturally unconnected populations (distant populations) can almost certainly be dismissed as not fulfilling the requirement of copying.

As for symbolism, we can pose that this is most likely to be found in cases for which there is no good, non-opaque, ordinary explanation yet. In the last fifty or so years, ape behaviour has been intensely studied. This effort uncovered ordinary explanations for many behaviour patterns, many of which initially seemed extra-ordinary (see below). While we are nowhere near a complete understanding, on the whole, most of the observed ape behaviour is therefore no longer mysterious – and, with it, no longer potentially symbolic. However, a few cases remain that currently are not well explained.

Our first example is “accumulative stone throwing”, where “chimpanzees habitually bang and throw rocks against trees, or toss them into tree cavities, resulting in conspicuous stone accumulations at these sites” (Kühl et al. 2016, p 2). Public media declared this behaviour ritualistic (e.g. Hopper 2016). However, *first*, the behaviour was observed – *in similar form* – across several distant (i.e., likely culturally unconnected) populations of chimpanzees (Kühl et al. 2016) – hence is unlikely to require copying. *Second*, while the behaviour at first seemed immune to ordinary explanations (though Kühl et al. 2016 actually listed such possibilities) an ordinary explanation has since been found. The trees that are targeted by the throwing behaviour have favourable acoustic properties *for display purposes* and are specifically selected for stone throwing because of this (Kalan et al. in revision). Overall, then, accumulative stone throwing in chimpanzees is likely an ordinary behaviour (functionally transparent and favoured by natural and/or sexual selection), which in addition does not require copying. It therefore fulfils none of the major components of our minimal ritual definition and is therefore not a ritual.

Another claim for ape ritual made in public media is mourning and other death-related behaviours (subsumed under the umbrella term thanatological behaviour; see e.g., Gonçalves & Carvalho 2019). Occasionally, this claim also appears in academic writing (Harrod 2014). Yet, not only do the vast majority of the described behaviours again appear across many culturally unconnected populations, they even re-appear in *different species* of apes (and also other primates; compare Gonçalves & Carvalho 2019). That is, these behaviours very likely do not require copying. In addition, and perhaps surprising at first, thanatological behaviours are likely ordinary. Roughly speaking, on the level of both species and individuals they correlate with behavioural and ecological constraints and with social investment. For example, everything else being equal, there is more/longer thanatological behaviour from a

¹⁰ We also searched for “[ape species] ritual” and “ritual[s] of [ape species]” and “rituals of the [ape species]” and “rituals in [ape species]”, but these searches also did not lead to many hits. The few hits mostly led to thanatological descriptions (which we cover here) or to very esoteric approaches to ape ritual (which we do not cover here).

close relative of the deceased than from a more distantly related individual. The same is true for investment: a close ally will receive more/longer thanatological attention than others, perhaps serving to guard against a false conclusion of death (see Gonçalves & Carvalho 2019 for an excellent recent review of the topic). A possible exception to this general pattern is one population of chimpanzees who sometimes threw twigs at dead conspecifics. However, the same chimpanzees also generally showed such behaviour towards other dead animals – plus, *several* different primate species also throw objects at other species (Gonçalves & Carvalho 2019). This behaviour too, therefore, does not require copying. Yet, it is noteworthy, as such covering in thrown objects might constitute a potentially alternative explanation for some hominin “burials” patterns that might be found.

