# 13

# Alcohol and Humans

## Reflections and Prospects

*Kimberley J. Hockings and Robin I.M. Dunbar*



### Introduction

As the chapters in this volume make clear, humans and alcohol have shared a very long history. Not only is the use of alcohol widespread across the world's cultures (notwithstanding the few cases where its use is prohibited on religious grounds), but almost every culture with access to fermentable resources and the containers in which to ferment them has manufactured alcoholic beverages in some form. The capacity to handle ethanol (the most common alcohol produced) has depended on our having evolved novel alleles of the alcohol dehydrogenase enzymes that allow alcohols to be converted rapidly and efficiently into useable biomolecules (albeit via a complex biochemical chain reaction) before the alcohol itself starts to adversely affect cognition and other aspects of bodily function. Humans share with the African great apes a set of alleles that are unusually effective in doing this, and this has led to the suggestion that our history of exploiting ethanol (in particular) may go back at least as much as 10 million years to the common ancestors of the African great apes (gorillas, chimpanzees, and humans).

The nutritional benefits of ethanol consumption notwithstanding, it is equally clear that the use of alcohol by humans is both complex and socially diverse. It is not simply a food that, like honey or ripe fruits, is cherished for its taste or its high energy properties. It is cherished in addition for its psychotropic properties, in some cases in an explicitly religious context. More generally, however, its use seems to be most common in purely social contexts, even if those social contexts can sometimes have ritual elements (e.g. celebrations, sealing agreements, libations in which a beverage is wasted by being poured on the ground). This social use seems to be related to the bonding of social and communal relationships.

In this chapter, we want to emphasize three related points. One is the length of the historical association with alcohol. The second is the social uses of alcohol and its cross-cultural distribution. The third is an incongruity created between these observations and the growing medical advice that any amount of alcohol consumption is medically damaging (Griswold et al., 2018). We will conclude by drawing attention to a number of topics that the contributions to the present volume highlight as issues for further research.

### The Miocene Backstory

It seems that, around 10 million years ago during the mid-Miocene geological era and a long time before the human lineage branched off from the ape rootstock, the African apes

Kimberley J. Hockings and Robin I.M. Dunbar, *Alcohol and Humans* In: *Alcohol and Humans*. Edited by: Kimberley J. Hockings and Robin Dunbar, Oxford University Press (2020). © Oxford University Press.
DOI: 10.1093/oso/9780198842460.003.0012

began to exploit fallen fruit on the forest floor, most of which would have been overripe—and because of this would have begun to ferment (see Carrigan, Chapter 3; also Dudley, Chapter 2). The alcohol content of such fruits is typically in the region of 1–4%, or something like a weak beer. Being able to efficiently convert the ethanol in the fruit into useable, energy-rich molecules—a capacity that required a genetic mutation to produce more efficient alcohol dehydrogenase enzymes—would have provided a valuable source of calories that was not available to the apes' ecological competitors (mainly Old World monkeys). It seems that this metabolic capacity was particularly refined in the African apes, since the Asian apes (gibbons and orangutan) lack the same form of *ADH4* (even though they show some changes in *ADH2* that allow more efficient processing of ethanol).

The mid-Miocene was a particularly formative period in the history of the African apes. Prior to this, the apes had been the dominant component of the Old World primate communities (Andrews, 1981), all of which were dependent on the extensive broadleaf tropical forests that then dominated the African and Eurasian continents (Jablonski, 2005). However, the climatic cooling and drying that set in during the mid-Miocene had dramatic consequences for these forests, causing them to contract and break up into small isolated units, mostly within the tropics (Jacobs, 2004; deMenocal, 2004). As a result, apes were forced into ecological competition with a diversifying group of Old World monkeys (Andrews, 1987; Hunt, 2016).

