Bee Representations in Human Art and Culture through the Ages

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Abstract

The field of bioaesthetics seeks to understand how modern humans may have first developed art appreciation and is informed by considering a broad range of fields including painting, sculpture, music and the built environment. In recent times there has been a diverse range of art and communication media representing bees, and such work is often linked to growing concerns about potential bee declines due to a variety of factors including natural habitat fragmentation, climate change, and pesticide use in agriculture. We take a broad view of human art representations of bees to ask if the current interest in artistic representations of bees is evidenced throughout history, and in different regions of the world prior to globalisation. We observe from the earliest records of human
representations in cave art over 8,000 years old through to ancient Egyptian carvings of bees and hieroglyphics, that humans have had a long-term relationship with bees especially due to the benefits of honey, wax, and crop pollination. The relationship between humans and bees frequently links to religious and spiritual representations in different parts of the world from Australia to Europe, South America and Asia. Art mediums have frequently included the visual and musical, thus showing evidence of being deeply rooted in how different people around the world perceive and relate to bees in nature through creative practice. In modern times, artistic representations extend to installation arts, mixed-media, and the moving image. Through the examination of the diverse inclusion of bees in human culture and art, we show that there are links between the functional benefits of associating with bees, including sourcing sweet-tasting nutritious food that could have acted, we suggest, to condition positive responses in the brain, leading to the development of an aesthetic appreciation of work representing bees.

Keywords
Ancient; perception; aesthetics; moving image; iconography; motif; modern; contemporary

1. Introduction

From childhood days of following bees in the garden, to the culinary delights of honey and the wide variety of fruits and vegetables available through pollination, it is well appreciated that bees are an essential part of our modern lives. Honeybees (primarily represented by the European honeybee, Apis mellifera), bumblebees (Bombus spp.), stingless bees (Meliponini spp.), and a wide diversity of solitary and semi-social bees, are known to contribute to the pollination of many flowering plants (Ollerton et al., 2011, Ballantyne et al., 2017), including those that produce fruits, nuts, and vegetables which are essential for the nutrition and health of growing human populations. In modern times, estimations of the contributions of bee pollination to food production for human consumption is valued in the range of 235–577 billion US$/year (Potts et al., 2016), with the Food and Agriculture Organisation (FAO) of the United Nations highlighting the potential impacts of climate change on bee pollination and food production (Kjøhl et al., 2011).

Although there is still much to understand about the diversity of bees and their ecologies, especially of non-Apis species, bees are strongly represented in scientific, public, and political spheres. Pollinators have a central place in the United Nation’s Sustainable Development Goals for food security and economic stability (Patel et al., 2021). There is an increasing scientific and public awareness that many bee species appear to face threats due to the expansion of human industrialised living and agricultural practices, with habitat fragmentation, climate change, increased urbanisation and pesticide use being potentially important factors affecting bee health (Brown et al., 2016; Dicks et al., 2021; Potts et al., 2016; Wagner et al., 2021; Zattara and Aizen, 2021).
In the community of the arts, awareness of bee sustainability is a growing theme and expressed through many varying mediums and platforms, including but not limited to sculpture, mixed-media, installation, architecture, and music (Fig. 1a-d). Indeed, the diversity of art forms and the influence of the bee in creative practice suggest that human appreciation of bees is not restricted to a single demographic group of people, but may reflect a cross-cultural phenomenon spanning diverse societal groups evidencing a potentially broad aesthetic appreciation of these insects. Prum (2017) argues that art production and the aesthetic appreciation of art are intertwined and must develop together.

Researchers considering the neuro-aesthetic appreciation of art in a biologically plausible evolutionary framework thus evaluate how early forms of meaningful communication may utilise existing neural mechanisms and enable contemporary aesthetic art appreciation (Westphal-Fitch and Fitch, 2018; Zaidel, 2018). For example, neuro-imaging studies in humans show that hearing basal emotive musical compositions (e.g., sad: slow tempo, minor key; happy: fast tempo, major key) modulates reactions in the evolutionarily ‘survival-related’ mesolimbic reward system (Brattico and Pearce, 2013). This ancient neural pathway is also hypothesised to be a shared evolutionary trait between some species, as music and birdsong have been reported to produce similar neuro-aesthetic responses in their respective listeners (Earp and Maney, 2012). To inform such debates, Westphal-Fitch and Fitch (2018) argue that to build a better understanding of aesthetics and human perception, research must incorporate a rich and thorough understanding of human proclivity required to acquire aesthetic culture, and suggest that ‘artwork’ needs to include productions across long-time frames including visual art, musical works, architecture, and a wide range of patterned objects such as tapestries, jewellery, tattoos and pottery. Within this framework it is interesting to consider evidence of longer-term relationships between bees and humans, beyond that in which bees provide ecosystem services (Prendergast, 2020), and the cultural values humankind has imparted to bees in a diverse range of cultures (Quezada-Euán, 2018). Here we seek, in particular, to understand how bees have been represented in artwork through time and across cultures and mediums, and explore why such representations may have been important at that time, and remain important to art today.

2. Bees in Antiquity

One of the first known depictions of humans and bees that still exists today is rock art in the Spider Caves ( Cuevas de la araña ) near Valencia in Spain (Fig. 2a) which is dated to have been created over 8,000 years ago during the Epipalaeolithic or Mesolithic periods. This rock art shows a human figure accessing a nest of bees at some height above the ground while several
Figure 1. Expressions of appreciation and concern on bee declines through street art and public installations. (a) Artist Louis Masai expressing contemporary concern about bee losses and its implication for people around the world. (b) Street art in Melbourne (Australia) depicting bees along with native birds and flora. (c) Mural in Manchester (United Kingdom) painted as part of “The Bee in The City trail”. (d) Sculpture installation on the Eureka Tower in Melbourne (Australia) designed by Richard Stringer recognising bees’ frenetic activity and their harmonious high-density living. (a) Louis Masai and Jim Vision reproduced with the permission of the artists. (b, c) Image by Scarlett R. Howard. (d) Image by Adrian G. Dyer.

Figure 2. Early representations of bees in art. (a) Reproduction of rock art depicting a honey collector surrounded by bees painted on a wall in the Spider Cave (near Valencia, Spain). (b) Logogram for the king of Upper and Lower Egypt including the bee hieroglyph. (c) Carving of the same logogram (centre) followed by a cartouche on a wall of a temple in Karnak (Luxor, Egypt). (a) Free software illustration by Achillea, reproduced under the General Public License (GNU) 2.0. (b) Unicode standard representation of the hieroglyph L002A. (c) Image by Jair E. Garcia.
bees fly around (Ransome, 2004). The artistic representation is potentially instructional, and shows a connection between bees and humans that was so important as to risk one’s life to collect prized food in the form of honey that produced a pleasant sensory taste experience and had healing benefits (Boukraâ, 2019; Schifferstein et al., 2020). There is evidence that honey from both honeybees (Apis spp.) and stingless bees (Meliponini) was, and often still is today, an important dietary component for indigenous people around the world in Australia, Africa, Asia, Europe and South America, and has been expressed in artwork including bee species that are important in different communities (Crittenden, 2011; Dams, 1978; Mathpal, 1984).

In Australia, ‘sugarbag’ or ‘stingless’ bees (Tetragonula and Austroplebeia spp., tribe Meliponini) have held cultural significance for First Nations people for over 65,000 years (Clarkson et al., 2017; Fijn, 2014; Halcroft et al., 2013; Perichon et al., 2020). The native bee motif as well as their wax and honey feature in gifts, diet, art, religion, medicine, toys, tool and weapon production, and didgeridoo construction (Akerman, 1979; Fijn, 2014; Powell et al., 2013; Rayment, 1935; Welch, 1995, 2017; Yunkaporta, 2007). The beeswax from native bee species has been used for over 4,000 years in rock art produced by First Nations people (Nelson et al., 1995; Watchman and Jones, 2002; Welch, 1995). Furthermore, Tetragonula species are known to feature in traditional stories such as Jabreen the Warrior of the Kombumerri people (Middleton, 2019) and the story of a bee woman abducted by a fly man (Bozic and Marshall, 1972). Native bees also feature in stories from the Yolŋu people such as in the story of the Wawilak sisters searching for honey (Fijn, 2014) and the story of The First Bees from northern Gunwinggu (or alternatively spelled Kunwinjku) (Fijn, 2014). Many First Nations people have extensive knowledge of native bee ecology and behaviour, nest structure, tracking and locating bees and nests, the use of bee products as medicine, honey hunting and gathering strategies, and even encouraging nesting in favourable locations (Fijn, 2014; Perichon et al., 2020). For example, the Yolŋu peoples (consisting of many different clan groups) in northeast Arnhem Land (Northern Territory, Australia) are highly skilled at hunting and gathering honey from sugarbag bees. Bee and honey hunting knowledge ranges from the ideal time (time of year and time of day) and locations to search for the nests, to the sound of tree trunks containing nests, to how to efficiently track a single bee back to a nest (by attaching spider web silk, grass, feathers, hair, or flour to the bee) (Fijn, 2014; Halcroft et al., 2013; Perichon et al., 2020). In Yolŋu culture, the practice of searching for sugarbag bee nests is integrated into many ceremonies and also linked with key ancestral beings (Fijn, 2014). These cultural practices included both singing and dancing to communicate the importance of native bee sugarbag honey (Fijn, 2014), and while modern dance is a widely appreciated artistic expression linked to fundamental neural processes in the modern
human brain (Basso et al., 2021), it is likely that the origins of ceremonial dance served a fundamental purpose central to survival like group cohesion, communication and resource collection (Osborn et al., 1990; Zaidel, 2018). The knowledge and practices of First Nations people regarding native bees and use of bee products suggest a semi-domestication of native bees well before the present time (Perichon et al., 2020).

To enable practices that enhance important nutrition collection, different communicative representations such as dance and song lines likely allowed meaningful communication that was persistent through many generations (Fijn, 2014). The artistic representation of bees also shows evidence of meaning to human culture that extends beyond instructional communication that was likely the first purpose of representing bees. The description of the kinship between a man of the Yirritja moiety, Neparrnga Gumbula, and the Birrkuda (or ‘short-nosed bee’) is described in Fijn (2014, p. 46): “My mouth is the entrance to the beehive. My nose is beeswax. My eyes are nuts from the warraga (‘cycad palm’). My hairs are the fine roots of the mayku (‘paperbark tree’) and the wulu (‘white foam’) that they produce in the swamp at Djiliwiirri. My head and my knowledge are guku (‘honey’) from the wangarr Birrkuda (‘Short-Nosed Bee’). In death, my name is no longer Neparrnga. It is Birrkuda.”

Interestingly, the use of simple stick and stone tools to access honey and insect larvae is evidenced in both human foraging behaviour and also other hominins like chimpanzees. This suggests that sourcing high-calorie-value nutrition from bees may have been an important cognitive step in the evolution of tool use (Van Lawick-Goodall, 1968; Crittenden, 2011). Artistic representations about bees to help enable gathering of nutritious food may have initially served as a constructive form of communication that in a positive feed-forward loop helped enable higher-level neural representations about artistic representations incorporating bees. Indeed, over the past decade, research on taste perception in the human brain shows that sweet-tasting fluid rewards can act as an appetitive conditioning to enable fast learning of associated visual stimuli by the human brain (Franken et al., 2011; Ohla et al., 2012), providing a plausible explanation for how initial communication representations of bee artforms may promote neural activity associated with a positive observer experience. This simple associative mechanism fits with thinking on how aesthetics for artistic representations likely needs to link to an initial functional explanation of why different observers develop a neural capacity for experiencing certain representations in an appealing or aesthetically pleasing way (Westphal-Fitch and Fitch, 2018; Zaidel, 2018), as personal relevance is linked to the sensorial response of the aesthetic experience (Vessel et al., 2012).
In ancient Egypt from about 3500 BCE there are carvings of bees into important archaeological sites like temples (Fig. 2b, c), likely representing the Asian honeybee, *Apis cerana*, as being managed for both honey and crop pollination. Representations of individual bees were symbolic of health and wealth, and in some cases show relationships to divine worship, and/or the status of important rulers (Ransome, 2004). These representations show a level of abstraction, broadly consistent with Egyptian art of the time, suggesting that the honeybee was being incorporated into what might have been considered an aesthetic representation of important motifs in reality. The hieroglyph for the honeybee was part of the title of the king of upper and lower Egypt (Fig. 2b), evidencing its perceived importance as a symbol for the organisation of society. In combination with other hieroglyphic symbols, the bee was also used to represent various dynasties or place names (Ransome, 2004), suggesting that representations of bees entered into the formation of novel language and thus cultural concepts. The use of bee products was common in Egyptian society for both food and ritual purposes, which likely serves as the catalyst for the incorporation of bees into a variety of art, religious and design principles. For example, mummies were sometimes embalmed in honey, and often sarcophagi were sealed up with beeswax. In the famous tomb of the pharaoh Tutankhamun, honey was found representing the perceived value to the pharaoh in the afterlife (Price, 2016). This level of abstract thinking goes beyond the basic need for human survival, at least in the living world, and suggests that bees and bee products were regarded as symbolic to the meaning of life and death and may have been part of higher-level representations in the brain that enable a perceptual quality consistent with the biologically plausible evolution of aesthetics framework proposed by Westphal-Fitch and Fitch (2018).