Although the literature on animal courtship often speaks of “courtship rituals”, this does not make them rituals according to our minimal definition. Sometimes, however, the claim is more clearly made that certain courtship behaviour is copied. Perry (2016) described potential candidates for socially learned “communicative rituals” in chimpanzees, among them leaf-clipping behaviour. Arguably, this behaviour (and its associated meanings) remains somewhat understudied, so the situation would benefit from more data (Kalan & Boesch 2018). Still, what can already be said is that the actions (*and* the results: clipped leaves with associated sounds) seem to reappear across unconnected populations. At the majority of chimpanzee sites, leaf-clipping is performed with the mouth - but there is also a version where chimpanzees do leaf-clipping by hand (Whiten et al. 1999). However, even the latter version is being performed in several culturally unconnected places - namely at Tai, Kibale and Budongo (and sometimes also at Mahale's M-group; Whiten et al. 1999). Given these repetitions, the various forms of leaf clipping are unlikely to require copying (a conclusion we share with Fröhlich & Pika 2019). Importantly, the various described *meanings* of leaf clipping *also* re-appear across culturally unconnected populations. Thus, chimpanzees in Bossou (Guinea) produce leaf clipping in association with a *variety* of meanings seen elsewhere for leaf clipping, and this also *includes* the meaning of courtship (in total the meanings in Bossou include frustration, copulation (courtship) and play; Sugiyama, 1981, as cited in Kalan & Boesch 2018). Most importantly, all these meanings associated with leaf-clipping are ordinary. In summary, leaf-clipping neither requires copying nor requires the assumption of extra-ordinary, symbolic meanings. For the time being we therefore conclude that leaf clipping should not count as ape ritual.

There are many more ape behaviours that may at first sight appear symbolic and/or copied (we are unaware of published claims for ritual in these cases but have encountered such claims verbally). But, first, they also re-appear across culturally unconnected populations (i.e. are likely uncopied and/or are ordinary). In addition, second, there are well-described ordinary explanations for these behaviours – they are therefore also not symbolic. For example, this list includes Macchiavellian behaviour (e.g. Whiten & Byrne 1977); grooming styles (reviewed in Tennie et al. 2009; for claims of ritual instead, see Perry 2016); using sticks as play objects (Kahlenberg & Wrangham 2010); hunting (e.g., Gilby & Wrangham 2007); patrolling (e.g., Langergraber et al. 2017); killing (e.g., Watts 2004); travel direction communication (van Schaik et al. 2013), and kiss-squeaking sounds with leaves (which makes the emitting individual appear bigger: Hardus et al. 2009).

Cases that do not require copying but that may be symbolic (proto-rituals)

Next we will turn to cases whose forms still do not require copying (as they appear across unconnected populations) but which, at least currently, escape an ordinary explanation. These cases may therefore be symbolic, and to mark their special (and rare) status (no

copying necessary, yet perhaps symbolic), we will label these proto-ritual¹¹. Note that we would have labelled cases that are not symbolic, but that seem to require copying as proto-rituals, but we did not find any.

One proto-ritual is **object-in-ear** behaviour, best known from a study in which chimpanzees placed grass blades into their ears (van Leeuwen et al. 2014). The behaviour currently escapes ordinary explanation (and thus may be symbolic). But – again – the behaviour also appears elsewhere and thus does not depend on copying (captive chimpanzees at other institutions have also been observed to insert elongated, thin objects into their ears; namely at Bastrop, Texas, Dr. Lydia Hopper and Lisa Reamer, pers. comm; and at Leintal zoo, Germany, Alba Motes-Rodrigo, pers. comm.).

Another proto-ritual is the chimpanzee **rain dance**¹² (Lawick-Goodall 1975), i.e. vigorously and noisily charging¹³ as a reaction to rain (or waterfalls), but without clear chimpanzee targets. Copying is probably not necessary for this behaviour as all variants of chimpanzee rain dance (re-)appear in culturally unconnected populations of chimpanzees (compare data in Whiten et al. 2001) suggesting that it does not qualify as ritual. Note also that it is present in similar form in bonobos (Nishida et al. 2010). Rain dance “appear[s] to incorporate aspects of universal chimpanzee behaviour such as aggressive displays” (Whiten et al. 2001, p 1511), and so, the behavioural *forms* of rain dance do not require copying. Still, the behaviour is currently resisting an ordinary explanation and might therefore create symbolic meaning, which is why it is listed here as proto-ritual.