A key difference between the monkeys and apes is the ability to detoxify the phenolic compounds (e.g. tannins) and alkaloids that plants place in their unripe fruits to protect them from herbivores until the fruit is ready to be dispersed (Wrangham et al., 1998). Many of these compounds actively interfere with the digestive process and inhibit protein absorption, often causing stomach pains, vomiting, and diarrhoea. These toxins gradually break down or are converted into more palatable sugars as the fruit ripens. Apes (including humans) lack the enzymes to detoxify these compounds, and so find unripe fruits unpalatable (e.g. the astringency in the mouth caused by tannins when we eat unripe fruits), or even toxic. Monkeys, however, evolved the capacity to detoxify many of these compounds, and so were able to access and harvest fruits long before they became accessible to apes. Because of this, ape populations began to crash dramatically as the Miocene drying progressed, resulting in the extinction of many ape lineages and the contemporary dominance of the monkeys (Andrews, 1987; Fleagle, 2013).

What seems to have saved some ape lineages from complete extinction was the acquisition, at least by the ancestors of the one lineage that survived, of anatomical and biochemical adaptations that allowed them to eat overripe fruits on the forest floor (many of which would have been dropped by frugivorous birds and mammals foraging in the canopy above). Since these were not accessible to the then largely arboreal monkeys, this gave these ape lineages an advantage over their ecological competitors. The key adaptation lay in the capacity to detoxify the alcohols that build up through the action of natural yeasts in overripe fruits that monkeys cannot readily process (Dudley, Chapter 2; Carrigan, Chapter 3). Being able to efficiently convert ethanol into energy-rich biomolecules provided the African apes with a ready source of calories that was otherwise unavailable (or, at least, highly risky because of the intoxicating neurological side effects of ethanol accumulation). This remarkable story reminds us how complex and serendipitous evolution can sometimes be.

These mildly alcoholic fruits were the product of natural airborne yeasts. This was by no means the first time we humans have made use of microorganisms of this kind. In fact, the primate (and human) gut is full of bacteria and other microflora (some of which are yeasts) that play an essential part in our well-being (Round & Mazmanian, 2009; Flint et al., 2012; Sarkar et al., 2018). It is estimated that the human gut microbiome contains as many cells as the human body itself (around 39 trillion). It is responsible for turning much of what we eat into a form that we can digest, in many cases as excreta from their own cellular processes. Ethanol in overripe fruits is no exception: ethanol derives from the yeast's exploitation of the sugars in ripe fruits and is microbicidal, particularly in the context where sugar concentrations are high and yeasts are competing with faster-dividing bacteria for use of this resource (Thomson et al., 2005). In many ways, there is a close parallel here between the way we exploit these yeasts and the way we exploit the tuberculosis (TB) bacillus: this excretes nicotinamide as a by-product of its cellular processes, and we in turn are able to exploit this as a source of niacin (vitamin $B_3$, an essential requirement for normal brain growth) (Williams & Dunbar, 2013; Hill & Williams, 2017).

## The Ethnography of Alcohol Consumption

Perhaps the one message that comes across from the contributions to this volume is how ubiquitous alcohol production and use is across a wide range of human cultures (Daly, Chapter 9; Dietler, Chapter 8; Hockings et al., Chapter 4; Rosinger & Bethancourt, Chapter 10), not to mention the depth of its archaeological history (Dietrich & Dietrich, Chapter 7; Guerra-Doce, Chapter 5; McGovern, Chapter 6). This often involves rituals of production as well as rituals of use (Daly, Chapter 9). In the ethnographic world, the actual production of alcoholic beverages is, in many cases, 'women's work', though exceptions such as the production of palm wine in West Africa do exist (in this case, perhaps reflecting the risk of injury from climbing raffia palm trees; see Hockings et al., Chapter 4). It is perhaps only with industrialization of distillation to make stronger spirits that production becomes mainly a male activity. Despite this, in ethnographic and historical contexts, consumption of these beverages seems to be dominated by men, at least as far back as we have written historical records (Dietler, Chapter 8; McShane, Chapter 12). Aside from festivities associated with celebrations and the welcoming of visitors, the provision of alcoholic beverages is often associated with communal labour in the fields and orchards, either to motivate the workforce or as a reward after the day's work has finished (Daly, Chapter 9; Hockings et al., Chapter 4).