Another long-lasting form of human representations of the value of bees to our society and culture is demonstrated in both ancient and modern numismatic items. Figure 3a shows a bronze coin from ancient Greece evidencing the importance of the honeybee at that time. Coin design is difficult due to the highly reduced working area to visually present important depictions, and especially in ancient times, animals symbols were carefully chosen to be informative about the value or function of the coin (Pavlek *et al.*, 2019). Throughout time coins have frequently reflected the views or interests of powers controlling mints and the orderly distribution of coins (Williams *et al.*, 1997). The use of bees on coins has extended since ancient times though to modern times with examples from around the world (Markowitz, 2019). For example, as part of the FAO international coin programme to help promote sustainable agriculture, the circulating 20 senti (1975–1979 series) from the island nation of Tonga in the South Pacific Ocean features 20 honeybees flying from a central hive (Fig. 3b). In recent times bees have been incorporated on relatively
expensive non-circulating collector coins like a hexagon-shaped silver coin from New Zealand in 2016. This coin features a colourful honeybee forager, suggesting a move from a more functional use of bees on coins to representations that are principally aesthetic. Collector coins often serve no practical purpose beyond their aesthetic appeal, but for bee designs does build on a more functional use and the desire of humans to represent important motifs in our lives. This development is consistent with theories of how aesthetics may develop from more functional aspects of communication in earlier art representations (Westphal-Fitch and Fitch, 2018; Zaidel, 2018).

The use of bees as a symbol of health, wealth and power has also been incorporated into the design of jewellery (see below), tapestries, clothes, and flags. For example, Napoleon Bonaparte viewed the honeybee as a symbol of hard work, order, and good health (Fig. 4a). The bee was thus an important part of the first French Empire and represented the values Napoleon wanted the growing empire to hold, and considerable effort was employed to incorporate the motif of the bee into French designs of the time.

Bees and some other insects are commonly occurring motifs in jewellery throughout history with themes persisting to the modern age due to their symbolic significance to a number of ancient societies (Akre et al., 1991; Hogue, 2009; Liu, 2001). In modern society, patterned design and more specialised artwork incorporating bees feature on many clothing items and, alongside other insects, are popular in jewellery design (Akre et al., 1991; Hogue, 2009; Kelly, 2019; Liu, 2001). Many early types of insect jewellery involved wearing live or dead insect specimens for decoration (Akre et al., 1991). Living

Figure 3. Bees on ancient and modern coins. (a) Ancient Greek bronze coin depicting a honeybee. (b) Coin from Tonga depicting 20 honeybees flying around a central hive produced as part of the FAO international coin program (1975–1979) to promote sustainable agriculture. Images by Adrian G. Dyer.
insects which produced light have and continue to be worn by people from a
number of regions for practical and decorative reasons, such as Pyrophorus
noctilucus L. (Ritchie, 1979) in Mexico worn by women attending balls, flash-
ing beetles (Wigglesworth, 1964) worn by Native American Indians for both
decoration and on their toes to see paths at night, and fireflies in the Caribbean
(Metcalf et al., 1962), which can be worn as decorative hair accessories. Such
functional relationships to certain insects may help lead to direct benefits that
promote a positive association that could subsequently improve aesthetic
appreciation of artwork representing the insect. The earliest known insect jew-
elery dates back to 1600–1100 BCE in Egypt and is a pendant depicting two
bees or hornets over a honeycomb with a cage containing a gold bead above
their heads (Akre et al., 1991). Bees were a popular model in jewellery from
the Mediterranean region with carvings into gems also present from the first
century BCE (Akre et al., 1991). Insect jewellery became popular in Europe
during the 19th century following a renewed interest in natural objects (Akre
et al., 1991). This trend in insect jewellery extended to the bee motif, which
became popular during the 1860s when it became the emblem of the Bonapartes
(Akre et al., 1991). In France during the reign of Emperor Napoleon, the

Figure 4. (a) Imperial coat of arms of the French First Empire depicting the golden bees chosen by Napoleon as symbols of his empire. Image by Katepanomegas reproduced under the Creative Commons Attribution ShareAlike licence 3.0 and General Public Licence (GNU) 1.2. (b) Imperial Bee from the Coronation decorations in Notre Dame Cathedral (Abeille impériale de bronze doré ayant servi à la décoration de Notre-Dame lors du Sacre) 1804, gilt bronze; 9.0 × 8.0 cm; Musée de l’Armée, Paris (inv. 05297; Ce 22) © Paris - Musée de l’Armée, Dist. RMN — Pascal Segrette.
imperial bee symbolised the higher-level hardworking goals Napoleon wanted the republic to achieve (Fig. 4b). Whilst there is no complete consensus of why insects are used so frequently in jewellery and other adornments throughout time and regions, it is suggested that their popularity in jewellery arises from the perceived positive and negative attributes represented by insects (Liu, 2001). For example, specific beetles and butterflies signify immortality traits such as resurrections, rebirth, rejuvenation, regeneration, longevity and protection from decay (Liu, 2001), and dragonflies and flies indicate military prowess attributes such as swiftness, courage, bravery, and valour (Cooper, 2012). Social insects, such as bees, tend to represent positive characteristics such as unity, cooperation, and industriousness, with parallels being drawn between human and social insect societies (Hogue, 2009). Insects can also symbolise negative traits, such as the evil, corruption, and putrefaction associated with flies (Cooper, 2012). These functional traits of certain insects that are reflected in jewellery representations fit the necessary link in rationale for why aesthetic appreciation may evolve for certain artworks (Westphal-Fitch and Fitch, 2018).

In modern and contemporary times, the use of bees in western visual art is widespread, with practitioners exploring many diverse mediums and interaction methodologies to enhance and expand the viewer/observer aesthetic experience. Below we further consider how bees are represented in a diverse range of artwork through the ages (i.e., music, sculpture, and installation), and in different cultures like South America and Asia, especially with respect to evidence existing prior to major European influences. This broad approach looking for commonalities in how humans seek to represent bees aims to inform the theory on how art perception and aesthetics might develop due to functional benefits of human communication about important motifs (Westphal-Fitch and Fitch, 2018; Zaidel, 2018). We finally consider how new communication tools like social media and photography are sharing the ways bees and art are communicated, and we make initial interpretations from this overview of recent bee art to promote new thinking about how bees are valued by humans.

3. Bee Representations from the Americas

A ‘New World’ opened to Europeans following the discovery of the Americas by the Italian explorer Cristopher Columbus in the 15th century. In present-day Colombia, South America, people sometimes use the word ‘bee’ as an adjective to celebrate the formulation of a clever idea, or to describe someone as being smart. In its latest edition (2014), the Dictionary of the Royal Spanish Academy (RSA) defines the word bee (abeja) both as ‘a social Hymenopteran insect capable of producing honey’, and as an adjective describing a
hardworking and farsighted person (Real Academia de la Lengua Española, 2014). The use of animals to refer to human personality traits, zoomorph, reflects the meaningfulness given to an animal group and it is often charged with an emotional feeling (Nesi, 1995). In the case of bees, the definition given by the RSA clearly reflects a positive trait; an appreciation likely shared by some North American English speakers. Sommer and Sommer (2011) showed that the word bee also described a positive trait for most of the native English speakers participating in their study (Sommer and Sommer, 2011).

Nesi (1995) proposed that animal metaphors are rooted in rural societies. Such organisations were already present in the New World and reconfigured by European settlers through the 16th and 17th centuries. Honeybees were very likely to be already present in the culture of European settlers arriving to the New World during the early years of the colonial era, who valued them both as honey producers and as a useful tool for adapting the new landscape to the one they were familiar with. A letter, dated 5 December 1621, addressed to the Governor and Council in Virginia, the Council of the Virginia Company in London, includes beehives in the cargo manifesto of a boat headed to the new colonies (Padilla et al., 1992), thus reflecting the interest of settlers to quickly introduce bees into the New World. The historicity of this letter evidences how highly regarded bees were as a valuable tool for the colonisation effort. In fact, the first stable settler colony in North America, Jamestown, had been established in Virginia by English settlers merely 14 years before the letter (1607), and the Plymouth Colony was founded in 1620 following the voyage of the Mayflower.

Whilst the arrival of *A. mellifera* to Central and South America is not as well documented as for the north of the continent (Padilla et al., 1992), it is clear that produce from the honeybee was valuable for Spanish conquistadors. Records from 1573 show that both native bee honey and wax were demanded as a tribute from the native population by Spanish conquistadors (Dehouve, 2002), and both products were also actively imported from Spain for use in Catholic rituals until the late 18th century when apiculture became prominent in Central and South America (Padilla et al., 1992). The need for bee products for Catholic mass was both practical, as candles made from bee wax were the only accepted sources of artificial illumination for churches until the 20th century as they burnt clearly, as well as symbolic. Candles made from bee wax were considered to symbolise the light of Christ and its wax represented the virginity and fecundity of the Virgin Mary according to the Catholic belief. Following the conversion to Catholicism of native inhabitants of Central America by Spanish settlers, the Mayan name for bee was also used for invoking the Virgin Mary (Quezada-Euán, 2018). This perception of bees and bee products from initially functional purposes like pollination and candlelight through to higher-level symbolism like religious beliefs is consistent with the
framework that aesthetic appreciation may derive from more basal purposes of high value to human survival (Westphal-Fitch and Fitch, 2018; Zaidel, 2018).

Prior to the arrival of Spanish conquistadors to Central and northern South America, different indigenous groups had constructed a solid knowledge base of local bees from the tribe Meliponini (stingless bees), and used different species of this tribe for food, medicine and religious ceremonies (Rasmussen and Castillo-Carillo, 2003). Bees from the tribe Meliponini are characterised by a reduced or absent sting, weakness of the wing venation and presence of long setae on the hind tibia, or penicillum (Wille, 1983). Early Spanish chroniclers like Pedro de Spinoza reported to Queen Isabella of Castille in 1529 the presence of *Melipona* hives in the residences of indigenous people in northern South America, praising the ‘goodness’ of these bees, due to the lack of a sting, and the quality of their honey (Samper Pizano, 2003). Similar reports were produced in Central America, particularly from explorers and chroniclers visiting regions corresponding to modern Guatemala and the province of Yucatan in Mexico (źrałka et al., 2018). The reputation of stingless bees as being a good-natured animal has permeated through language, and in various regions where stingless bees occur, present-day people can refer to them as ‘little angels’ (*angelitas*) (Nates-Parra and Rosso-Londoño, 2016) or ‘little maidens’ (*doncellitas*) (źrałka et al., 2018). Both of these words imply an affectionate relationship with these insects that could have been borrowed from the Catholic tradition and likely linked to the idea of purity.

Meliponiculture is still practiced in some Latin-American countries where natural and man-made hives are maintained both in rural and urban environments (Nates-Parra and Rosso-Londoño, 2016; źrałka et al., 2018) implementing pre-Columbian beekeeping techniques, or derivations from these (Fig. 5a). Whilst these cultural practices must compete with the dominance of the introduced European honeybee (De Jong, 1999), there are promising signs of revitalisation (Bratman, 2020; Cortopassi-Laurino et al., 2006).

One of the best recorded examples of the deep relationship between stingless bees and human culture occurs in the Maya culture; a term used to describe a broad group of different city states and cultures distributed from modern southern Mexico to Honduras and El Salvador, from about 400 BCE to the arrival of the first Spanish settlers in the early 16th century (Molina and Rosas, 2015). The legacy of the Maya people is vast, including the discovery of the concept of zero, monumental architecture exemplified by the castle and magician pyramids in Chichen-Itza and Uxmal (Mexico); astronomical observations, and a calendar of 365 days (Molina and Rosas, 2015).

The stingless bee, *Melipona beecheii*, called Xunan-kaab or Kolel kaab (woman bee or lady bee, respectively) by modern Yucatan Mayas, as well as some present-day communities, was perceived as a gift of the gods to the Maya people and therefore considered as sacred animal (Koedam, 2018;
Present-day Xunan-kaab keepers, descendants from the Maya, may consider their bees as an extension of their family and refer to them as people (gente) (Quezada-Euán, 2018). Xunan-kaab bees are still treated with the utmost respect, caring for individual bees, burying those accidentally killed, and performing rituals of cleansing before and after collecting honey (Weaver and Weaver, 1981).

Texts and letters produced by early Spanish chroniclers and explorers allow us to conclude that the Mayans had developed advanced meliponiculture techniques by the early 16th century; however, the precise period in Mayan history when these practices were acquired is still a topic of debate among experts.

Figure 5. Contemporary and ancient man-made stingless bee hives (jobones) in Latin America. (a) Present-day jobones used for housing Melipona beecheii by native communities of Yucatán Peninsula (Mexico). Note the words amor (love) and alegria (joy) written on two of the hives. (b) Ceramic artefact likely to serve as a beehive for Melipona bees found as part of an offering in El Petén (Guatemala) dated about 2,000 years ago (Źrałka et al., 2018). (a) Image by Jorge Ramírez Petch reproduced with permission of the author. (b) Image by Jarosław Źrałka, courtesy of the Nakum Archeological Project.
Recent archaeological exploration near Petén (Guatemala) unearthed an artefact which was likely to be used as a beehive (*jobón*) included as part of an offering dated almost 2000 years old (Fig. 5b). Likewise, Post-Classic (900 CE–1521 CE) ritual paraphernalia depicting similar artefacts have also been recovered at different Mayan sites including modern Mexico (Źrałka *et al.*, 2018).