The last proto-ritual is **surplus nest making procedures** in orang-utans. When orang-utans in Suaq (Sumatra) and Tuanan (Borneo), but not at most other sites, build their evening nest (which involves making pillows with twigs and leaves) they seemingly always pick small leafy twigs, which are arranged in parallel, to make the pillow. During this phase of nest building, they may bite or smoothen the ends of these twigs with their teeth, but often they may simply pass the twigs by their mouth while merely making a biting movement (“air-biting”). They then place them on the nest with a crisp flick of the wrist. At that very moment (but also at other moments in this same context), orang-utans at Suaq in Sumatra (van Schaik et al. 2006; Wich et al. 2012), and at Sabangau in Borneo (Wich et al. 2012) produce a raspberry sound (“nest raspberry”). Yet, at Tuanan, Borneo (van Schaik et al. 2006; Wich et al. 2012) they make instead a smacking sound (“nest smacks”). Given that the action of passing the twig as well as air biting is found in at least two culturally unconnected populations (see above; and also in captivity; van Schaik et al. 2006), it is unlikely to require copying. The same is true for both the raspberry sound and the smacking sound: the raspberry sound appears at least in the two populations described above, and the smacking sound appears also in rehabilitated orang-utans (Russon et al. 2009) and it is also heard at Suaq – when orang-utans there chew on liana stems – although in neither case has there been a formal analysis to compare the acoustic structures. And so, while these sounds almost certainly do not require copying, the functional significance of the elements is (currently) obscure: the air-biting seems extraordinary because the twig is no longer attached to the branch, and especially the sounds likewise serve no function in pillow formation *per se*. And so, orang-utan surplus nest making procedures are currently resisting an ordinary explanation and might therefore create symbolic meaning.

Yet, these orang-utan nest sounds may also be too weak to serve as a communicative function to others, unless these others are nearby (but then they can actually see that the

¹¹ Note that such proto-rituals may exist in humans, too.

¹² Which here we will lump with its rarer version, the waterfall dance.

¹³ Roughly speaking, there is a range in vigour and noise levels across the described instances of rain dance in the literature.

subject is finishing a nest)¹⁴. At two well-studied sites, all individuals studied virtually always perform these sounds when they build their big evening nest, regardless of whether they are in association with infants or others (van Schaik et al. 2006). The fact that these behaviours seemingly are performed primarily individualistically, i.e. without a social goal, fails to support the view that the sound is symbolic (*unless* we would allow for private symbols; more on this below).

Discussion

Even when a specifically derived, stripped-down, minimal (*ape*) ritual definition is applied, there is as yet no clear, unequivocal, full-blown evidence for any spontaneous minimal ritual in non-enculturated, untrained apes. Furthermore, even the single necessary core components of the minimal ritual definition, namely symbolism and copying, seem largely absent in apes (with the possible exception of some basic, but frequent, result-matching). We found a few cases (orang-utan surplus nest-making procedures, chimpanzee and bonobo rain dance, chimpanzee object-in-ear behaviour) that, although not *requiring* copying, at least currently appear extra-ordinary. These cases may therefore be symbolic – and would then fulfil at least part of our minimal definition – which is why we have called these cases proto-rituals. However, given that also these cases do not require copying they cannot be considered full-blown rituals under the minimal definition of ritual (even if they were to be found to really be symbolic). In turn, our finding *at the moment* supports the view that the LCA likely did not have full-blown (minimal) ritual either (though the LCA might have had proto-ritual). However, dedicated studies of ape ritual are still outstanding, and our conclusion must remain tentative.

The three potential cases of proto-ritual we identified also warrant further examination in future. On the one hand, ordinary, functional explanations may be found after all for these cases. If so, each case would cease to be a proto-ritual. On the other hand, they may sometimes be found to require some copying after all (e.g. in specific sound structures (currently unexamined), of the various nest-making sounds of the orang-utans across populations and contexts). However, again, with the data currently available we found no evidence for copying. This should not be surprising as the vast majority of ape behavioural form seems best explained by a natural (“ordinary”) behavioural repertoire potential (compare Tennie et al. 2009; *in press*). To be clear, this is not to say that social learning plays no role in apes. Social learning very likely even plays a very large role for explaining the relative frequencies of behaviour within and across groups (see also introduction). That is, we do not deny ape cultural status – they have culture, though their culture is likely based on non-copying social learning mechanisms (see introduction).