The importance of the social rituals of consumption have all the hallmarks of social bonding. Indeed, they often incorporate many of the other behaviours that are known to play a core role in social bonding in humans, including laughter, singing, dancing, and emotional storytelling (Dunbar, Chapter 11). This is not to say that social bonding, either at the dyadic level of friendships or the communal level, cannot occur in the absence of alcohol consumption. Clearly, it can and does, but when it does so it may well be because it triggers the same psycho-pharmacological mechanism (the endorphin system) as all these other social bonding behaviours do (Herz, 1997; Gianoulakis, 2004). Everyday experience suggests that this process is facilitated by the consumption of alcohol, such that the inclusion of alcohol has become ritualized in a way that probably magnifies the effect. And it is very likely that this whole process is exaggerated by the hedonic and psychotropic effects of alcohol.

Perhaps, inevitably, it has been the hedonic and psychotropic effects of alcohol consumption that have tended to draw attention in the search for why we find alcohol so attractive. However, these are far from being the whole story. More importantly, the emphasis on them tends to reflect a view of biology that is focused on the individual to the exclusion of all else. Such a view is common in many of the life sciences, including psychology, but it overlooks the crucial fact that primates are intensely social, and the individual is embedded in a complex, dynamic social world that both yields many benefits and requires a great deal of work to maintain: it does not appear simply by magic (Sutcliffe et al., 2012). Individuals have to invest considerable time and effort in building and maintaining friends as well as communal bonds (Dunbar, 2018). By and large, these processes are not well understood, even in the behavioural sciences, and more detailed study would help to illuminate the role that alcohol consumption plays in them.

## The Good, the Bad, and the Very Ugly of Alcohol Consumption

We are struck by the apparent contradiction between much of what is reported in this volume and the largely negative attitude towards alcohol consumption espoused by the medical profession. There continues to be a steady stream of publications demonstrating that alcohol consumption, in some cases in *any* quantities, has negative medical consequences, often with explicit advice that governments should impose strategies designed to inhibit or reduce consumption (see, for example, Griswold et al. [2018] and Sabia et al. [2018]). However, anything that is as old in evolutionary terms as alcohol consumption is very unlikely to be something that we are not well adapted to. This much is implied by the fact that we share with the African great apes some extremely ancient genetic adaptations for alcohol consumption. How do we reconcile these two seemingly incompatible propositions? This is not, however, to say that overconsumption of alcoholic beverages whose ethanol content is significantly higher than those found in nature (i.e. the kinds of distilled drinks produced and consumed in industrial societies) is good for humans. Clearly, it is not. The issue, rather, is that there are two distinct questions here, one about the impact of moderate consumption of low alcohol content beverages and the other about regular excessive consumption of high alcohol content beverages.

In this respect, alcohol is one of many biologically relevant substances that exhibit this kind of ambivalent pattern. It applies to almost everything we ingest—salt, protein, carbohydrates, sugar, oxygen . . . the list goes on. While the medical admonitions against overindulgence are not to be ignored or underestimated, a more rounded picture will recognize that ethanol, like all other nutrients, has played an important role throughout human history. Many of the problems associated with ethanol, sugar, salt, and fat arise because the concentrations we have ready access to in the postindustrial world is far higher than anything found in the traditional ethnographic world, giving rise to the so-called diseases of civilization (Carrera-Bastos et al., 2011). For all of these dietetically important macromolecules, our metabolism is adapted to natural concentrations, but we are now experiencing concentrations far beyond those that could be produced by natural processes. In this respect, ethanol's historical role as an energy source is not to be underestimated, though as yet this has not received the detailed analysis in historical or archaeological contexts that it deserves. Over and above this energetic benefit, however, ethanol also seems to play an important role in a social context. Given the evidence for the extensive health benefits of friendships (Dunbar, 2018) and alcohol's role in facilitating friendships, its potential value in social bonding continues to be relevant and needs to be offset against whatever costs it might have in other medical respects. Exploring this social role in more depth is an important avenue for future research.

In this respect, alcohol, like everything else in the biological world, has both costs and benefits, and it is the balance between these that is of crucial importance in deciding how organisms evolve and adapt to the presence or use of particular biological elements. In this respect, banning all access to alcohol would be equivalent to the complete banning of access to salt or carbohydrates. Biologically, neither makes sense, even though in both cases we would observe some kinds of medical benefits from *limiting* access (reduced alcoholism and the diseases associated with this in one case, reduced hypertension or obesity, or diabetes and the 'diseases of civilization' associated with these on the other hand).