The presence of beehives and other bee-related themes such as honeycombs in temples, ritual objects, and codices (Fig. 6) highlights the deep relationship between the Mayans and stingless bees. In fact, Mayans had a bee-representing god: *Ah-Mucen-kab* (Fig. 6a, 6b), which is often depicted landing or taking off similarly to the way bees approach and leave flowers (Ayala *et al.*, 2013). *Ah-Mucen-kab* has not been totally forgotten and its name has recently been re-introduced into popular culture through the online multigame ‘Smite’ by Hi-Rez Studios (Hi-Rez Studios, 2021). Another important deity for the Maya people was the god *Hobnil* (Koedam, 2018), one of the four sons of the Mayan creator god, protector of beehives and to whom rituals are still performed by some modern *M. beecheii* beekeepers in Mexico (Weaver and Weaver, 1981). Interestingly, the same beekeepers do not invoke the god’s protection for their *Apis* hives, as it is believed that *Hobnil* does not look after this introduced species (Weaver and Weaver, 1981).

The best surviving evidence we have of the intimate relationship between bees and the Maya people are the detailed depictions they left of Xunan-kaab and deities associated with beekeeping and honey harvesting in the

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**Figure 6.** Bee influence and their importance in pre-Columbian cultures of Mesoamerica. (a) Sculpture of the bee-representing Mayan god *Ah-Mucen-kaab* located at its temple in Tolum (Mexico) presented in its typical descending form. (b) Drawing of a ritual censer depicting the descending god holding in his arms honey pots like those produced by stingless bees and *jobones* as earrings (Źrałka *et al.*, 2018). (c) Details of the Trojo-Cortesan Mayan codex depicting rituals related to honey harvesting and protection of *Melipona beecheii* (Xunan-kaab) hives.

(a) Image by Dr Erich Legner reproduced under creative commons license 4.0. (b) Image by Christopher Helmke courtesy of the Nakum Archaeological Project. (c) Reproduced from images produced by Fundación para el Avance de los Estudios Mesoamericanos (FAMSI) at (http://www.famsi.org/spanish/mayawriting/codices/madrid.html), public domain.
Trojan-Cortesan codex currently displayed in Madrid (Fig. 6c). Mayan codices are folding books made on paper produced from tree bark incorporating hieroglyphs and images of gods and rituals (Fig. 6c). Current understanding of these books suggest that they represent astronomical tables, divinatory and agricultural almanacs (Vail, 2006). The codex residing in Madrid is the longest surviving codex and contains a detailed representation of various activities and rituals related to the keeping, caring and harvesting of beehives as well as an indication of the seasons when such activities should be carried out (Vail, 2006; Źrałka et al., 2018). This codex was very likely written by various priests and it is possible that they were also the people assigned to interpret them (Lacadena, 2000), thus reinforcing the idea that a sacred relationship exists between the bees and the Maya people. Such a relationship may have initially formed due to a functional benefit derived from maintaining bees for food, health, and wellbeing. In fact, archaeological evidence suggests that indigenous tribes in Ecuador have consumed insects for a long time (Onore, 1997), a tradition that is still practiced by certain Amazonian tribes in Ecuador, and by people in Colombia and Mexico (Sancho et al., 2015). Although traditional inhabitants of the Amazon region in South America prefer eating species from the Coleoptera (beetles) and Lepidoptera (butterflies and moths) orders, certain Hymenopterans such as ants, bumblebees, stingless bees and various wasp species are frequently present in their diet (Onore, 1997). Interestingly, after the introduction of Africanised ‘killer’ bees in the continent in the 1970s, indigenous tribes in Ecuador quickly learned to harvest honey and to consume combs full of larvae and pupae of Apis mellifera (Onore, 1997). The recent and relatively quick introduction of honeybee produce in the diets of South American tribes opens a window into the likely very early adoption of honeybee products such as honey by early humans.

Stingless bees also play an important role in the cosmology of some indigenous groups residing in the north of South America. For example, Tunebo (Uwa) people living in the east region of modern Colombia, consider bees to be daughters of the solar god, sent to the world of humans to produce honey and wax in exchange for gold and seeds, symbols of wealth and fecundity (Fachetti, 1997). Uwa people also perform the mythical song of the bees (mito cantado de las abejas) after harvesting honey from their hives. At the beginning of the ritual, all tribe males sit facing east and commence singing the myth following the lead of a main singer; then, mimicking the flight of the bees, the singers move from the outside of the hut towards its centre. The ritual ends with the dawn of the new day (Osborn et al., 1990).

The persistence of the mythical song of the bees in Uwa people is in itself evidence for the continuous prevalence of bees in this culture. Myths, in general, describe rites performed by someone at some undefined time and which often hold religious importance (Raglan, 1955). Rites, in turn, consist of a
series of actions with a specific purpose resulting from the transformation of normal behaviours into signals under the influence of unintentional reinforcement by others (Genty et al., 2009), and are not unique of humans. In fact, ritualisation has been observed with different variations in primate species such as gorillas (Genty et al., 2009) and bonobos (Halina et al., 2013) and classically associated with other forms of animal behaviour as for example displays by some bird species (Tinbergen, 1960). Therefore, rituals associated with bees can be considered as examples of both biological and cultural evolution sensu Westphal-Fitch and Fitch (2018). Likewise, rituals associated with the preparation of jobones for hosting bees and subsequent collection of honey observed by pre-Columbian and contemporary Mesoamericans can also be explained in this context.

The ability of bees to transform pollen and nectar unusable to people into edible and medicinal honey was greatly appreciated by pre-Columbian inhabitants of Central and South America (Osborn et al., 1990). Furthermore, the wax produced by *Melipona* was also fundamental for the production of items made of gold, silver, copper, or alloys by implementing the lost-wax casting technique (Carcedo and Vetter, 2014). Evidence of the use of this technique by indigenous goldsmiths in Colombia dates back over 2,000 years ago (Scott, 1991). By using this technique, goldsmiths were able to produce ornamental items and the gold wire necessary for elaborating delicate items with ritual purpose (Plazas-Uscátegui, 1987). Therefore, for many pre-Columbian societies, bees and their produce was the key that enabled them to communicate with the gods through ritual.

For many pre-Columbian societies present in Central and South America, stingless bees had a direct impact in their society either as the producers of honey used for food and medicine, or as a source of the wax necessary for the production of ritual items. Because of their importance, bees were considered as holy animals by some of these groups including the advanced societies of Mesoamerica who devoted temples and rites to protect and thank the bees for their services (Quezada-Euán, 2018). European settlers later brought with them not only *A. mellifera* hives, but also the complex symbolic association between honeybees with purity, fertility, and kindness. We hypothesise that the mixture of these beliefs has resulted in a close and emotional relationship between beekeepers and their hives, and the positive image that most people have of bees is reflected in the use of the word bee both as a noun and as metaphorical adjective inviting us to behave more like ‘bees’ and less like humans.

4. A Taste of Bee Art from China

China has the longest written and continuous history of any country in the world (Swingle, 1921). The use of honeybee (*A. cerana*) products within China
dates back to the time before the written recordings (Lau, 2012). However, compared with the long tradition of using plants for medicine, bees are not as prominent in Chinese history and culture as they were in some other parts of the world (Kritsky and Smith, 2018; Pattinson, 2019). This trend of more plant/flower-dominated culture still exists today, with many more botanists studying plant–pollinator interactions, but relatively few entomologists (Ren et al., 2018).

“Feng” (蜂) is the Chinese character of bee and includes bees and wasps, “mi” (蜜) is honey, so “mifeng” (蜜蜂) is honey bee, and typically referred to the native species *A. cerana*, which is endemic to Asia and existed in China prior to the introduction of the western or European honeybee, *A. mellifera*, in the early 20th century (Yang, 2005). For a long time in Chinese history, bees were considered as being toxic and the focus was on their tendency to sting, and there appear to be only rare representations of bees in Chinese art prior to the Tan Dynasty (618–907). This attitude of considering bees as ‘menacing’ began to change during the Tang Dynasty after a rapid development of beekeeping and the introduction of honey into many Chinese medicines (Yang, 2019). Beekeeping and the increasing use of bee products in medicine and food during the Tang Dynasty in China subsequently spread to neighbouring countries, and appears to have developed at a similar time in Japan during the 7th century (Kohsaka et al., 2017). Interestingly, there was also an increased appreciation of bees and their environment in Japan like in the woodblock prints by Katsushika Hokusai *Chrysanthemums and Bee, from an untitled series of Large Flowers c. 1831–1833* (Art Institute Chicago, 2021). During the Tang Dynasty, bees began to be more frequently included into Chinese culture and art, especially through the mediums of poetry, painting, and music. In some regions like the mountainous areas of Southwest China, which have high biodiversity (Liang, 2011), local ethnic communities explored and domesticated the native honeybees and developed a rich bee-related culture and subsequent art including music.

When honey and beeswax became more commonly used in Chinese medicine and food preparation during the Tang Dynasty, poems appreciating bees’ sweet contribution to humans, and their hardworking spirit started to emerge. “The Bee” by Luo Yin (罗隐, 833–910) of the Tang Dynasty is one of the most well-known poems. “无论平地与山尖，无限风光尽被占，采得百花成蜜后，为谁辛苦为谁甜?”, “Wherever plains and hills, honeybees take all the landscape. They visit hundreds of flowers to make honey, their hard working enriches sweet for whom?” The sentiment conveys the hardworking dynamic of honeybees within nature and the appreciation of the sweet honey that can be used to improve food and as medicine for humans. Following the publication of this poem during the Tang Dynasty, there has been a continued tradition of poems voicing an appreciation of bees to human wellbeing (Yang, 2019).
The Asian honeybee (A. cerana), domestic silkworm (Bombyx mori) and Chinese white wax scale insect (Ericerus pela) (for Chinese wax), have been listed as the three most important economic insects in Chinese history, with both honeybee and silkworm products dating back to the 5th century, while the production of Ericerus wax began in the Ming Dynasty (1368–1644; Yang, 2019). In the following poem, “蜜蜂两股大如茧, 应是前山花已开.” by Rao Jie (饶节, 1065–1129), Song Dynasty: “I saw honeybees carrying pollen loads large as silkworm cocoons on their legs. This suggests that the plants in the front mountains are in bloom now.”, the author compared the honeybee pollen basket with silkworm cocoons, reflecting on the importance of both the honeybee and silkworm.

Evidence of an appreciation of bees for pollination appears to only have started to emerge during the Qing Dynasty. The following poem by Yuan Mei (袁枚, 1716–1798) “偶步西廊下, 幽兰一朵开. 是谁先报信, 便有蜜蜂来” (see Note 1) describes the poet taking a walk at the west corridor, where he found a Cymbidium orchid that was in flower. He observes that honeybees already found this flower, and wonders who has provided the flowering message to them. The poem vividly provides an observation of honeybee pollination for Cymbidium. Currently, we know that many of the cultivated Cymbidium orchids are pollinated by honeybees, including some orchid species that produce a unique honeybee pheromone mimicry to attract drones (Sasaki et al., 1991).

As discussed above, Chinese culture and art are frequently plant- and flower-dominated, and when present, bees are typically observed in visual art in the context of flowers. Especially, in Chinese art, the Four Gentlemen, (四君子, Sijunzi), a collective term used for referring to four plants: the plum blossom (Armeniaca mume), the Cymbidium orchid (Cymbidium spp.), the bamboo, and the chrysanthemum (Chrysanthemum spp.), and other flowers including peony (Peonia spp.) are most typically depicted in traditional ink and wash painting, and they belong to the category of bird and flower painting. The earliest recorded painting of bees is a sketch by Huang Quan (903–965), which, in addition to several bird species, shows several insects including two bees (Fig. 7a). Based on the colour pattern of the bee and its body size (ratio of width and length) in the artwork, this artistic representation is most likely to be a bumblebee, which would be consistent with the author of this painting coming from Chengdu, Sichuan province, which harbours a high bumblebee diversity (Williams et al., 2009). China has more than half of the bumblebee species in the world (Huang and An, 2018).

The paintings in Figs 7b and 7c also suggest an understanding of bees in the context of flowers, including a bee landed on a flower in Fig. 7b while other bees are flying, indicating an appreciation for representing transport. Whilst it appears rare that bees in this era of Chinese art are presented as the key motif,
Fig. 7b is interesting as its title “蜜蜂凤仙图” (Bees and *Impatiens* flowers; translation by ZXR) does highlight bees. Another painting worth mentioning is *Cymbidium* orchids with bees (Fig. 7c), conveying the honeybee–*Cymbidium* orchid interacting relationship in the poem mentioned above.
4.1. Music of Bees in Yunnan

Some of the oldest recordings of music evidence a long and continuous relationship between bees and humans, and were created in remote mountain regions like the Yunnan Province in Southwest China. This province is a biodiversity hotspot incorporating about half of the plants and animals of China (Ren et al., 2014). There also exists broad cultural diversity with about 25 ethnic minorities in the Yunnan province (Liang, 2011). Such diversity resulted in a long, multicultural history of agricultural practices and the exploitation of the native flora for food, medicine, and apiculture, all activities relevant for the wellbeing of the community. Yunnan remains one of the last Chinese provinces known for extensive apiculture of the native *A. cerana* (Cheng et al., 2020; Ren et al., 2014).