Even though apes do not spontaneously copy novel actions, it should be noted that they at least seem to realise when *their* actions are being copied (Nielsen et al. 2005), and there is some evidence that other primates show the so-called chameleon effect (where those that imitated subjects seem to be liked more; e.g. Paukner et al. 2009). This could mean that one of the many possible effects or functions of rituals (bonding) may lie dormant in apes (and may sometimes be *triggered* even without copying, e.g., in synchronized walking during chimpanzee border patrols; compare Yu & Tomonaga 2015). If, additionally, apes understand these actions as ritualistic (which is of course hard to say) then they may be on the brink of also understanding human rituals when these are directed towards them.

¹⁴ Limited playback experiments, at one site with and without the sounds, were inconclusive (M.Paul, unpubl. 2006).

Our largely negative finding regarding ape ritual could suffer from false negatives (as any finding), and so we do not consider the case closed yet. Another way to phrase the question is to ask what kind of rituals (should they exist) would we *expect* apes to have? Our answer to this was that we would expect these ape rituals to involve symbolic meaningful *results*. This proposal stems from the fact that apes seem to frequently express their ability to match results (see above), and from the fact that their potential for symbolic, causally- and goal-opaque results remains currently relatively untested. Future studies should therefore focus on testing ape symbolic abilities *in the results domain*. It might be possible that apes may be naturally susceptible to at least *understand* symbols when the symbol involves object *changes*, rather than fixed object states. It could also be tested whether specific results (but also actions) can produce symbolic meaning for apes. For example, what would happen if a study like Clay & Tennie (2017, actions on objects) would involve various extraordinary actions and/or results differentially applied to several objects – and where the apes would have to merely later *choose between objects* (i.e. similar to the human study of Kapitány and Nielsen, 2019)?

Indeed, two of the three cases of proto-ritual we identified involve environmental results produced by the apes themselves¹⁵: *objects* that are placed and in ears (chimpanzees) or air biting *twigs* (orang-utans). The latter case also involved sounds produced by the orang-utans. At first, this might seem to go against our prediction that the likelihood for spontaneous ape ritual (or proto-ritual) can be expected to be highest in the results domain. However, as noted by Byrne (2002), sounds *are* in effect environmental results. Therefore, at least two out of the three proto-ritual cases actually fit into our prediction rather well.

The orang-utan nest-making sounds and air-biting action are a seemingly inherently *solitary* activity. If validated as symbolic, or even as ritual, such “*private ritual*” might be a precursor to social ritual from within the individual domain (e.g., imagine if a human places her pencils on her desk in a specific order each day¹⁶). Can we even imagine such private rituals in the absence of (language-aided) copying of the concept of ritual? This is an inherently difficult question to answer (as we said above, we currently remain agnostic), but if the answer is yes, then apes may (sometimes) have private rituals.

There could be several critical objections regarding our use of the criterion of symbolism (which distilled and replaced several of the usual criteria of ritual in our own definition). It might be objected that also ordinary (and uncopied) behaviour should potentially count, and that we have therefore produced many false negatives. This is a reasonable objection. Thus, *human* interpretations of ape behaviour may at times be wrong – and an apparently ordinary behaviour may, in fact, be symbolic/extraordinary after all. And even where the human interpretation of ape behaviour is correct, the apes *themselves* may *perceive* the behaviour as extra-ordinary (i.e. maybe apes themselves cannot understand the behaviour’s function and/or its outcomes). Note that it might be argued that (many? or all?) human rituals might likewise appear ordinary from a similarly detached, scientific standpoint (e.g., religious ritual being *ultimately ordinary* as it serves as a group-binding exercise; e.g. Atran & Norenzayan 2004).

Another possible objection might be that ritual may nonetheless be buildable out of available actions and/or results acting as building blocks. That is, ritual *may not* require copying of novel actions or results and may be built of actions and results that are in the (latent) repertoire of the species (*sensu* Tennie et al. 2009, in press). Yet, we note that this possibility is encompassed in the category of proto-ritual, which had relaxed this very

¹⁵ And the third (rain dance) involves naturally occurring environmental results (rain or waterfalls).

