

Chapter 2

Lessons from Tasmania – Cultural Performance Versus Cultural Capacity

Miriam N. Haidle

Abstract Characterized as ‘primitive’ and compared with chimpanzee and Middle Paleolithic capabilities, the Tasmanian culture has been subject to an intensif debate lasting for more than 40 years. This paper gives a reconsideration of the set of material cultural performances in the Tasmanian ethnographic record and applies the EECC model of the evolution and expansion of cultural capacities to it. Based on the analyses of problem-solution-distances in tool behavior, modular, composite, complementary, and notional cultural capacities are identified. The Tasmanian cultural record is a perfect example that apparently simple performances cannot be easily equated with archaic or non-modern behavior. Instead, the performances have to be seen as products of interdependent developments in biological, historical-social, and individual dimensions embedded in the group specific environment.

Keywords Complementary cultural capacities • Composite cultural capacities • Material culture • Modular cultural capacities • Notional cultural capacities • Problem-solution distance • Simplification • EECC model of the evolution and expansion of cultural capacities

The Primitive Tasmanian Image

Tasmania, today a large island southeast of Australia, has been settled by humans for around 35 kyr (Jones 1995). Around 12,000 years ago, rising sea levels isolated the

human population from the Australian mainland. The cultural development since differed from that of Australian aborigines. Some technical achievements and cultural expressions like bone points and the use of volcanic glass as raw material known from prehistoric contexts got lost or were given up until the colonization by Europeans starting in 1773 (Murray and Williamson 2003:316). It is a common feature to characterize the Tasmanian pre-contact material culture as deficient by listing the items which are said to be lacking: bone tools, cold-weather clothing, ground stone tools, hafted tools, bow-and-arrow, boomerangs, spear-throwers, the knowledge to make fire and consequently pottery and metal working as well as canoes, fishery and thus also nets and fishhooks (McGrew 1987:250; Henrich 2004:197). These negative characterizations rather represent the presumptive expectations (cf. Davidson 2007:81) drawn from the Australian record, respectively European assumptions which have not been met, than the real nature or development of the cultural set. However, actually or presumably lacking features like fish-eating (Jones 1978; Allen 1979; Horton 1979; Bowdler 1980; Walters 1981; Taylor 2007) or fire-making (Gott 2002; Taylor 2008) dominated the discussion. The material culture of the aboriginal population of Tasmania by the end of the 18th century is said to have been one of the most ‘primitive’ in the world (Jones 1977). Sollas (1911) equaled its developmental level to the Mousterian. On the basis of the label of primitiveness and the equation with Paleolithic cultural remains William McGrew (1987) compared a segment of this “impoverished” (ibid.:250) material culture – the toolkit used to access food – with that of wild chimpanzees from Tanzania. His aim was to gain insight in the minimal range of differences between ape and modern human tool behavior. He stated (ibid:247): “The results show surprising similarity in the number of items in the toolkit, raw materials used, proportion of tools made versus those used unchanged, extent of complexity, type of prey, etc. Key contrasts also emerge: only human

M.N. Haidle (✉)
Heidelberg Academy of Sciences and Humanities, Research Center “The Role of Culture in Early Expansions of Humans”, Senckenberg Research Institute, Senckenberganlage 25, 60325 Frankfurt am Main, Germany
e-mail: mhaidle@senckenberg.de

tools have more than one type of component and are made using other tools. Overall, however, the gap between the most technically diverse nonhuman toolkit and the simplest human material cultures seems narrow.” Sometimes, the characterization of the Tasmanian material culture as primitive goes hand in hand with the implicit or explicit assumption of a more primitive, deteriorating mind. Rhys Jones associated “a simplification in the tool kit” (Jones 1977:202) (actual in the abandoning of bone points and assumed by comparison of Australian and Tasmanian tool kits) and “a diminution in the range of foods eaten” (ibid.) (based on abandoning of scale fish as part of the diet) with “perhaps a squeezing of intellectuality” (ibid.:203). He summarizes his results with the often cited speculation “Even if Abel Tasman had not sailed the winds of the Roaring Forties in 1642, where they in fact doomed – doomed to a slow strangulation of the mind?” (ibid.). It is the aim of this paper to illuminate the record of a supposedly increasing simplification in the Tasmanian material culture by applying the EECC model of the evolution and expansion of cultural capacities in the course of human evolution. It will be shown that a simple status or even the ostensible simplification in cultural performance is not contradictory to a concurrent consistence or even expansion of cultural capacities. Thus, the paper addresses central questions of the sapient behavior paradox (Renfrew 1996). The EECC model