Nu People are mainly distributed along the Nu River (the upstream of Salween River) and worship the honeybee as their totem with a belief that their ancestor was born by a bee mating with a snake and other animals (Kuang and Kuang, 1993). In this province the Nu people maintain a long history of beekeeping using wooden barrels (a hollow wood trunk) as beehives. This tradition is not restricted to Nu people, and is also commonly used by other ethnic groups in Yunnan (Cheng et al., 2020), as well as showing interesting parallels to beekeeping culture that had independently developed in South America (Fig. 5a). A beehive drum is an important part of national heritage dancing of Bulang People at Yunnan. Similarly, in Guangxi Province, the local Zhuang people and Yao people have another drum called Feng Drum (Bee drum) because the drum draws similarities to the visual form of a bee.

These ethnic groups use various ways to present their love to the honeybee. Lisu people at Weixi County have a long traditional song about honeybees with sounds mimicking the bee buzz (Susan, 2017), and in the lyrics they sing that the harmony between Lisu people with the honeybee makes their lives happy. Other peoples such as the Bai, Naxi, and Yi people, have many recordings of songs involving bees and flowers telling a love story that symbolises the relationship between young lovers (Fig. 8).

Bee-inspired music is still alive in China today, and popular on social media, for example, TikTok. A popular karaoke (KTV) company is named after bees, as ‘The Bee Hive’, which originated from Kunming, and now has chains across China (sohu.com, 2017). One of the reasons they named the KTV after beehives is that the company advertised that their workers will serve singing customers like a busy bee. In China, other bee-inspired names of stores and companies occur in Kunming, for example, Honeybee Real Estate, expressing similar meaning of hardworking busy bees. Busy bee and love stories between flowers and bees are examples of artistic representations that likely serve an aesthetic sense of appeal to contemporary consumers of art, although this appeal in itself may lead to commercial benefits to companies.
associating themselves with bee themes. This modern use of bee art and thematic representations thus fits with a bioaesthetics framework (Prum, 2017; Westphal-Fitch and Fitch, 2018) that initial art representations that might have more principally served to improve communication about food and wellbeing to a community, may evolve into representations that are mainly experienced as pleasurable and separate from the initial purpose of art production.

Overall, the artistic representations of bees in China fits with a greater appreciation of the value of bees for food production and medicine practice, suggesting that the artists wished to express bees as something of value to how we live. The change of attitude from treating bees as toxic to a hardworking and selfless sweet honey provider during Tang Dynasty provides a good example of how aesthetic representation may develop by appreciation of the bees’ value for humans, and effective communication via several types of art practices and mediums representing bees is an important part of that journey.

5. The Voice of the Bee (Bee Sounds in Art and Culture)

The sounds and signals bees generate appear to be a shared musical influence between humans in many cultures around the world. Throughout history, a
theme of human curiosity is the sound that bees mechanically generate via the rapid movement of their wings, or, for some species, vibrations of the thoracic muscles (King and Buchmann, 2003). The bee not only produces this recognisable hum during flight, but for eusocial species of *Apis*, they also generate ‘piping/tooting’ and ‘quacking’ signals for communication within the hive (Terenzi *et al.*, 2020). The distinctive bee ‘voice’ has long fuelled inquisitive humans to further understand this phenomenon, and how it may be applied and/or co-opted to human forms of communication in a broader artistic context, such as music composition and creation. The ‘droning’, the bagpipe reminiscent ‘piping/tooting’, and duck-like ‘quacks’ of the bees auditory aesthetic, together with the human perceptual interpretations of the insects ‘busy’ and ordered social hierarchy, has influenced many areas in the auditory sphere such as music theory, composition, reproduction, artist names and composition titles, lyrical themes, and musical genre. In research culture, the buzzing of the beehive has a long history as a means to decipher bee communication, and assess hive health (Terenzi *et al.*, 2020), and ‘buzz pollination’ of non-*Apis* bees is also a topic that has generated much interest (Cardinal *et al.*, 2018; Switzer *et al.*, 2016). As we will evidence in this section, humans’ appreciation of the bees’ aesthetic qualities (both auditorily and socio-dynamically), not only afford humans the ability to musically mimic/abstract and share bee sound interpretations, but also to use these auditory signals as a means to interpret order, project human emotions, and explore co-species musical construction.

### 5.1. Early Human Bee Voice Interpretation and Music

The Greek philosopher Aristotle was deeply fascinated with bee culture (Barnes, 1984) and observed that when honeybee swarming is imminent, a particular sound is produced continuously by the hive bees some days before the event occurs (University of Glasgow Library, 1850–1860). This astute observation by Aristotle documents an early example illustrating the human processing and interpretation of one dimension of the bee aesthetic, namely, audio. Although not intended for human observers, but rather to prepare the exiting Queen’s ‘followers’ for the expedition to a new residence, it may be hypothesised that the by-product of the ‘swarm-signal’ culminates in an auditory cue to many species signalling not to approach or interfere with the swarming bees’ pursuit for a new home. In this regard, bee swarm sound aesthetics in the human perceptual context may substantiate their powerful and dynamic representations that have been portrayed by many artists through song narratives and musical compositions which continues today (see Section 5.2). Contemporary empirical research by Ferrari *et al.* (2008) has shown that when the Italian honey bee *Apis mellifera ligustica* approaches swarming, the
hive sound rises in frequency from 110 Hertz (Hz, ~A2) to 300 Hz (~D4), and occasionally rapid changes occur from 150 Hz (~D3) to 500 Hz, or just below C5 in the chromatic musical scale, a common aesthetic selection for musical composition. As perceived by humans, the honeybee swarm signals appear to align with the musical notes’ humans are attuned to.

A seminal body of work documenting a naturalistic study of bee sounds, signals, and their relationship to human music composition, song, and societal order lies in the work of Charles Butler. Regarded as the father of English beekeeping (Morse and Hooper, 1985), Butler’s renowned authorship on beekeeping, *The feminine monarchie: or the history of bees* (1609), was dedicated to the merits of the bee and their queens, their hierarchy, and the ‘voices’ they produce (Hayes, 1925). Contained in his writings, Butler provides qualitative musical transcriptions of the tones that he observed the bees to sound based on his wealth of beekeeping experience. In the first edition (Butler, 1609), Butler notates three musical phrases arranged in triple time to sound the voices of the bee: one (A la-mi-re) for the sound of the ‘Princess’ (new Queen); a higher pitched tone sequence to represent the new Queen piping (C sol-fa); and a lower tone for the buzz of the older Queen where each note ends in C sol-fa-ut (Hayes, 1925). In following decades, two further editions of this knowledge were produced (1623 and 1634; Hayes, 1925) where Butler evolved the original concept into a comprehensive four-part madrigal, the *Melissomelos* (or *Bees’ Madrigal*, Fig. 9; Hayes, 1925), highlighting an ‘inner’ coevolutionary loop within Butler’s artistic process where he is not only producing an aesthetic set of signals for the human viewer (the *Melissomelos*), but at the same time is also evaluating the piece from the envisaged viewpoint of an audience (‘The Queen of England’ for example) and revising it accordingly over time in an evolutionary fashion to improve aesthetic quality from the seminal sounds sourced from bees, consistent with framework proposed by Westphal-Fitch and Fitch (2018). Within the *Melissomelos* are sections where Butler specifically concentrates the four human singers on the vocalisation of the ‘voices of the bees’ (Hayes, 1925). When performed in choir, *The Bees’ Madrigal* elicits a mournful sweet auditory experience, which may be described as ‘honey to the ears’ that transcends any functional use of experiencing bee-related sounds. Preceding Gombrich’s (1980) hypothesis of acquired aesthetic faculty and the human ‘sense of order’ (Westphal-Fitch and Fitch, 2018), *The Bees’ Madrigal* represents a concerted effort on behalf of Butler through the rationalisation of observed bee signals as vocalisations, music, narrative, and visual art to illustrate societal hierarchy (Fig. 9). In doing so (as in many examples presented throughout this manuscript), he emphasises the widespread human fascination with exploring qualities of the bee that move from a more simple communication about bees to reside in the human perceptual faculty.
Figure 9. Cover of the Melissomelos (Bees’ Madrigal) from *The Feminine Monarchie, or the History of Bees* (1623) by Charles Butler. Image taken from the Biodiversity Heritage Library (https://www.biodiversitylibrary.org/page/50686654#page/115/mode/1up), public domain.
Fittingly, the madrigal was performed at Wootton St Lawrence church in 1954 (where Butler is buried) to the dedication of a stained-glass window that marked Queen Elizabeth II’s coronation (Heath, 2017). The stained glass contains the motif ‘Solertia et labore’ (ability and effort) derived from the iconography in the front section of Butler’s manuscript, bridging the inspiration of the bees’ auditory and socio-structural aesthetic as viewed by Butler to the artistic fields of music, visual art, literature, and the architectural.

5.2. Nineteenth-Century Bee Voice and Beyond

Throughout the 19th century bees became increasingly more prevalent in human artistic endeavour as the protagonist in music performance, narrative, and creation/replication, indicating a potential cultural evolution (Westphal-Fitch and Fitch, 2018) with respect to bees and their growing popularity in this human artistic domain. For example: The Bee-Hive: a Musical Farce, in Two Acts (Horn and Millingen, 1811); The Bee, a Glee for Four Voices (Elliott, 1825); The Bee, the Golden Daughter of the Spring (Hawes, 1836); The Bee by Schubert, 1860 (Kennedy and Bourne, 2018); and The Bee and the Rose (Woolf and Trevor, 1877). Reflective of Butler’s representation of the bee as previously discussed (Section 5.1), in this period, we observe an appetite for representing the bee not only through music and song, but through the human interpretation and metaphoric abstraction of their seemingly flourishing societal construct. For example, The Bee-Hive: a Musical Farce, in Two Acts (Horn and Millingen, 1811) imagines the “Bee Hive” as a bustling trade port Inn, laying bare the human interpretation of the ‘hive’ by the authors as a micro-ecosystem of vibrant and prosperous industry; aware of intruders that may disrupt the hive’s cohesive balance, as the finale chimes: “Friendly Bee, and buzzing Drone, Welcome to my Hive; Critic Wasp, leave me alone; Let Industry thrive!” (Horn and Millingen, 1811).

Perhaps the most recognisable composition of this time period to mimic the bee’s auditory aesthetic of flight among the flowers is the orchestral interlude Flight of the Bumblebee written by the Russian composer Nikolai Rimsky-Korsakov in 1899–1900. Penned for the opera The Legend of Tsar Saltan (The Concise Oxford Dictionary of Music, 2021a, b), Rimsky-Korsakov by means of rapid [144 beats per minute (BPM)] and relentless sounding of notes (in the key of A minor, B minor, F-sharp minor), aimed to auditorily depict the ‘skittish’ and ‘frenetic’ movement and activity of the foraging bee. Although composed in the accepted and familiar tonal register palatable to the human ear, and temporally slower than an actual bee buzz, to the listener, the piece sufficiently captures the intensity of the bee kinetic aesthetic through the sheer physicality, dexterity, and cognitive processing required for performing the task. To illustrate the broad acceptance of Rimsky-Korsakov’s interpretation
of the bee voice in modern human perception, an examination on Spotify in April 2021 revealed that the 19th-century masterpiece has been reproduced and recorded by different artists and orchestras over 1000 times, with the two most popular renditions being; (i) Performed by: Columbia Symphony Orchestra, Isaac Stern, Milton Katims; Produced by: Thomas Frost; Sony Classical; 1963 and (ii) Performed by: London Symphony Orchestra, Andre Previn; Produced by: Peter Dellheim; Sony Classical; 2008. These two performances have a combined audience exceeding 8,000,000 listeners. Considering these metrics, it is a remarkable uptake as the *Flight of the Bumblebee* was originally written as an incidental element of the opera, which may allude to the permeation of a bee’s auditory aesthetic in the broader human psyche over time, and our fascination with humans performing such a complex composition to achieve the magnificent auditory experience.

The cultural evolution of the bees’ voice did not wain moving through the 20th century; indeed, bee-inspired music continues to grow in influence and styles of artistic representations at the start of the 21st century. Assisted by advancements in communication technologies and information sharing (e.g., recordings, television, and radio), the bees’ place in the human music sphere expanded beyond the pages of music notation and concert halls to a wider audience, and in turn surreptitiously broadened the plight of this extraordinary provider. “*Oh, what a wonderful thing to be — A healthy, grown-up, busy-busy bee*” sang Arthur Askey on the BBC’s variety entertainment show in 1937 (British Pathé, 2014). Accompanied by a piano that simulates the bees buzzing in complement to the vocal ‘Bzzzz’ trill, Askey’s somewhat ‘silly’ and catchy ditty *The Bee Song* (Blain, 1938), was later to become the advertisement jingle for the Rowse honey company (Advocate Agency, 2012), a strong promoter of honeybee sustainability (Rowse Honey, 2021). In this instance, we witness a salient example of the human interpretation of the honeybee as a positive symbol of health and vitality which has transcended popular comic relief of the time to be utilised as a branding device for the protagonist’s preservation and its premium quality produce which humans enjoy so much. Indeed, we may hypothesise that artistic endeavour and the bee aesthetic (as auditory, and hardworking nature) more than likely has a connection to public sentiment as also evidenced in Napoleon’s French republic and the rise of bee appreciation in China. These links can be traced back to a more fundamental first appreciation of bees to our survival, serving as a bridge to why bees evolved a presence in human culture and art practice.