¹⁶ The relationship between private ritual and OCD is deserving of further study (Thanks to R. Kapitány, for pointing this out to us).

assumption. Anybody who would like the minimal definition of ritual to not include a need to copy may thus place our three candidate proto-rituals into a ritual bracket instead. But in this case it should be noted that the symbolic status of our three candidate cases is as yet not clear.

Finally, we suggest that a future examination should look at enculturated and/or trained apes, to answer a *different* question, namely whether apes can ever be expected to have full-blown ritual (even if it is ritual borrowed from humans). This would be especially important if language is a requirement for ritual (as language-trained apes can display some rudimentary language skills). Unfortunately (to the best of our knowledge), the current literature on enculturated apes does not include any formal studies of ritual. But even if ritual is then found in apes, it would not mean that apes *spontaneously* develop and maintain ritual among themselves – and the same is true for the LCA.

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References

- Atran, S., & Norenzayan, A. (2004). Religion's evolutionary landscape: Counterintuition, commitment, compassion, communion. *Behavioral and Brain Sciences*, 27(6), 713-730.
- Bandini, E., & Tennie, C. (2017). Spontaneous reoccurrence of “scooping”, a wild tool-use behaviour, in naïve chimpanzees. *PeerJ*, 5, e3814.
- Bohn, M., Call, J., Tomasello, M. (2015) Communication about absent entities in great apes and human infants. *Cognition* 145, 63–72
- Bohn, M., Call, J., & Tomasello, M. (2019). Natural reference: A phylo-and ontogenetic perspective on the comprehension of iconic gestures and vocalizations. *Developmental Science*, 22(2), e12757.
- Boyer, P., & Liénard, P. (2006). Why ritualized behavior? Precaution Systems and action parsing in developmental, pathological and cultural rituals. *Behavioral and Brain Sciences*, 29(06), 595–650.
- Byrne, R. W. (2002). Imitation of novel complex actions: What does the evidence from animals mean?. *Advances in the Study of Behavior*, 31, 77-105.

Byrne, R. W., Cartmill, E., Genty, E., Graham, K. E., Hobaiter, C. & Tanner, J. (2017). Great ape gestures: intentional communication with a rich set of innate signals. *Animal Cognition* 20(4): 1-15.

Clay, Z. & Tennie, C. (2017). Is overimitation a uniquely human phenomenon? Insights from human children as compared to bonobos. *Child Development*, 89(5), 1535-1544.

Deacon, T. (1997). *The symbolic species*. Norton, New York.

Eerkens, J. W., & Lipo, C. P. (2005). Cultural transmission, copying errors, and the generation of variation in material culture and the archaeological record. *Journal of Anthropological Archaeology*, 24(4), 316-334.

Fröhlich, M., & Pika, S. (2019). Gestural usage and development in two subspecies of wild chimpanzees (*Pan troglodytes schweinfurthii/verus*). In: *The chimpanzees of the Tai forest: 40 years of research*. Cambridge University Press.

Gilby, I. C., & Wrangham, R. W. (2007). Risk-prone hunting by chimpanzees (*Pan troglodytes schweinfurthii*) increases during periods of high diet quality. *Behavioral Ecology and Sociobiology*, 61(11), 1771-1779.

Hardus, M. E., Lameira, A. R., van Schaik, C. P., & Wich, S. A. (2009). Tool use in wild orang-utans modifies sound production: a functionally deceptive innovation?. *Proceedings of the Royal Society B: Biological Sciences*, 276(1673), 3689-3694.

Harrod, J. B. (2014). The case for chimpanzee religion. *Journal for the Study of Religion, Nature & Culture*, 8(1)

Henrich, J., & Tennie, C. (2017). Cultural evolution in chimpanzees and humans. In: *Chimpanzees and Human Evolution*. Ed.: Muller, M., Wrangham, R & Pilbeam, D. Harvard University Press.

Herrmann, E., Melis, A. P., & Tomasello, M. (2006). Apes' use of iconic cues in the object-choice task. *Animal Cognition*, 9(2), 118.