Aside from the disease consequences of alcohol overconsumption, alcohol can have negative effects in other respects. The relationship between alcohol consumption and violence in the developed world has been explored in considerable detail over the past half century (among many other examples, see Collins & Schlenger, 1988; Pernanen, 1991; Parker & Auerhahn, 1998; Klostermann & Fals-Stewart, 2006; Foran & O'Leary, 2008; Bye & Rossow, 2010; Norström & Pape, 2010). The short-term effects can include higher risk taking (see, for example, Abrams et al., 2006), which in turn can result in significantly increased mortality risk. The destructive effects of excessive alcohol use in many indigenous societies, especially when this involves high-concentration distilled liquor, include violence, poverty, marginalization, and exploitation (May, 1996; Bjerregaard et al., 2004; Oishi & Hayashi, 2014; Kalema et al., 2015).

Whereas the short- and long-term social consequences of excessive consumption (some of which may have drastic ramifications for family and friends, as well as strangers) are uncontroversial, the consequences for cognitive capacities are less clear cut. The recent UK Government Chief Medical Officer's (2016) report on alcohol consumption, for example, made much of the cognitive effects of alcohol consumption. Yet the evidence is not as straightforward as some of these reports have claimed. In a large-scale longitudinal study of the ageing population, for example, Lang et al. (2007) found that, among both the middle-aged and elderly, moderate alcohol consumption correlated with better cognition and mental health than did abstinence and overconsumption. Similar results were obtained in a study of women by Stampfer et al. (2005). In a series of experimental studies, Dolder et al. (2017) showed that people who drank an alcoholic beer were better at identifying the social emotions expressed in a standard set of photographs, as well as enhancing emotional empathy, than those who had drunk a non-alcoholic beer, but especially so for those who were emotionally or socially more inhibited. In another experimental study, Carlyle et al. (2017) found that a 2-hour period of ad libitum alcohol consumption significantly improved memory for a previously learned task compared to subjects who had abstained.

This is not, of course, to suggest that ethanol consumption has no detrimental effects on health, or indeed short-term social behaviour and psychological performance. Our point is, rather, that the effects of alcohol are more complex and subtle than such views have often suggested. Excessive consumption is, surely, to be actively discouraged. However, it has to be said that emphasizing future health risks is rarely an effective deterrent: as the concerted attempts to reduce obesity have rather depressingly demonstrated, humans are psychologically so heavily invested in discounting the future (Dunbar, 2012) that the long-term consequences of any behaviour seldom carry much weight, no matter how dire those consequences may be. In addition, humans well understand that these effects are statistical and not deterministic, and are often prepared to take the risk on the assumption that they will end up on the right side of the probability equation.

## Themes for the Future

A number of themes emerge from the various chapters that point the way to avenues that can be explored in future research.

Our understanding of the natural history of ethanol consumption by animals is at best patchy. It is only recently that we have realized that overripe fruits produce consumable alcohol and that any animals make intentional use of these. Field workers studying primates or species such as tapirs that make extensive use of fruits have not paid much attention to whether the fruits being eaten, especially on the ground, are fresh or fermenting, and if the latter what their alcohol content might be. The same may be said of nectarivores (mainly birds and some bats), since nectar also readily ferments to produce consumable ethanol. There is a need for future research to focus on tropical environments and especially on the feeding habits of sympatric species. Are there other species that can exploit the ethanol in overripe fruits, or is this an exclusively hominoid adaptation? If so, do they have similar enzyme adaptations to the African apes? In terms of its ADH genetics, the Madagascan aye-aye provides an intriguing case of convergence with the mainland apes (see Carrigan, Chapter 3; see also Gochman et al., 2016), and more detailed studies of its feeding habits in the wild might help clarify the origins and function of this adaptation. More detailed studies of the genetics of other primate and non-primate frugivores and nectarivores are needed to clarify the biological mechanisms involved. In addition, there are a whole series of largely unexplored questions about the structure of ethanol plumes and how well different species can identify these olfactory cues—not least because primates in general have relatively poor olfactory senses compared to many other mammals. Technological improvements will hopefully allow us to measure levels of ethanol in wild fruits and nectars more accurately in the field so that we can estimate amounts of ethanol ingestion.