5.3. Contemporary Bee Voice

As we have explored in the previous Sections 5.1 and 5.2, the bees’ auditory aesthetic and socio-behavioural dynamics have had a meaningful influence
on the way in which humans attempt to make sense of the intricacies of bees, and how this may be reflected in human culture. In contemporary music, we observe an extension and refinement of perceived bee attributes from past endeavours, to now traverse many genres and styles. In some instances the perceived aesthetic features of bees’ are strategically composed as signals for specific means, such as group identity (Hargreaves and North, 1999). These signals may be witnessed as artist names, album and song titles, and lyrical content. The modern era reveals that the influence of the bee in music extends beyond the literal expression of song and lyric to now diverge as separate elements within the musical artistic enterprise. Thus, perceived aesthetic features of the bees’ aesthetic characteristics are not only interpreted as multidimensional and separable, but appealing to diverse, and niche audiences.

In the first study to uncover the use of insect themes in modern rock music, Coelho (2000) discovered that Hymenopteran artist names were the most common. A further consideration of this position shows that bee themes are sometimes perceived to project a sense of ‘menace’, for example, in artist names and album titles such as: Wu-Tang Killa Bees (Wu-Tang Killa Bees, 1998; Fig. 10) and Bees (Bones and Jones, 2020), yet also adopt the beneficial and sensitive qualities of the insect with names such as: The Bee Charmers (The Bee Charmers, 2021) and Free the Bees (The Bees, 2004). Through these examples (and many more) we identify contrasting interpretations of how humans perceive bees, and how this divergence may be consciously adopted by artists or musical groups to convey their ‘attitude/persona’ to their

Figure 10. Copy of the album The Swarm of Drones by Wu-Tang Killa Bees (1978). Image by Stuart McFarlane.
audience, the viewer. However, one recent example shows caution is required in interpreting meaning like menace to names as the names may be an attribution to support their post-punk musical aesthetic; such as the band Killer Bee Queens (Killer Bee Queens, 2021), fronted by bee researcher Professor Lars Chittka, donates funds raised by the band to conservation charities which enable protection of bees (Queen Mary University of London, 2019), blurring the lines between artistic endeavour, philanthropy, and the tendency of humans to use salient labels to capture attention.

Song titles appear to differ from artist names and album titles in symbolism. In this category the bee is often used to imply human intimacy and relationship, drawing some parallels to the cultural representations from the Bai, Naxi people, and Yi people of China. For example, Be My Little Baby Bumble Bee (Marshall and Murphy, 1912); Honey Bee (Dean et al., 1968; Petty, 1994); and Bumble Bee (Sting me) (Drayton et al., 1970). However, bee themes are represented/misrepresented in broader contexts also, which reflects the now detailed interpretations artists derive from the bee for nuanced expression and narrative: I’m a King Bee (Harpo, 1957); The Bees (Animal Collective, 2005; Snaith, 2005); Bee of the Bird of the Moth (They Might Be Giants, 2007), and Beez in the Trap (Maraj et al., 2012). Thus, to have a protagonist with such a widespread appeal in conveying a range of emotional content and co-opted human traits beyond representations of previous generations, reveals the deep and evolving resonance that bees enjoy in contemporary music culture today.

Lyrically, bees are expressed literally, metaphorically, and in abstract to assist the artists’ narrative, and by virtue of this communicative signal, we may hypothesise that the now complex personas of the bee are commonly understood and accepted by a wider, global audience, reinforcing the bee as a meaningful subject for human communication and connection. For example, The Supremes’ ‘Honey Bee’ (Dean et al., 1968) tells a tale of love and the wanting for a ‘sting’ in the heart: “You started a fever burnin’ deep inside of me. Since you stung me with your sweet love. My whole life is rearranged. My heart looks like love has changed. Honey bee, you’re such a part of me. Honey bee, you stung the heart of me. Honey bee, keep on stinging’ me” (Lyrics © Sony/ATV Music Publishing LLC). In contrast, Animal Collective (2005) sing of human/bee interactions, and contemplative resolve: “So sudden. The bees. They came flying. So violent. The bees. They came sly. So scary. The bees. They came wide. So wild. The bees. They came crying. They said: “I take my time”. You take your time. Please take your time. I take my time. I take my time. You take your time. Just take your time. I take my time. And if you need us. And if you need. The bees. The bees. The bees. The bees.” (Lyrics © Domino Publishing Company). Award-winning rapper Nicki Minaj taps the bee in ‘Beez in the Trap’ (Maraj et al., 2012) to demonstrate power and wealth: “Bitches ain’t shit and they ain’t saying nothin’. A hundred mothafuckas can’t tell me nothin’. I beez in the trap, be-beez in the trap. I beez in the trap, be-beez
“in the trap” (Lyrics © Universal Music Publishing Group, Reservoir Media Management Inc).

Lastly, beyond adult popular music, modern primary education calls upon the bee as source material for the inspiration of educational songs, that perhaps, may drive the evolution of the bee in culture by priming the younger generation with digestible bee attributes that young humans may relate to and further explore in adult life. Popular kids jams include: *Here Is The Beehive* (Super Simple Songs, 2018; ~ 31,449,975 YouTube views [8th March, 2021]) (Super Simple Songs – Kids Songs, 2018); *My Little Bee* (LooLoo Kids, 2017; ~ 8,329,962 YouTube views [8th March, 2021]) (LooLoo Kids – Nursery Rhymes and Children’s Songs, 2017), and *Bumblebee (Buzz Buzz)* (Laurie Berkner, 2007; ~ 4,185,137 YouTube views [8th March, 2021]) (txsgrlz, 2007). As we observe from the small sample of YouTube metrics above, children’s bee ditties have the capacity to garner a substantial audience of young eyes, ears, and minds.

5.4. The Drone of the Bee Voice and Co-Species Music Creation

Musical genre, specifically the term ‘Drone’, is directly derived from the male bee of eusocial species and their buzzing aesthetic. Middle English *drane* or drone meant the ‘male honeybee’, and is drawn from Old English *dran* or *dræn* (Online Etymology Dictionary, 2021). Today, the noun ‘drone’ means to “make a sustained deep murmuring, humming, or buzzing sound” (Merriam-Webster, 2021a). Drone music refers to a musical approach and sound aesthetic that is usually low in pitch, and provides a foundation for a melody or melodies sounding at a higher pitch level (The Editors of Encyclopaedia Britannica, 2017). If we refer to Ferrari *et al.* (2008) who studied the baseline hive frequency to reside around 110 Hz (~A2), the interpretation of the bee drone as a low-frequency sustained hum holds true.

Drones exist in many cultures including Asia, Europe, India, Africa, and Australia by way of the traditional landowners and the didgeridoo (Devoto, 2011). The drone eventually made its way into popular culture through artistic acts such as the Beatles and their ethno-musical experiments of the 60s with songs such as “Tomorrow Never Knows” (Lennon and McCartney, 1966). However, it was not until 2015 that the bee’s relationship to drone came full circle. *ONE*, is a drone symphony recorded by musicians Tony Foster and Kevin Bales (Be, 2015a, 2015b) from the space rock musical group and brain-child of Jason Pierce, *Spiritualized* (Ankeny, 2021), together with Amiina (the string section regularly used by Sigur Ros), Deirdre Bencsik, Camille Christel, Julian Cope, Dave Gahan and Mark Lanegan, among others (Be, 2015a, b). The music for the album was constructed by the musicians through improvisation in the key of C to a live audio feed of 40,000 bees and their hive sounds via Dr. Martin Bencsik (Nottingham Trent University). In this example of
contemporary art as music, the artists collaborate with the bees and their hive drone auditory output to produce a compelling and complex inter-species composition rooted in what Westphal-Fitch and Fitch (2018) refer to as a coevolutionary loop model for artistic aesthetic production. Thus, by virtue of the improvised nature of the music’s construction, each artist must respond and adapt to all musicians contributing ‘signals’ in real-time, which also complement and respond to the bees’ auditory offerings to produce the final result. This remarkable co-species endeavour was conceptualised as the official soundtrack to artist Wolfgang Buttress’s multiple-award-winning UK Pavilion at the 2015 Milan Expo (Be, 2015a, b; Buttress, 2021b) One, which complements Buttress’s highlighting of the plight of the honeybee, and the importance of pollination (Be, 2015b). Similar themes of bee–human music collaboration and production have also been explored in the Australian musical Dance of the Bee, by Martin Friedel and Michael Kieran Harvey. In this performance, live bees by way of their buzz and humans through instrumentation and singing, play together to create unique interspecies drone music (Peard, 2015).

In sum, and as Butler aptly stated almost four centuries prior: “In the bee songs are the sounds of music” (Butler, 1623, p. 71).

6. Bees and Architecture (The Bee House to our House)

Themes originating from bee life and how humans have learned to work and live with bees have also provided insights leading bio-inspired bee architecture. Bio-design, ranging in application from design and architecture to robotics, has frequently been inspired by honeybee behaviour, their collective decision-making, and colony structures (Bitam et al., 2013; Srinivasan, 2011; Stepney et al., 2007; Wang and Suda, 2005). Indeed, observations of beehives and the unique hexagonal hive structures that some varieties of bees (such as A. mellifera) construct have long fuelled human curiosity to explore this geometry in detail, and at scale, for both functional, symbolic, and artistic purposes. Perhaps, among all the offerings the bee provides including pollination, honey, and wax, it is their innate engineering expertise that continues to inspire built environments, building materials, structural configurations, and imagined future 3-D printed space habitats. The capacity of humans to derive bio-inspired design from bees evidences a move in several cases from perhaps a more simple imitation processes, to new designs that require imagination and creativity in how we derive design principles from bees.

6.1. Early Bee-Inspired Architecture

Early examples of an influence of bee management on human architectural design practices resides in the stone-and-gravel domed huts typical of Celtic
dwellings from 2000 BCE in Scotland and Ireland (Cagle, 2007). Referred to as *clocháns*, and more commonly ‘Beehive houses’, as they visually resemble the ancient straw skep beehives (Fig. 11a; Kritsky, 2017), these mortarless structures were erected to serve a functional purpose and primarily employed as domestic dwellings for monks among Christian settlements of the time (Cagle, 2007; Curl and Wilson, 2015). Construction of the domes followed a systematic procedure where individual stones are arranged on a circular plan, and each successive layer is placed marginally inward over the course below to form a hemispheric (hive-like) structure (Curl and Wilson, 2015, Cagle, 2007). Such structures, including original Celtic building designs on the island of Skellig Michael, have also featured in popular culture films like Star Wars “The last Jedi” (Weinberg, 2018).

Indeed the ‘Beehive house’ architectural typologies are not unique to Celtic design, with similar structural features (particularly the domed roof) observed in several other regions of the world, yet differing in construction methods and materials complementary to the particular geographies. The prehistoric Sardinian ‘*nuraghi*’ (1900–730 BCE; Depalmas and Melis, 2011; Lilliu, 1959) in their most essential form take the shape of a round cobbled stone tower, where the chambers are roofed by corbelled vaults, reinforcing their visual similarity to the shape of honeybee hives (Lilliu, 1959). The ‘*trulli*’ of southern Italy (~1800) that (in contrast to the *clocháns*) are governed by an intricate

![Figure 11. Bees as inspiration for architecture and art installations. (a) Skip beehive, a classic design that has inspired humans for over 2,000 years. (b) The Beehive building in Wellington (New Zealand) which hosts the Executive Wing of the New Zealand Parliament. (c) Cover for the album The Hive, an award-winning architectural installation derived from a multidisciplinary collaboration between various musical and architectural artists. The installation is an abstraction of the honeycomb used by bees. (a) Image by Rosser, 1954, public domain reproduced under Wikimedia Commons license. (b) Image by Ulrich Lange reproduced under Creative Commons Attribution-Share Alike 3.0 and General Public License 1.2. (c) Photograph reproduced with permission by Wolfgang Buttress. Photo credit: Mark Haddon.](image-url)
construction process where each stone is first cut and matched for purpose, and as per the ‘nuraghi’, are then completed with the hive-like corbelled dome (Todisco et al., 2017). The ancient Bantu of South Africa approached the beehive typology with the use of grass, leaves, and laths, which culminates in an insulated hive environment well suited to the harsh climate of the continent, and in some instances are completed with a door to protect from inquisitive animals in the region (Knuffel, 1973). However, foremost among such bee-centric typologies and regarded as the finest Antique example is the Mycenaean ‘Treasury of Atreus’ (Wace, 1940); a habitat not for the living, but the dead. The tomb is one of the most important monuments of the Bronze Age (~1250 BCE) in Greece and largely recognised as the highest example of Mycenaean beehive architecture (Wace, 1940). Constructed as an underground chamber that takes refuge in the side of Panagitsa Hill (Mycenae, Greece; Wace, 1940), the stone hive is formed of a circular-plan chamber (similar to the clocháns) with a corbelled dome of precision stonework. What sets the Treasury of Atreus apart from similar structures of the time is its humbling scale, as it was the tallest and widest hive dome spanning 14.5 m in diameter, and 13.5 m height in the interior (Wace, 1940).