Hopper, R. (2016). What do chimp 'temples' tell us about the evolution of religion? *New Scientist*, 3064. <https://www.newscientist.com/article/2079630-what-do-chimp-temples-tell-us-about-the-evolution-of-religion/>

Hopper, L. M., Lambeth, S. P., Schapiro, S. J., & Whiten, A. (2008). Observational learning in chimpanzees and children studied through 'ghost' conditions. *Proceedings of the Royal Society B: Biological Sciences*, 275(1636), 835-840.

Kahlenberg, S. M., & Wrangham, R. W. (2010). Sex differences in chimpanzees' use of sticks as play objects resemble those of children. *Current Biology*, 20(24), R1067-R1068.

Kalan, A. K., & Boesch, C. (2018). Re-emergence of the leaf clip gesture during an alpha takeover affects variation in male chimpanzee loud calls. *PeerJ*, 6, e5079.

Kalan, A. K., Carmignani, E., Kronland-Martinet, R., Ystad, S., & Aramaki, M. (in revision). Chimpanzees use tree species with a resonant timbre for accumulative stone throwing. *Biology Letters*

Kapitány, R., & Nielsen, M. (2019). Ritualized objects: How we perceive and respond to causally opaque and goal demoted action. *Journal of Cognition and Culture*, 19(1-2), 170-194.

Kühl, H. S., Kalan, A. K., Arandjelovic, M., Aubert, F., D'Auvergne, L., Goedmakers, A., ... & Ton, E. (2016). Chimpanzee accumulative stone throwing. *Scientific Reports*, 6, 22219.

Langergraber, K. E., Watts, D. P., Vigilant, L., & Mitani, J. C. (2017). Group augmentation, collective action, and territorial boundary patrols by male chimpanzees. *Proceedings of the National Academy of Sciences*, 114(28), 7337-7342.

Legare, C. H., & Souza, A. L. (2012). Evaluating ritual efficacy: Evidence from the supernatural. *Cognition*, 124(1), 1-15.

Legare, C., Wen, N., Herrmann, P., & Whitehouse, H. (2015). Imitative flexibility and the development of cultural learning. *Cognition*, 142, 351-361.

Musgrave, S., Morgan, D., Lonsdorf, E., Mundry, R., & Sanz, C. (2016). Tool transfers are a form of teaching among chimpanzees. *Scientific Reports*, 6, 34783.

Neadle, D., Allritz, M., & Tennie, C. (2017). Food cleaning in gorillas: Social learning is a possibility but not a necessity. *PloS ONE*, 12(12), e0188866.

Nielsen, M., Collier-Baker, E., Davis, J. M., & Suddendorf, T. (2005). Imitation recognition in a captive chimpanzee (*Pan troglodytes*). *Animal Cognition*, 8(1), 31-36.

Nishida, T., Zamma, K., Matsusaka, T., Inaba, A., & McGrew, W. C. (2010). Chimpanzee behavior in the wild: an audio-visual encyclopedia. Springer Science & Business Media.

Paukner, A., Suomi, S. J., Visalberghi, E., & Ferrari, P. F. (2009). Capuchin monkeys display affiliation toward humans who imitate them. *Science*, 325(5942), 880-883.

Perry, S. (2016). Cultural primatology. *The International Encyclopedia of Primatology*, 1-5.

Russon, A. E., van Schaik, C. P., Kuncoro, P., Ferisa, A., Handayani, D. P., & van Noordwijk, M. A. (2009). Innovation and intelligence in orangutans. In: *Orangutans: Geographic variation in behavioral ecology and conservation*, 279-298.

Schjoedt, U., Sørensen, J., Nielbo, K. L., Xygalatas, D., Mitkidis, P., & Bulbulia, J. (2013). Cognitive resource depletion in religious interactions. *Religion, Brain & Behavior*, 3(1), 39-86.

Sugiyama, Y. (1981). Observations on the population dynamics and behavior of wild chimpanzees at Bossou, Guinea, in 1979-1980. *Primates*, 22(4), 435-444.

Tennie, C., Call, J., & Tomasello, M. (2009). Ratcheting up the ratchet: on the evolution of cumulative culture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1528), 2405-2415.

Tennie, C., Call, J., & Tomasello, M. (2012). Untrained chimpanzees (*Pan troglodytes schweinfurthii*) fail to imitate novel actions. *PLoS ONE*, 7, e41548.