offers new ways to differentiate between performances and capacities and demonstrates a way to test for potential by analyzing the problem-solution distance in tool behavior as a basic feature instead of looking for outstanding manifestations (cf. Haidle 2014). The approach draws attention to the complexities of the Tasmanian material evidence and opposes unilinear schemes of human history/evolution, that evaluate the simple or sophisticated appearance of a segment of cultural performances in order to classify the performing groups as basic to or high up on an evolutionary ladder (cf. Gamble 1992).

The Three Dimensions of Cultural Performances

The EECC model of the expansion of cultural capacities differentiates between cultural performances as sets of expressions of cultural behavior and cultural capacities as underlying potential faculties which can exceed the actual performances by far (Haidle and Conard 2011; Haidle et al. 2015). Cultural performances are determined by three dimensions: an evolutionary-biological, a historical-social and an ontogenetic-individual one, embedded in and interdependent with the specific environment (Fig. 2.1).

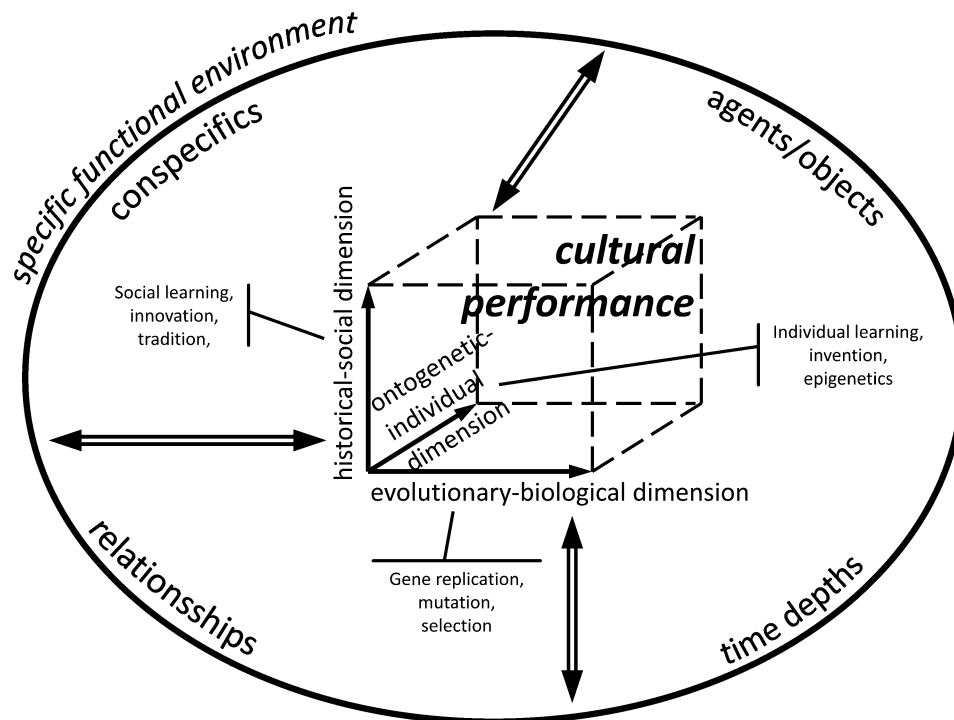


Fig. 2.1 Cultural performances develop in three dimensions: an evolutionary-biological, a historical–social, and an ontogenetic-individual. These are interdependent with each other and the embedding specific environment