In early human architecture, it appears links between bee management and influences on building design traversed a more functional roll rather than aesthetic beauty, where the additive constructivist process (resembling honeybee hive construction) was well suited to a variety of regions and the natural building materials that they afford.

6.2. Modern Bee-Inspired Architecture

Following the significance of early bee-inspired architectural typology, throughout modernity, and expanding across many different regions and styles, we now observe numerous cases of honeybee-inspired architecture around the globe that embrace not only the functional dome attributes, but metaphor, and bio-inspired engineering (Imani, 2017).

Catalan architect Antoni Gaudi (1852–1926), who is known for his organic and naturalistic inspired designs often referenced the features of the honey bees, both literally and metaphorically (Ramírez, 2000). Most notably is his frequent employment of the parabolic arch which (like the clocháns; see Section 6.1) is believed to be derived from his interest in skep-shaped beehives and wild honeycomb (Ramírez, 2000). When viewed in section, the parabolic arch resembles a 2-D profile of a hive dome. The recurring arch feature was executed in many designs throughout his career, such as the Casa Batllo loft (1877), the Cooperativa Mataronese factory (1882), the Palau Güell (1886–1888), and the Casa Mila (1906) (Ramírez, 2000).
Beyond early hive dome structures (see Section 6.1) and Gaudi’s parabolic arches, the skep-shaped form has influenced many modern buildings throughout the 20th and 21st century’s (e.g., Beehive, Eric Owen Moss 1994–2001; Reichstag Dome, Sir Norman Foster 1999; Learning Hub, Thomas Heatherwick 2015), with the New Zealand parliament’s ‘beehive’ building (1969–1981; Fig. 11b) representing an exemplary example. Designed by Sir Basil Spence (1907–1976), not only does the ‘beehive’ portray the visual hive-like form in steel, glass, and copper, but blends the typology with the metaphor of the bees lauded social and work structure, befitting of the aspired to standard for parliamentary duties. These more modern designs move beyond functional purposes to reflect perceived value of living or working like bees, linking early functional benefits to subsequent perceived aesthetic value in latter design as proposed by Westphal-Fitch and Fitch (2018).

6.3. The Bee: The Architect, the Engineer

The Hanna–Honeycomb House (1937) (also known as the Hanna House) by American Modernist Frank Lloyd Wright differed from the hive dome form of past architectural endeavours and expanded the bee aesthetic by incorporating the geometric features of the honeycomb, namely, the hexagon (Stanford University, 2021). As a result, the Honeycomb House was devoid of right angles (which was uncommon of the period) within the designs floor plan that resulted in a “remarkable degree of spatial continuity and flexibility” (Frank Lloyd Wright Foundation, 2021). Further, to complement the hexagonal honeycomb aesthetic, Wright designed furnishings that move beyond pure function and built-in facilities to match the geometry, including ottomans, chairs, tables, and an open fireplace. The Hanna–Honeycomb House was recognized as a National Historic Landmark on June 29 1989 (Frank Lloyd Wright Foundation, 2021).

The functional hexangular form of honeycomb that influenced Wright’s architecture has been a source of human curiosity for centuries, that began with Roman scholar Marcus Terentius Varro (~36 BCE), who observed that when compared to a shape such as a triangle or a square, a hexagon inscribed in a circle encloses the greatest amount of space (Varro and Storr-Best, 1912), demonstrating higher-level appreciations of the mathematics and form that underpins good design practice. Later to be known as the ‘the honeycomb conjecture’, Varro’s studies (and further explored by Pappus Alexandria ~290–~350 BCE; Hales, 2001) implied an inherent efficiency in the bees’ cell engineering, and as Darwin observed, may be a result of natural selection, that may lead to an economy of wax production (Darwin, 1859). Indeed, constructing sound wax cells with the least material that store the maximum amount of honey of any other geometry would support this hypothesis. In 1999 ‘the
honeycomb conjecture’ was validated by mathematician Thomas C. Hales (Hales, 1999).

Without question, the most successfully derived architectural design to employ the hexagonal geometry is the ‘geodesic dome’ typology popularised by Buckminster Fuller (1895–1983), American architect, designer, inventor, and futurist (Sieden, 1989). Admired for their economy of materials, structural rigidity, and stress distribution, the hexagonal varieties have been erected in numerous cases, with outstanding examples including: the Eden Project Biomes by Grimshaw Architects (Cornwall, England; 2000–2001), and the world’s largest open air geodesic dome which serves as the headquarters of the American Society for Metals (ASM) International by John Terrence Kelly (Ohio; 1958). Upon viewing, these domes draw the viewer closer to the imagined life of a hive, and the engineered beauty of the habitat.

The hexagonal attributes of the hive structure not only have shown benefits on Earth, but may be rehearsals for future inhabitants on other planets. One vision is a modular, hive-inspired hexagonal building aimed for Mars. Designed by Noah Hershberger, and a winning entry of NASA’s Jet Propulsion Laboratory challenge to imagine a bio-shielding habitat for the red planet, this dwellings most fascinating feature is the proposed 3-D printed construction (Peters, 2014). Here, we witness not only inspired geometric constructions coming from the long association of humans working with and managing bees, but a building technique the worker bees have innately employed for comb construction long before human observation. Just like additive manufacturing that modern 3-D printing provides, for centuries the worker bees have been converting sugar content of honey into wax and processing this substance through small pores to produce tiny flakes of wax on their abdomens. Workers chew these pieces of wax until they become soft and mouldable (Sanford and Dietz, 1976), and just like 3-D printing, then add the wax in sequence to the honeycombs open profile.

Experimental architecture moves beyond construction methods and geometry into multisensory domains to explore the bee, the offerings they can provide, and their fragility. The Hive is an award-winning architectural installation by Wolfgang Buttress in collaboration with physicist Dr Martin Bencsis, engineer Tristan Simmonds, and Manchester-based architectural practice BDP. The Hive is a fourteen-metre aluminium lattice cuboid that highlights the decline of the honeybee. By measuring the activity of a remote living bee colony, accelerometers feed live signals to 1000 LED lights which line the interior of the sculpture. The energy informs an ever-changing and fluid soundscape created by a selected ensemble of musicians who now write and perform under the name of “Be” (see Section 5.4). In this work, architecture, art, science, and honeybees come together to collectively focus attention on the importance of pollination for food production. One was the title of the
accompanying music where the album cover image (Fig. 11c) abstractly depicts the honeycomb structure of *The Hive*, its scale, and the immersive quality of the elements combined. Thus we see, consistent with recent theories that aesthetic appreciation needs to link to some initial functional reason of representation that benefited humans (Westphal-Fitch and Fitch, 2018), that in architecture initial functional designs linked to how we work with bees directly connect to modern multisensory art representations that have wide popular appeal by connecting to individual observers and the broader audience how important bees are to how we live.

7. Bees Representations in the Arts (To Art or to Bee)

We have observed in previous sections that the influence of the bee and their representations have been a figure of spirituality, providence, communication, societal structure, and connection to nature, that, we posit, may be derived originally through evolutionary development stemming from both the nutritional benefit of an association with bees, and the positive conditioning response of a sweet-tasting food source that provides health benefits (see Section 1). Indeed, during the Renaissance of Western and European painting, bee representations (and their produce) are more commonly cited within landscapes and scenes as positive symbols, protagonists and metaphors for religious beliefs and mythologies, or to represent mortal themes such as pleasure and admiration (e.g., *Agony in the Garden*, 1457–1460, by Andrea Mantegna; *Stuppacher Madonna*, ~1516, by Matthias Grünewald; *Venus with Cupid, the Honey Thief*, 1529, by Georg Flegel; and *The Miracle of Bees*, 1673, by Juan De Valdes Leal; see Antonius, 2019 for a review). In modern and contemporary arts practice, we witness a ‘collective’ sense of connection to the insect, through the increased exposure to knowledge, and the evolving array of artistic mediums and technologies utilised (see Section 7.2.6). Today’s artist increasingly presents a poignant ‘voice’ of empathy towards the bee, where perceived aesthetic beauty (in its many representations) informs a higher objective and collective awareness, that is, for the sustainability of this delicate life force, and their significance to our own (and many species) survival.

7.1. The 20th Century

Inspired by Rudolf Steiner’s (1861–1925) influential nine lectures on bees and his anthroposophical philosophy (Steiner, 1964; Wilkinson, 2001), 20th century artist Joseph Beuys (1921–1986) is perhaps the most significant figure of the modern era to integrate bee representations and their offerings (i.e. beeswax and honey) within their works (Borer, 1996). Beuys questioned the idea that humans can holistically understand the fundamental workings
of the world through the ‘normal’ modes of perception (Adams, 1998), and thus, contemplated evolutionary concepts that may impact human awareness (Adams, 1998; Borer, 1996). Through a “totalised concept of art” (Adams, 1998), he viewed aesthetic signals projected by art as more than simply assemblages of matter produced exclusively by an elite ‘artist’ for viewer appraisal, but a deeper ‘force’ that pervades our existence (Adams, 1998; Borer, 1996), and may be created by any human, either through physical objects, music, thoughts, speech, or social interaction. This consideration now extends to contemporary mediums such as online media, the world-wide web, and scientific communication (see Section 7.2.6 below). Interestingly, Westphal-Fitch and Fitch (2018) note that: “despite a long-standing prejudice to treat such variable factors as completely independent of human biology, the fact that all human cultures engage in some such artistic practices...indicates that the capacity to acquire the aesthetic proclivities of one’s culture does have a biological basis, essentially universal in our species” (Westphal-Fitch and Fitch, 2018, p. 5).

Beuys’ use of Apis offerings as an artistic medium began in the late 1940s and early 1950s by way of beeswax. Enamoured with wax metaphorically, Beuys saw the medium more from a spiritual, alchemic, and versatile standpoint, where its ability to transform between states, such as the warm ‘chaotic’ liquid form intrinsic in hive production, and the cold ‘crystallised’ hexagon of the honeycomb, could assist him in exploring the nexus between artistic thought, and objective resolve (Adriani et al., 1979). Queen Bee III (1952) exemplifies Beuys’ theories as sculptural forms during this period. Produced from beeswax to resemble the organic form of the provider (the bee, the artist), the wax not only represents the ‘chaotic’ sculpting process, but through ‘crystallisation’ takes its final form as presented, reinforcing Beuys’ organic-to-inorganic, warm-to-cold, thought-to-object experimental methodology (Adams, 1998).

In later decades Beuys expanded his material palette to include honey (among others), that served as an important feature in two of his most recognised works (Adams, 1998; Beuys, 1990; Borer, 1996) including How to Explain Pictures to a Dead Hare, and The Honey Pump. An example of Beuys’ theoretical development lies in his use of honey as a metaphor for human thought, which was physically performed by smothering his head in the golden viscous material during the performance of How to Explain Pictures to a Dead Hare, clarifying that: “The human capacity is not to give honey, but to think — to give ideas...Honey is doubtlessly a living substance. Human thought can also be living.” (Adriani et al., 1979, p. 132). In this way, Beuys equates perpetual human thought to Apis honey production, and implies that to maintain fresh and alive thought processes, we must continue to share and replenish them (like bee’s honey production) as contributions to humankind (the hive).
In a related yet expanded fashion, Beuys’ *Honey Pump* installation consisted of an elaborate mechanism that forced large quantities of honey through clear tubes installed around the lecture hall of the Museum Fridericianum in Kassel (Adams, 1998). Here, Beuys moved beyond human thought to represent an entire organic system of social organisation and harmony, where the honey represented the human life stream as a metaphor for hive cohesion itself (Adams, 1998).

Undoubtedly Beuys’ deep admiration for bees and ground-breaking arts practice has been a major catalyst for the promotion of the insect as a protagonist in contemporary art spheres; however, he may have also inspired another central work of a similar period, namely Michael Ayrton’s (novelist and sculptor; 1921–1975) 1968 *Golden Honeycombs* (Michaelis, 1992). In this work Ayrton reverse-engineered what he considered to be the method the legend of Daedalus used to produce the golden honeycomb for the temple of Aphrodite. Indeed, Ayrton translated the fable into reality by casting a golden honeycomb in the lost-wax method using the bees’ produce. To complete the sculpture, like Daedalus, Ayrton affixed cast golden bees to the comb (Michaelis, 1992). Interestingly, the sculpture has been reported to be utilized by living bees while residing in the works late patron and owner’s garden, Sir Edmund Hillary (1919–2008; Preston, 2006), giving credence to the aesthetic of the artefact, that, as Beuys envisioned, extends beyond human sensibility.