Tennie, C., Hopper, L., van Schaik, C. P. (in press). On the origin of cumulative culture: consideration of the role of copying in culture-dependent traits and a reappraisal of the zone of latent solution hypothesis. In: *Chimpanzees in Context: A Comparative Perspective on Chimpanzee Behavior, Cognition, Conservation, and Welfare*. Ross S, Hopper L (eds.) University of Chicago Press

Tomasello, M., Call, J., Warren, J., Frost, T. G., Carpenter, M., & Nagell, K. (1997). The ontogeny of chimpanzee gestural signals: a comparison across groups and generations." *Evolution of Communication*, 1(2): 223–253.

Tomasello, M., Call, J., & Gluckman, A. (1997). Comprehension of novel communicative signs by apes and human children. *Child Development*, 68(6), 1067-1080.

Tomasello, M., & Call, J. (2019). Thirty years of great ape gestures. *Animal Cognition*, 22(4), 461-469.

Townsend, S. W., Koski, S. E., Byrne, R. W., Slocombe, K. E., Bickel, B., Boeckle, M., ... & Glock, H. J. (2017). Exorcising G rice's ghost: an empirical approach to studying intentional communication in animals. *Biological Reviews*, 92(3), 1427-1433.

van Lawick-Goodall, J. (1975). *The Quest for Man*. Phaidon, London

van Leeuwen, E. J., Cronin, K. A., & Haun, D. B. (2014). A group-specific arbitrary tradition in chimpanzees (*Pan troglodytes*). *Animal Cognition*, 17(6), 1421-1425.

van Schaik, C. P., van Noordwijk, M. A., & Wich, S. A. (2006). Innovation in wild Bornean orangutans (*Pongo pygmaeus wurmbii*). *Behaviour*, 143, 839-876.

van Schaik, C. P., Damerius, L., & Isler, K. (2013). Wild orangutan males plan and communicate their travel direction one day in advance. *PloS ONE*, 8(9), e74896.

Wadley, L. (2001). What is cultural modernity? A general view and a South African perspective from Rose Cottage Cave. *Cambridge Archaeological Journal*, 11(2), 201-221.

Watanabe, J. M., & Smuts, B. B. (1999). Explaining religion without explaining it away: Trust, truth, and the evolution of cooperation in Roy A. Rappaport's "The Obvious Aspects of Ritual". *American Anthropologist*, 101(1), 98-112.

Watson-Jones, R. E., Legare, C., Whitehouse, H., & Clegg, J. (2014). Task-specific effects of ostracism on imitative fidelity in early childhood. *Evolution and Human Behavior*, 35(3), 204–210.

Watts, D. P. (2004). Intracommunity coalitionary killing of an adult male chimpanzee at Ngogo, Kibale National Park, Uganda. *International Journal of Primatology*, 25(3), 507-521.

Wich, S. A., Krützen, M., Lameira, A. R., Nater, A., Arora, N., Bastian, M. L., ... & Perwitasari-Farajallah, D. (2012). Call cultures in orang-utans?. *PLoS ONE*, 7(5), e36180.

Whiten, A., & Byrne, R. W. (Eds.). (1997). *Machiavellian intelligence II: Extensions and evaluations* (Vol. 2). Cambridge University Press.

Whiten, A., Custance, D. M., Gomez, J. C., Teixidor, P., & Bard, K. A. (1996). Imitative learning of artificial fruit processing in children (*Homo sapiens*) and chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, 110(1), 3.

Whiten, A., Goodall, J., McGrew, W. C., Nishida, T., Reynolds, V., Sugiyama, Y., ... & Boesch, C. (1999). Cultures in chimpanzees. *Nature*, 399(6737), 682.

Whiten, A., Goodall, J., McGrew, W. C., Nishida, T., Reynolds, V., Sugiyama, Y., ... & Boesch, C. (2001). Charting Cultural Variation in Chimpanzees. *Behaviour*, 1481-1516.

Yu, L., & Tomonaga, M. (2015). Interactional synchrony in chimpanzees: examination through a finger-tapping experiment. *Scientific Reports*, 5, 10218.