On the *evolutionary-biological dimension* the biological potential and constraints for behavior are exposed – in genes, gene expressions, anatomical blueprints and physiological standards of a group of organisms. It is expressed, for example, in the structure of the nervous system and the brain, in sensory perception, in motor and articulation skills, in the form of sociality, and in the abilities to communicate. The evolutionary-biological dimension constitutes the foundation of any behavior. It affects the basic course of life history and the anatomical-physiological potential to perceive and express, create and reflect, learn and remember. For example, the genus *Homo* is characterized by generalized hands facilitating material cultural expressions, by the development of a sound production and perception apparatus enabling language – a specific form of very detailed communication, by an increase of the relative brain size, by changes in brain anatomy, and by shifts in life history giving more time for learning. Regardless which form of training they undergo: dolphins will never be able to talk to us like humans because of their different anatomy of the sound production apparatus; chimpanzees will never succeed in producing sophisticated handaxes because of their different anatomy of the hand. The species-specific characteristic of the evolutionary-biological dimension of behavioral performances enables the finding of species-specific solutions to species-specific problems. Continuity or change in this dimension in general underlies evolutionary mechanisms like gene replication, mutation and selection, but it may be partly modified through long-term interaction with the environment and, as part of it, material culture (Fisher and Ridley 2013).

The Tasmanians can be assumed to share with all other *Homo sapiens* conspecifics the vast majority of biological factors influencing cultural performances. Although developments in the evolutionary-biological dimension like the persistence of lactose tolerance in adulthood (Burger et al. 2007) or the ability to cope with hypobaric hypoxia in high altitudes (Beall 2006) show biological adaptations of *Homo sapiens* after the last glacial maximum that alter the range of cultural performances of some human populations, there is no evidence of a profound change in biological factors associated with cognitive competences. The Tasmanian population would be a noteworthy exception, if a reduction of cultural performances were due to evolutionary-biologically based mental impairment.

The *ontogenetic-individual dimension* of behavior reflects individuals' preferences, aversions, skills and disabilities. The ontogenetic-individual dimension incorporates the potential and constraints of an individual, or of a group of individuals, set by individual talents or poor aptitudes, by the personal social setting and by individual life histories of physical, mental, and emotional experiences. Already in the womb, monozygotic twins with the same genetic complement have different experiences with different epigenetic effects

(Petanjek and Kostović 2012). Siblings can be raised in the same family within the same historical-social setting, but nonetheless experience different influences by parents, relatives, friends, teachers etc., by support or deprivation, by diseases, fortuitous timing or traumatic accidents. All these factors affect the additional mechanisms of change, which are operative on this dimension: individual learning, personal inventions, and epigenetics, “factors that influence gene expression without modifying the DNA sequence” (Ledón-Rettig et al. 2013:311). Tasmanian cultural performances are affected by the individual dimension in the same way as those of other humans. Evolutionary-biological and ontogenetic-individual factors are, to a greater or lesser extent, the basis of every behavioral expression, be it self-referential or directed to the environment. Cultural behavior, however, is defined by having a third dimension of factors influencing the behavioral expression: the historical-social.

The *historical-social dimension* represents historical and social potentials and constraints. The set of historically acquired knowledge and skills, customs, views and opinions, makes up a part of the individual's environment that can be acted on, and used as a basis for further innovation. Social access to the knowledge and skills, customs, views and opinions can be affected by population density, active communication systems, child raising habits, teaching systems, systems of religious and political participation, and general group-specific attitudes about learning, innovation and progress (Rogers 1995). The forms and extent of storage, transmission, permutation, and transformation of the knowledge and skills, customs, views and opinions support or hamper the unfolding of cultural performances. The historical-social dimension in general affects the ways in which the evolutionary-biological foundations are used for cultural behavior, but can also affect the properties of some biological bases (Malafouris 2010; Woollett and Maguire 2011). This dimension unfolds via social transmission from stimulus enhancement to the capacity of teaching, via group-wide adoption of innovations and via transgenerational traditions. The historical-social dimension is self-enhancing; cultural behavior influences factors that foster cultural transmission and creativity (Enquist et al. 2008).