Nonetheless, we should bear in mind that not all environments will be representative of the constraints faced by competing apes and cercopithecoids in the mid-Miocene. For example, some East African habitats where chimpanzees have been studied intensively (e.g. forests in the Albertine Rift such as Kibale and the Budongo Forest Reserve) have undergone logging in the recent past and consequently have an abundance of figs which serve as important chimpanzee foods. Just because apes at some sites do not feed on overripe fruits on the ground does not indicate that this behaviour does not happen elsewhere.

In humans, the transition from casual consumption of overripe fruit to the production of alcoholic beverages (beers, meads, and wines) is assumed to coincide with the period of the Neolithic settlement some 8000 years ago. One reason for supposing this is obviously that vessels with residues from brewing and winemaking only appear at this time, and perhaps with good reason: most of these vessels were not of the size or kind that could easily be transported. Perhaps the residues on pottery should be seen as the first evidence of brewing on an *industrial* scale rather than the origin of human-directed brewing in any form. The question that is hovering in the background here is whether the shift from casual brewing to industrial-scale production of alcoholic beverages coincided with or led to a change in the scale of social feasting.

Given the apparently deep ancestry of alcohol consumption, it seems likely that even nomadic hunter-gatherers may have been able to ferment sugars to produce alcohol on a small scale using natural containers (calabashes, woven grass, or palm frond containers, ostrich eggshells, and so on) in their temporary camps. From an archaeological perspective, the problem is, of course, that these kinds of containers do not preserve well. However, there is surprisingly little evidence that modern hunter-gatherers make and consume alcoholic drinks. Whether this is because contemporary hunter-gatherers with easy access to natural vessels also live in dry areas where fermentable fruits are scarce is an open question—although most of these people also forage for wild honey and presumably this could easily be turned into mead. Milk, which readily ferments to produce a palatable ethanol, could not have been used until after cattle, sheep, and goats had been domesticated (perhaps around 11 000 BC: Marshall & Hildebrand, 2002).

Even so, there is little or no ethnographic evidence from the last century to suggest that any hunter-gatherers living in forested habitats (e.g. Amazonia, Southeast Asia) have ever manufactured alcohol—although it is perfectly possible that they might have regularly eaten fermented fruits and this might have gone unnoticed by ethnographers. This is a puzzle: if regular consumption of alcoholic fruits has such a deep evolutionary ancestry, some continuity into the present day might be expected. And if early hunter-gatherers did not make and consume alcohol, how was it that early farmers started to do so? What sequence of steps led from non-user hunter-gatherers into the habitual manufacture of alcoholic drinks? The fermented fallback food hypothesis suggests one possible answer to this puzzle: fermented foods are often inferior to non-fermented foods and may have been utilized only as fallback foods when superior foods were scarce. Natural selection could initially favour the fixation of alleles that enabled efficient ethanol metabolism even if this trait is only beneficial during food scarcity that occurs once every few years. How this metabolic capacity is subsequently exploited could be very context-dependent.

In terms of alcohol production in the aftermath of the Neolithic settlement, there remains an ongoing debate as to whether the earliest alcoholic beverages were fruit- or grain-based. A case can be made for the priority of fruits on the grounds that wines are easier to produce than beers (which also had a short shelf-life prior to the addition of natural preservatives like hops during the Middle Ages). In addition, grains probably have to be cultivated to ensure sufficient quantities, which would have deferred the production of alcohol until after the agricultural revolution of the Neolithic. Fruits would certainly have been a more natural source of sugar-rich brewing substrates for hunter-gatherers.

Nonetheless, there is still debate as to whether corn was initially cultivated for bread or for beer. Opinion still seems to be divided on this point. Although archaeological opinion seems to be swinging behind the bread-first view (see Guerra-Doce, Chapter 5), early einkorns lacked the glutens of modern wheats and therefore do not rise well, so were not well designed for bread. It is certainly possible to make bread with these grains, but the quality would have been coarse and similar to bannocks and other unleavened breads. Nonetheless, many contemporary agricultural cultures have breads of this kind. Since it is unlikely that the archaeological record will yield a definitive answer, more experimental work may be called for on the way these early grains might have been used. Grains certainly produce a mash that is ideal for brewing. Indeed, perfectly palatable (and nutritious) beers of this kind are made by agriculturalists. An example is the traditional Ethiopian *talla*, typically made from *tef* (a cultivated *Eragrostis* grass) or sorghum using buckthorn (*Rhamnus prinoides*) leaves both for fermentation and as a hop.