7.2. The 21st Century

Following the seminal works of Beuys, many contemporary artists and collectives continue to appraise the bee through a variety of perspectives, mediums, and audiences. What is evident in this period is the strong focus on promoting collective awareness of the bee’s plight to the broader audience. Indeed, we observe that the bees’, at times, menacing connotation (see Sections 4 and 5.3) has largely been laid to the wayside through, we hypothesise, an increased appreciation of the bees’ positive attributes in the global ecosystem which contemporary art promotes via complex aesthetic signals (Westphal-Fitch and Fitch, 2018), that are often derived from, or directly attributed to the bee. Below we present an impression of the many facets of bee-orientated representations in contemporary arts practices as a means to further understand the influence of bees in the human aesthetic faculty.

7.2.1. The Bee as Art and Collaborator

Co-species collaboration is not only evident in music creation, as observed in Section 5, but is identified to be a frequently explored theme within the broader arts fields today. In this capacity, the bee may not only be an organic medium involved in the artefact, but also an active contributor to the creative
process and observer experience through their variety of aesthetic attributes (e.g., physical form, hive dynamics, sonics, and physical offerings).

One such artist to represent the bee as medium and collaborator in a somewhat ‘familiar form’ and traditional technique is Pierre Huyghe of France. His sculpture: Untitled (Liegender Frauenakt) (originally created for Documenta 13 in 2012), in part builds on Beuys’ concepts of ‘thought’ (see Section 7.1 above) by creating a sculpture of a female form reclining, yet juxtaposing the figure with a live beehive positioned to visually resemble the subject’s head. In doing so, the artist (like Beuys) questions the ‘classic’ principles of aesthetic beauty by metaphorically representing the brain as a living organic mass, and more broadly, our evolving, collective human thought. In this work a reciprocal relationship is formed between the artist, the honeybees, and the audience. Here, not only are the bees a medium in the creation, but through their activity are essential in realising the sculpture, and viewer experience (Museum of Modern Art, 2015).

Employing a more intimate and participatory methodology comparative to Huyghe, Canadian-American installation artist Sarah Peebles creates works that accentuate bee aesthetic properties by way of lived experience (Parson, 2007). Through the Sensory Bee Cabinets in her Resonating Bodies project (Peebles, 2021), Peebles produces installations that focus attention on the intricacies of solitary wild bee life within their nests, and leverages the act of observation as a creative tool to impart information from the inhabitants (the bee), their habitat, and biology in real-time. Here, the artist transports the observer into the life of the bees through their form, scents, and sounds that results in a complex sensory experience for the audient in an effort to amplify our appreciation of native solitary bees. As a result, Peebles’ work fosters wider discussion and discourse by facilitating aesthetic signal transmission from the bee, to the observer, to the community.

The Melliferopolis (2021) project, conceived by Austrian Christina Stadlbauer is a multidisciplinary initiative that originally sought to explore novel ways of understanding bees, beekeeping, and the ecology of the hive. Today, by merging disciplines such as life sciences, architecture, engineering, and the visual arts in an ‘anti-disciplinary’ spirit, the now global network of collective enterprise works across public art installations (e.g., Hexa-Hive Village with Airstrip for Bees, 2015), participatory interventions (e.g., Eat Like a Bee, 2016; Explore Like a bee, 2016), and performances (e.g., Pollen Gold, 2017) among many. Similar to the works of Huyghe and Peebles discussed above, living hive installations are the most visible element of Melliferopolis; however, they are dispersed throughout larger geographies, aiming to attract pollinators to cities, thus promoting public awareness, and public discussion. This modern connection of bees directly to human activities
and art installations draws interesting parallels to cultural practices in southern American countries stretching back centuries (see Section 3), evidencing both the modern and long-term relationships that move well beyond simple functional communications about bees. Insightfully, Melliferopolis makes a concerted effort to mediate community fear that “is often transmitted unnecessarily by using alarming colours and symbols around beehives, and all too often communicated orally from parents to their children” (Melliferopolis, 2021).

Whilst during the history of art representations bees that produce a sweet food source like honey have been typically represented (Figures 1–4, 9–12), in recent times art forms like photography seek to document and exhibit colourful and dynamic representations of native bees specific to local geographies (Dorey, 2021; The Houston Museum of Natural Science, 2021). This medium allows practitioners to share and audiences to experience information about how bees are important to the environment in which people live, and thus components of aesthetic appreciation also incorporate an appreciation of our environment which may link to how the brain evolved to appreciate aesthetic environments (Orians, 2016). The development of bee representations in China since the Tang Dynasty also appears to focus on environment as evidenced by both painting and writing (see Section 4), suggesting that the aesthetic appreciation of bees is multifaceted and extends beyond gustatory or sting avoidance perceptual explanations.

Reflecting on the diversity of artistic approaches observed above, perhaps the largest and most technologically advanced exhibition to be presented with a focus solely on *Apis* is *Bees* (2024), an international touring exhibition conceived by Wolfgang Buttress (in consultation with Dr. Martin Bencsik; see Section 5.1) and commissioned by National Museums Liverpool (Buttress, 2021a). The ‘ground-breaking’ experimental showcase aims to raise awareness of bees and their plight, and to open the eyes, hearts, and minds of the general public across the globe. In the artist’s words: “to our world - bees are not optional” (Buttress, 2021a). With this sentiment, Buttress, informed by science and employing state-of-the-art technology (such as holographics and vibro-tactile immersive environments), extends well beyond representing bees as superficial figures for appraisal. This unique large-scale installation project strengthens the argument that the cultural evolution of bees in (and as) art throughout time have evolved from recognition and communication of their importance as pollinators and resources, to human’s appreciation of them in both aesthetic beauty and necessity. It is interesting to note that still, in many cases such as this example, art appears to convey a message about the importance of bees to our survival, suggesting some commonalities in how aesthetic sense may have developed in humans from a more functional grounding.
7.2.2. Street Bee

Beyond the gallery environment and curated public spaces, the bee now has a haven in the street-art community, and may appear almost anywhere, at any time. Indeed, the infamous Banksy has stencilled the qualities of *Apis* for passers-by to digest (Bull, 2011). In this domain there are a growing number of artists (such as Louis Masai, UK, and Mathew Willey, USA) devoting their time not only to produce free offerings to their society through street-focused murals, but also use their practice, like many others as we have observed, to raise awareness of the importance of pollination and bees (Fig. 1a and 1b). In this artistic sphere, bee representations rely on the visual sense as literal bee forms and are frequently accompanied with compelling ‘tag’ lines. Most notably is the work of Masai (2021) who in recent years embarked on the project “Save The Bees” (2015), that was aimed at any and every person that may happen to view his work while venturing by. In this gesture, Masai aimed to communicate through a familiar medium such as graffiti, the bee’s familiar form (often on an exaggerated scale), and his vibrant colour palette to people who are not necessarily aware of the influence bee pollination has in human survival, and how it may affect them personally (Chow, 2015). The *Save the Bees* initiative garnered such attention that works extended beyond London, to Bristol, Glastonbury, Croatia, New York, Miami and New Orleans (Chow, 2015), again, like the many artistic initiatives we have discussed, implying a resonance with human awareness.

7.2.3. Bees as Socio-Cultural Art Initiatives

Considering the vast bee representations and methodologies of communication presented in contemporary arts today, the use of art as a tool for information gathering and knowledge sharing is palpable. Beetime (2021), for example, conduct community learning projects in southern Spain where novice and skilled beekeepers come together through workshops to share their knowledge and tactics for sustainable hive health and ecology in the local region. To support this initiative, the project provides artist residency programme opportunities, where accepted applicants are encouraged to respond to the work of the bee enthusiasts. In this way, the project aims to foster a community of beekeepers and hives as an integral part of the local eco-industry, and together with the artists’ ‘reflections’, raise awareness to the “fascinating stories hidden within the hive” (Beetime, 2021).

Fittingly, Manchester (UK) and its affinity with the worker bee which originated during the Industrial Revolution (Dobraszczyk, 2020), and was further galvanised through the tragic Manchester Arena bombing on 22 May 2017 (Merrill and Lindgren, 2021), united together around the bee to conduct their own unique community engagement programme. Titled ‘Bee in the City’ (2018), many diverse communities and groups engaged to contribute to a city
arts trail aimed at raising money for The Lord Mayor of Manchester’s Charity Appeal 2018 (Manchester City Council, 2018). By enlisting members of the public, artists, and school children as creative collaborators, hundreds of individually painted ‘super-sized’ Bees and ‘little’ Bees were produced as the trail destination points. A primary feature of this project was the inclusion of approximately thirty thousand pupils from schools, colleges, and youth groups from across Manchester via the ‘Bee in the City Learning Programme’. By valuing both the bee, art, and education on a mass scale, the Manchurian ventured to explore themes such as bee conservation, equality, and diversity (Manchester City Council, 2018). Thus, not only did this artist trail engage the broader public with a bee to guide them through the Manchurian landscape, but also utilise art as a learning apparatus for the younger generation (Manchester City Council, 2018).

This is not the first time Manchurians have rallied together guided by their worker bee heritage and art, as the tragedy of the Manchester Arena bombing triggered an outcry of public support by the community. In this action, an estimated 10,000 members of the public offered up their bodies as canvases for bee representations as tattoo’s to raise money for, and show solidarity with the families and victims of the attack (Merrill and Lindgren, 2021). Tattoo art is known across time and many cultures (Westphal-Fitch and Fitch, 2018) form a special type of personalised representation of perceived important motifs to an individual as they elect to use their body as a canvas (Caplan, 2000). The long history of tattoos is testament to representing perceived important motifs of personal expression at a given time, and in contemporary times evidence that a wide range of people like in Manchester are willing to choose this medium and bees to express ideas of community suggests an aesthetic appreciation that extends beyond any simple functional explanation.

7.2.4. Bees and the Moving Image
Moving image has enjoyed incredible creative licence with respect to the bee, their representations, and metaphors they convey. In commercial ‘mainstream’ and ‘arthouse’ productions beginning in the mid-20th century, bees traverse a myriad of characters that have largely targeted viewers’ insecurities, fears, and entomophobia. From enormous monsters capable of storing humans in their gigantic cells [Mysterious Island, 1951 (S. Bennet)], to the heightened intelligence of insect killers committed to undo the cruel treatment bestowed upon them [The Bees, 1978 (A. Zacarías)], and more recently, autonomous drone insects that track and kill via hashtags [Black Mirror: Hated in the Nation, 2016 (J. Hawes)]. Indeed, film producers and writers appear to relish in promoting a perceived ‘darker side’ of the insect [e.g. The Swarm, 1978 (I. Allen); Killer Bees, 1974 (C. Harrington); and Candyman, 1992 (B. Rose)], and given
the genre has continued for over 50 years, audiences find the representation sufficiently engaging as to warrant reasonable commercial success.

The fear dimension of why audiences attend films of this genre is very interesting. The amygdala region of the human brain is known to be sensitive to conditioning to a fear response (Davis, 1992), and perceived threatening stimuli by cortical regions likely project to the amygdala to enable timely behavioural responses including to bee stings (Halladay, 2019; Halladay and Blair, 2015).

It is interesting that bee art may be considered to promote both positive responses that may link to appetitive conditioning and sweet rewards (Franken et al., 2011; Ohla et al., 2012), and also aversive responses to stings where either are processed by different regions of the brain (as above). Taken together, this may suggest that aesthetic appeal to engage audience attention extends beyond a beautiful experience to salient neural representations that cause occasion for artwork to stand out in the mind of the observer.

In comparison to aversive or fearful moving image representations, Apis has also enjoyed positive representations with characters such as Maya the Bee (2014; A. Stadermann), and the Bee Movie (2007; S. J. Smith and S. Hickner). In these roles, the bees play animated characters with inquisitive, friendly, assertive, and proud traits, that are ultimately targeted at the younger audience, yet may also bring a smile to an adult’s face. In particular, the Bee Movie attempted to bridge between the human domain of having a pleasurable and engaging cinema experience, whilst also incorporating insights of perception as experienced by bees when foraging for flowers. Here, colours were portrayed in pseudo-colour to represent the ultraviolet-sensitive vision of bees (Williams and Dyer, 2007). The animators of the Bee Movie thus sought to embody components of bees’ sensory perception based on scientific evidence into the human visual experience, and given the audience’s positive response and the commercial success of the film, it can be concluded this translation was aesthetically appealing to a large number of viewers. A sequel Bee Movie is planned for release in 2022.

Beyond the major commercial cinematic releases, the arts and sciences have many examples that objectively feature the bee and its life story not only to educate, but to investigate the many fascinating traits of these insects and the struggles they may endure [Vanishing of the Bees, 2009 (M. Henein and G. Langworthy); Queen of the Sun, 2010 (T. Siegel); More than Honey, 2012 (M. Imhoof); Honey Hunters, 2016 (K. Matysek); Honeyland, 2019 (T. Kotevska and L. Stefanov); The Pollinators, 2019 (P. Nelson)]. One recent release that incorporates cutting-edge technology and empirically backed science is an immersive viewing experience titled BeeScapes (Nguyen et al., 2021; Fig. 12). Here, the observer is the protagonist (the bee) that is guided on a nature trail similar to that of a foraging bee expedition. In this three-dimensional
landscape the viewer gets to perceive the life of the bees through their senses including pseudo-colour translations, visual acuity of the environment at a distance (Dyer and Williams, 2005), and interactions with different flowers in a complex natural environment. Produced in collaboration with animators, artists and behavioural bee scientists, this short documentary marks a new trajectory for how humans may experience the perception of a bee through the moving image medium.