There remains plenty to do in the ethnographic study of alcohol production. Production is a multispecies process, involving both a vegetable source of sugars, a source for the yeast, and sometimes the use of additional plants as flavourings or as part of the fermentation process (in some cases, this can be a fungus) (see Daly, Chapter 9). A better understanding of these processes and the components involved, as well as the functions that alcohol consumption serves, in these small-scale societies may provide us with insights into the sustainable use of natural resources. Yeast genetic diversity has been influenced by human technology through history (Legras et al., 2007), as well as by natural genetic drift and migration, leading to progressively differentiated populations of yeast. Some strains are specific to one type of fermentation, such as African palm wine yeast. Further understanding of the global diversity of yeast strains and how these strains came about offers a potentially valuable approach to understanding the origin of natural resource fermentation in human history. In addition, a broad comparative interpopulation perspective might provide us with important insights into the social and environmental factors that have influenced alcohol consumption across societies.

There is also, naturally, an important historical and material culture dimension to be explored. The written records and the artefacts bequeathed to us by history can tell us a great deal about the processes of cultural change in terms of both tastes and praxis (see McShane, Chapter 12). This can provide insights into how fast fashions change and, perhaps, why. There is considerable current interest in cultural change both within anthropology and evolutionary biology, and, given that it is often associated with very distinctive vessels and other paraphernalia, social drinking patterns may provide a particularly clear and easily identified trait for the historical study of these processes.

This book has obviously focused mainly on the past, but what can we say about our future relationship with alcohol? This is something that applies equally to both traditional and developed societies. Nicholls (2009) has reminded us that 'ideas about drink provide an insight into the wider culture' of British society (pp. 2–3), emphasizing that drinking, like all cultural practices, reflects, reinforces, and can challenge broader cultural values (see also Dietler, Chapter 8; McShane, Chapter 12). Concerns over drinking have historically been (and still are) tied to complex questions about national identity, individual freedom, and the relationship between government and the market (Nicholls, 2009). We should be mindful that alcohol has throughout history been entangled in political and cultural change. We can't understand changes in human use of alcohol over time without considering health, social order, and economic responsibility. The consumption of alcohol can be perceived differently depending on what is being drunk, who is drinking it, and where the drinking takes place. Nicholls has argued that there are 'few universal attitudes to alcohol, just as anthropologists have demonstrated that there are few universal or transcultural ways of being drunk'. In most cases, assumptions about drinking are largely a reflection of more-or-less unconscious attitudes: attitudes to leisure, to social interaction, to class, to gender, and to the value of intoxication itself. Studying attitudes to alcohol cross-culturally may enable us to observe those broader social, political, and philosophical value systems in action, and may give us a better handle on how best to promote responsible consumption. Lack of willingness to recognize the power and appeal of intoxication as an enjoyable state may well have undermined efforts to reduce consumption.

Indeed, it is worth noting that, along this continuum of change, contemporary Western relationships with alcohol are changing, whether that be due to changing fads (craft beer, gin in the United Kingdom) or reducing levels of alcohol consumption in the younger generation, or shifts from drinking in the pub (with its consequent pub closures) to drinking at home. In the more global world in which we now live, traditional societies are being exposed to 'modern' ways and products, mixing animist belief systems with other religions (Christianity, Islam, and so on), and traditional barter economies with monetary economies. We need more research on how these changes impact people's relationships with alcohol.

## References


Abrams, D., Hopthrow, T., Hulbert, L., & Frings, D. (2006). 'Groupdrink'? The effect of alcohol on risk attraction among groups versus individuals. *Journal of Studies on Alcohol and Drugs* 67: 628–36.