As an extension of the moving image, video gaming is recognised as an evolution in art (Museum of Modern Art, 2021) that incorporates digital 3D sculpture, illustration, narrative, and music, and with the advancements in technology [such as Global Positioning Tracking (GPS) tracking] now allow participants to be immersed in their own real-world environments as evidenced through Augmented Reality (AR) (van Krevelen and Poelman, 2010), and Alternate Reality Gaming (ARG) (Szulborski, 2005). Indeed, the incorporation of bee-inspired representations and themes in this form of contemporary art is yet another example of how diverse the bee motif is in contemporary arts and culture.

One of the most popular global gaming phenomena in recent decades is Nintendo’s Pokémon (Bainbridge, 2014). Originally released in 1996 in Japan (Bainbridge, 2014) on the Game Boy platform, today the game has also extended to the AR domain as an immersive experience. Pokémon’s original

Figure 12. Still images (panels a–d) from the animation movie *BeeScapes* which enables a viewer to take the perspective of a bee, including the colour perception of bees. The film thus bridges a new aesthetic appreciation of how bees see differently to humans, and engages large audiences to scientific information about bees.
concept narrative takes place in an imagined world that was inspired by the
creator’s (Satoshi Tajiri) love of insect collecting (Bainbridge, 2014; Schmidt-
Jeffris and Nelson, 2018). In gameplay, imaginary wild creatures can be col-
lected by each player, trained, and then put into battle against each other
(Bainbridge, 2014; Schmidt-Jeffris and Nelson, 2018). Within the vast collec-
tion of wildlife, several specific Pokémon characters are strongly based on bee
biology both in appearance and traits, including: Beedrill (a honeybee-like
insect), Combee (a flying honeycomb), and Vespiquen (a queen-like Apis).

Female Combees, for example, collect and deliver honey to their colony, and
during night cluster together and form a beehive. In Pokémon Go, when 50
‘candies’ (game tokens) are collected by the player, Combee evolves into a
Vespiquen (Pokémon, 2021). Here, the honeybee’s visual and biological aes-
thetic has been adapted with creative licence for the game; however, it retains
ecological and evolutionary concepts derived from the species. This dynamic
and artistic use of augmented bees likely draws from simpler static or iconic
representations that may have developed for functional communication rea-
sons, but in gaming the representations are clearly for enjoyable, pleasurable,
or even sometimes educational purposes. This form of contemporary art thus
shows a clear translation to bees can be perceived as an animal as aesthetically
beautiful, or dangerous depending upon the narrative of both the developer or
game player. In broader concepts, Pokémon is considered a transmedia story
dealing with the important issues of environmentalism, biodiversity, and
materialism (Bainbridge, 2014). Further, some authors have even suggested
that Pokémon can help in communicating entomology to a lay audience and
increase interest in nature (Balmford et al., 2002, Dorward et al., 2017,
Schmidt-Jeffris and Nelson, 2018). Thus, not only through game play do bees
inspire imagination and interaction, but through play experience help to
develop wider knowledge of ecologies and their mechanisms. Interestingly, for
the curious Pokémon player, the English name for Beedrill is a combination
of bee and drill; however, in Japanese, it is スピアー (Spear), and when
spelled backwards, spear (スピア) becomes Apis (アピス).

Minecraft, which is believed to be the best-selling, and most profitable,
video game of all time (Spanier, 2014), is a computer game where players cre-
ate and break apart blocks in 3D worlds (Mojang, 2021). Here observers of a
Minecraft bee also to some extent become their own artists in creating envi-
ronments (Fig. 13). That the game is so popular evidences this is found to be
a pleasurable and aesthetically appealing use of time interacting with bee art.
Minecraft recently collaborated with the World Wide Fund for Nature (WWF)
and, as a result, in 2019 the creators of Minecraft added bees into the game
hoping to promote the ‘save the bees’ movement (Fig. 13) (Howard, 2019;
Östergård, 2019; World Wide Fund for Nature, 2019). This evidence for bee-
gaming in a 21st-century world thus shows links back from the history of art
as bees being an important part of the community environment that deserves to be both represented and nurtured.

7.2.5. The Rise of Bee Popularity (Representations and Misrepresentations of Bees)

Scientific communication and media reporting on Colony Collapse Disorder (Johnson, 2007) has fuelled an interest and better understanding of the challenges *Apis* species face within the multidisciplinary arts practicing today, especially with respect to the honeybee and threats by the Varroa mite (*Varroa destructor*), pesticide use (Dicks, 2013), and large-scale intensive agriculture (De la Rúa *et al.*, 2009). However, the dominance of honeybees both in the environment and in artistic representations means the public may sometimes be ill informed and unaware of the conservation and needs of native bees — the majority of which do not live in combs, or create honey, or feature black and yellow stripes (Colla and MacIvor, 2017; Wood *et al.*, 2020).

*Apis mellifera* is the most abundant bee species on the planet, at low risk of extinction due to its distribution, abundance, and adaptability. Indeed, the status of honeybees as an introduced species in many places of the world means that it is potentially a contributing factor in the endangerment of wild bee biodiversity (Henry and Rodet, 2018; Ing and Mogren, 2020).

Figure 13. Bee avatars within a generated Minecraft natural environment. Bees were introduced into the game in 2019 as a recognition by developers for their invaluable services to humans. Users electing to incorporate bees into their own generated worlds show evidence of deriving pleasure from experiencing this dynamic form of interactive image experience. Image by Amelie Dyer.
Fortunately, through science communication, the arts, and literature, efforts are being made to increase the awareness and correctly inform the public of the importance of not only *Apis mellifera* but lesser known pollinators, that may be more important for local ecosystems and regions (Buchmann and Nabhan, 2012; Howard and Dyer, 2020; Peebles, 2021). This bridge between better awareness of the science of bee biodiversity and the broader and more diversified art practice representing bees will likely be an important nexus to understanding the evolving field of bee art and how we perceive the world in which we now live.

7.2.6. The Bee in the Hive (Opportunities of Social Media)

The rise in popularity of bees can be seen across social media, a contemporary technology and term that may reflect Beuys’ concept of collective ‘hive’ thought (Section 7.1), and evolved into what is commonly referred to as the “hive-mind” (Seeley et al., 2012). That is: “the collective thoughts, ideas, and opinions of a group of people (such as Internet users) regarded as functioning together as a single mind” (Merriam-Webster, 2021b). The coincidence of timing between initial scientific reports of Colony Collapse Disorder in 2007 (Johnson, 2007) and rapid improvements in internet technologies since the mid-1990s (Dyer et al., 2020) has led to widespread communication opportunities. By 2018, the use of social-media communication tools had reached in excess of two billion people (Iyengar and Massey, 2019). Thus, in a relatively short period of time since the 1990s there have been dramatic changes in world-wide ‘hive-like’ communication networks, including how research is communicated and discussed in a digital world (Iyengar and Massey, 2019; McCullough, 2018). Principal amongst these enabling tools has been the capability improvements in smart phones which encapsulate a quality camera, processing facilities and dissemination capacity in an affordable and highly mobile device, presenting new opportunities in the science/art aesthetic interaction domain (e.g. McFarlane et al., 2013). Indeed, platforms like FLICKR, Twitter, Facebook, LinkedIn, Instagram, and Snapchat provide an accessible and convenient way to capture data on how people photograph and share information about bees and pollination (ElQadi et al., 2017).

Prum (2017) writes “art consists of a form of communication that coevolves with its own evaluation” (Prum, 2017, p. 336). However, a conventional problem facing research on art perception is how to reliably quantify what is of interest to audiences to communicate at a given time. We propose that social media provide important insights into contemporary human interests that help inform how and why many artists seek to represent bees, and indeed why audiences find such representations engaging. The growing popularity of bees on social media is demonstrated through the use of hashtags and the number of posts on specific topics. For example, the hashtag #Bee currently features in
approximately 160 posts per hour (Best-Hashtags website, 2021). On the social media platform Instagram, at the time of data collection (Note 2) the bee hashtag (#Bee) appeared in 6.9 million posts. Indeed, many of the most popular bee-related hashtags centre around honey and other bee products (e.g., #HoneyComb, #BeesWax, #RawHoney, and #BeePollen, among others). In languages other than English, the prevalence of hashtags on Instagram also includes bees and bee products in high metric volume. For example, #Miel (French and Spanish word for honey) occurred in 1.3 million posts, #Abeja (Spanish for bee) in 233,000 Instagram posts, and #はちみつ (Japanese for honey) in 439,000 Instagram posts. Many of these posts include photographic images of bees and their environment, and here the publisher of such images is a generator of new art and frequently able to receive rapid feedback from others within the community.

The depth as represented by number, and breadth, as represented by sampled countries, of this social media engagement of predominantly younger demographic not only evidences cultural evolutionary concepts (Westphal-Fitch and Fitch, 2018) but that the cultural themes linking bees and humans since ancient times translate to a modern world. The medium of communication changes, as is often represented with different art forms evidenced within the current manuscript with respect to bees, but the commonality of a desire to represent bees in a way that engages an audience appears enduring. With increased availability of scientific evidence about bees this likely leads in many sectors of society to a desire to both produce and view art related to an important motif that has long been regarded as key to our survival, and how we wish to structure our societies.

8. Discussion and Considerations

Throughout this appraisal we have observed and reflected upon bee representations in human culture throughout early existence to current day, from ancient artefacts to South American and Chinese cultural perspectives, to physical and behavioural aesthetic interpretations of the bees’ attributes, and evolving methodologies within the human creative process. The representations we observe traverse a diversity of art practice, for example: the ancient song lines of First Nation peoples’ culture recording relationships with sugarbag bees in Australia, to the music of the Yunnan Province in China, and the bee-inspired drones in contemporary music. The types of artwork representing bees extend across many domains, consistent with proposals by Westphal-Fitch and Fitch (2018) that this is the type of broad and long-term evidence is required to inform how functional use and cultural practices may lead to aesthetic appreciations for art representing a particular motif. Indeed, the bee appears to be ubiquitous in human awareness and is often a positive reinforcing relationship that provides
for us, informs our methods of conception and sharing of knowledge, and the way in which we may contemplate our co-existence for survival and prosperity. In this regard, bees like the European honeybee, South American bees and the Australian native sugarbag bee all produce a sweet-tasting and highly nutritious food like honey, and this may provide a relatively straightforward neurobiological pathway for how a conditioned appetitive experience enables a perceived positive or beautiful experience in an individual, and such an experience may lead to developing aesthetic appreciation for artwork associated with bees. Indeed, we hypothesise that most artwork appears to represent bees that produce such rewards, and this evidence extends around the world and for different bee species. In a similar fashion, bee art may be considered to promote both positive responses that may link to appetitive conditioning and sweet rewards, but alternatively to aversive responses to stings processed by different regions of the brain (see Section 7.2.4). Taken together, these links to how and why different people find bee art representations engaging suggest that aesthetic appeal to engage audience attention extends beyond a beautiful experience to either positive or aversive salient neural representations that cause occasion for artwork to stand out in the mind of the observer (Vessel et al., 2012).

In modern and contemporary arts practice, a ‘collective’ sense of connection to bees is a recurring theme, and how creative endeavours can contribute to further expand our global awareness of the plight of these important insects. Certainly, the mediums through which bees are represented and appraised have diversified, so too have the types of bees being represented. We propose that this is likely due to readily accessible and digestible science communication of which many practitioners are seeking to further the aesthetic capabilities (and legitimacy) of their works. Indeed, we now witness science and technology as an evolving tool and palette for creation, and for some artists such as Wolfgang Buttress (2021b) and AnneMarie Maes (2021) among others, this union is vital to conveying the human story of understanding the world we live in through art.

9. Conclusion

By undertaking this research, we witness a striking human–bee relationship through artistic and cultural evidence that extends from thousands of years prior to our current day. During this expansive period many bee species appear to have influenced not only the way in which humans have evolved to appreciate, value, and commodify the offerings bees provide, but the social-structural dynamic of their hives and the way in which it may reflect on our own societies. Through the production and creation of artefacts, and their aesthetic signals of communication, indeed, the bees occupy a pervasive place within human awareness, across cultures and geographies, from Europe to
Asia, to South America and beyond. Certainly, the human connection to the bee through creative practice and the predominantly positive aesthetic signals they omit appear ubiquitous. In this research we consider the neuro-aesthetic appreciation of art through the lens of bioaesthetic principles (Westphal-Fitch and Fitch, 2018; Zaidel, 2018). Thus, within this framework it is interesting to consider evidence of longer-term relationships between bees and humans, beyond that in which bees provide ecosystem services (Prendergast, 2020), and the cultural values humankind has imparted to bees in a diverse range of cultures (Quezada-Euán, 2018). Further, we posit that the aesthetic appreciation of the bee attributes evidenced in this research may indeed be influenced by original interactions with the sweet nutritional benefits of honey, providing a plausible explanation for how aesthetic appreciation may evolve.

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Notes

1. “In case I am taking an infrequent walk along the west corridor and I find a Cymbidium orchid that is in flower, I am wondering who has provided the flowering message to honeybees, they already found this flower before me” (translation by ZXR and AGD).
2. All data referenced in Section 7.2.6 were compiled on 8 April 2021.

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