Andrews, P. (1981). Species diversity and diet in monkeys and apes during the Miocene. In: C.B. Stringer (ed.) *Aspects of Human Evolution*, pp. 25–41. London, UK: Taylor & Francis.

Andrews, P. (1987). Species diversity and diet in monkeys and apes during the Miocene. In: R.L. Ciochan & J.G. Fleagle (eds.) *Primate Evolution and Human Origins*, pp. 194–206. New York, NY: Routledge.

Bjerregaard, P., Kue Young, T., Dewailly, E., & Ebbesson, S.O. (2004). Indigenous health in the Arctic: an overview of the circumpolar Inuit population. *Scandinavian Journal of Public Health* 32: 390–5.

Bye, E.K. & Rossow, I. (2010). The impact of drinking pattern on alcohol-related violence among adolescents: an international comparative analysis. *Drug and Alcohol Review* 29: 131–7.

Carlyle, M., Dumay, N., Roberts, K., et al. (2017). Improved memory for information learnt before alcohol use in social drinkers tested in a naturalistic setting. *Scientific Reports* 7: 6213.

Carrera-Bastos, P., Fontes-Villalba, M., O'Keefe, J.H., Lindeberg, S., & Cordain, L. (2011). The Western diet and lifestyle and diseases of civilization. *Research Reports in Clinical Cardiology* 2: 15–35.

Collins, J.J. & Schlenger, W.E. (1988). Acute and chronic effects of alcohol use on violence. *Journal of Studies on Alcohol* 49: 516–21.

deMenocal, P. (2004). African climate change and faunal evolution during the Pliocene–Pleistocene. *Earth and Planetary Science Letters* 220: 3–24.

Dolder, P.C., Holze, F., Liakoni, E., Harder, S., Schmid, Y., & Liechti, M.E. (2017). Alcohol acutely enhances decoding of positive emotions and emotional concern for positive stimuli and facilitates the viewing of sexual images. *Psychopharmacology* 234: 41–51.

Dunbar, R.I.M. (2012). Obesity: an evolutionary perspective. In: A. Offer, R. Pechey, & S. Ulijaszek (eds.) *Insecurity, Inequality and Obesity in Affluent Societies*, pp. 55–68. Oxford, UK: Oxford University Press.

Dunbar, R.I.M. (2018). The anatomy of friendship. *Trends in Cognitive Sciences* 22: 32–51.

Fleagle, J.G. (2013). *Primate Adaptation and Evolution*, 3rd edition. New York, NY: Academic Press.

Flint, H.J., Scott, K.P., Louis, P., & Duncan, S.H. (2012). The role of the gut microbiota in nutrition and health. *Nature Reviews Gastroenterology & Hepatology* 9: 577.

Foran, H.M. & O'Leary, K.D. (2008). Alcohol and intimate partner violence: a meta- analytic review. *Clinical Psychology Review* 28: 1222–34.

Gianoulakis, C. (2004). Endogenous opioids and addiction to alcohol and other drugs of abuse. *Current Topics in Medical Chemistry* 4: 39–50.

Gochman, S.R., Brown, M.B., & Dominy, N.J. (2016). Alcohol discrimination and preferences in two species of nectar-feeding primate. *Royal Society Open Science* 3: 160217.

Griswold, M.G., Fullman, N., Hawley, C., et al. (2018). Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet* 392: 1015–35.

Herz, A. (1997). Endogenous opioid systems and alcohol addiction. *Psychopharmacology* 129: 99–111.

Hill, L.J. & Williams, A.C. (2017). Meat intake and the dose of vitamin $B_3$—nicotinamide: cause of the causes of disease transitions, health divides, and health futures? *International Journal of Tryptophan Research* 10: 117864691770466.

Hunt, K.D. (2016). Why are there apes? Evidence for the co-evolution of ape and monkey ecomorphology. *Journal of Anatomy* 228: 630–85.

Jablonski, N.G. (2005). Primate homeland: forests and the evolution of primates during the Tertiary and Quaternary in Asia. *Anthropological Science* 113: 117–22.

Jacobs, B.F. (2004). Paleobotanical studies from tropical Africa: relevance to the evolution of forest, woodland and savannah biomes. *Philosophical Transactions of the Royal Society, London*, 359B: 1573–83.

Kalema, D., Vindevogel, S., Baguma, P.K., Derluyn, I., & Vanderplasschen, W. (2015). Alcohol misuse, policy and treatment responses in sub-Saharan Africa: the case of Uganda. *Drugs: Education, Prevention and Policy* 22: 476–82.

Klostermann, K.C. & Fals-Stewart, W. (2006). Intimate partner violence and alcohol use: exploring the role of drinking in partner violence and its implications for intervention. *Aggression and Violent Behavior* 11: 587–97.

Lang, I., Wallace, R.B., Huperts, F.A., & Melzer, D. (2007). Moderate alcohol consumption in older adults is associated with better cognition and well-being than abstinence. *Age and Ageing* 36: 256–61.

Legras, J.L., Merdinoglu, D., Cornuet, J-M., & Karst F. (2007). Bread, beer and wine: *Saccharomyces cerevisiae* diversity reflects human history. *Molecular Ecology* 16: 2091–102.

Marshall, F. & Hildebrand, E. (2002). Cattle before crops: the beginnings of food production in Africa. *Journal of World Prehistory* 16: 99–143.

May, P.A. (1996). Overview of alcohol abuse epidemiology for American Indian populations. In: G.D. Sadefur, R.R. Rindfuss, & B. Cohen (eds.) *Changing Numbers, Changing Needs: American Indian Demography and Public Health*, pp. 235–61. Washington, DC: National Academies Press.

Nicholls, J. (2009). *The Politics of Alcohol: A History of the Drink Question in England*. Manchester, UK: Manchester University Press.

Norström, T. & Pape, H. (2010). Alcohol, suppressed anger and violence. *Addiction* 105: 1580–6.

Oishi, T. & Hayashi, K. (2014). From ritual dance to disco: change in habitual use of tobacco and alcohol among the Baka hunter-gatherers of southeastern Cameroon. *African Studies Monographs* 47: 143–63.

Parker, R.N. & Auerhahn, K. (1998). Alcohol, drugs, and violence. *Annual Review of Sociology* 24: 291–311.

Pernanen, K. (1991). *Alcohol in Human Violence*. New York, NY: Guilford Press.

Round, J.L. & Mazmanian, S.K. (2009). The gut microbiota shapes intestinal immune responses during health and disease. *Nature Reviews Immunology* 9: 313.

Sabia, S., Fayosse, A., Dumurgier, J., et al. (2018). Alcohol consumption and risk of dementia: 23 year follow-up of Whitehall II cohort study. *British Medical Journal* 362: k2927.

Sarkar, A., Harty, S., Lehto, S.M., et al. (2018). The prospect of microbial psychology: bacterial associations with emotion, cognition, and behaviour. *Trends in Cognitive Science* 22: 611–36.

Stampfer, M.J., Kang, J.H., Chen, J., Cherry, R., & Grodstein, F. (2005). Effects of moderate alcohol consumption on cognitive function in women. *New England Medical Journal* 352: 245–53.

Sutcliffe, A., Dunbar, R.I.M., Binder, J., & Arrow, H. (2012). Relationships and the social brain: integrating psychological and evolutionary perspectives. *British Journal of Psychology* 103: 149–68.

Thomson, J.M., Gaucher, E.A., Burgan, M.F., et al. (2005). Resurrecting ancestral alcohol dehydrogenases from yeast. *Nature Genetics* 6: 630–5.

UK Government Chief Medical Officer's' Alcohol Guidelines Review (2016). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/489795/summary.pdf & Alcohol Guidelines Review—Report from the Guidelines Development Group to the UK Chief Medical

Officers. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/545739/GDG_report-Jan2016.pdf. London, UK: Department of Health.

Williams, A.C. & Dunbar, R.I.M. (2013). Big brains, meat, tuberculosis, and the nicotinamide switches: co-evolutionary relationships with modern repercussions? *International Journal of Tryptophan Research* 3: 73–88.

Wrangham, R.W., Conklin-Brittain, N.L., & Hunt, K.D. (1998). Dietary response of chimpanzees and Cercopithecines to seasonal variation in fruit abundance. I. Antifeedants. *International Journal of Primatology* 19: 949–70.