The historical-social setting of the Tasmanian population at the time of contact is characterized by a small population size of probably 1500–22,000; most estimates assume less than 10,000 people (Murray and Williamson 2003:314). The ethnographic record of the Tasmanian society is weak (cf. Taylor 2007) and details about behavioral patterns and organizational structure are scarce. Up to nine endogamous regional tribes of 300–500 people have been described split in 48–80 local and exogamous, non-sedentary bands of 30–50 people (Jones 1977; Ryan 1981). They shared a lot of cultural performances and a common toolkit, but showed also some remarkable, but probably environmentally induced

differences as in dietary habits (Taylor 2007:21) or the construction and use of shelters (Hiatt 1968:201). Recent linguistic studies have identified 12 Tasmanian languages in five clusters (Bowern 2012).

All of the three major dimensions (evolutionary-biological, historical-social, and ontogenetic-individual) of cultural performances are multi-factorial, and they are not independent. Rather, they influence one another directly or indirectly via reciprocal effects in the context of a *specific environment* (Haidle 2008). The latter is the sum of the cultural (material and non-material) and social aspects of the environment of an organism or a group, plus the section of the natural environment that affects, or is affected by, the organism or the group. The functional relationships of a group of organisms with elements of the specific environment vary according to the resources they perceive in that environment, given the state of their evolutionary-biological, historical-social and ontogenetic-individual dimensions. Although the natural landscape of a lion and *Homo ergaster* may have been the same, their specific environments or realized resource spaces differed markedly. The elements include their conspecifics as well as biotic and abiotic agents (like predators, competitors, climatic conditions), plus objects (like prey or lithic raw material resources) that they affect or are affected by. These factors are linked to the group in focus by specific relations and with a certain time-depth (in perception, conception, and action) in both past and future directions influencing these relationships or behaviors. Cultural performances (and the deduced cultural capacities) are thus neither a mere biological product, nor solely a historical issue; and they are embedded into the specific environment in which the lives of individuals play out. The EECC model is thus an approach that can help to overcome the cultural modernity problem as claimed by Porr (2014): an approach “that recognize[s] humans as socially constituted dynamic beings that are also reflective and cognitively active [...]” with genetic factors as one influence within dynamic sets of relationships. “Human beings develop and grow through these relationships, which provide both potentials and constraints. What humans are and can do is not a reflection of internal essences of human nature but is a product of situated growth, reflections, interactions and negotiations” (Porr 2014:264).

The specific environment of the aboriginal Tasmanians has geographically been reduced to Tasmania as an island around 12 ka by the rise of the sea level after the last glacial maximum. Marine scale fish has been part of the diet for a long time but has probably been abandoned around 3500 ka (Jones 1977; but see also Taylor 2007). At the coast the consumption of shellfish continued, completed by the exploitation of seals, waterbirds, and penguins (Allen 1979; Taylor 2007). The settlement of the southwestern part of the island and the use of offshore islands that could be reached

by canoe extended the range of the specific environment (Vanderwal 1978; Allen 1979:5). The Tasmanian vegetation is characterized by dense scrub with consequences on technology as long-distance weapons like spear-throwers or boomerangs are not efficient there (Horton 1979:31). The controlled use of fire allowed vegetation changes to improve the landscape for food supply (Hiatt 1968:212, 219) and to ease movements and thus extend the range by opening forest paths (Völger 1973:62). Hiatt (1967:111) lists a wide range of animal and plant species which were used as dietary resources including large and small marsupials, monotremes, seals, marine crustacea and mollusks, freshwater crustacea, coastal, lagoon and land birds respectively their eggs as well as different vegetables from sea and land, and underground storage organs of plants. Wind brakes and small huts in the East, more stable and larger huts in the West gave shelter (Hiatt 1968:201).

Empirically, only single case studies of behavioral performances can be documented, applying an occurrence/presence-only approach. The potential capacity of a group for behavior with historical-social dimension (that is, for cultural behavior) or without historical-social dimension (for non-cultural behavior) can only be estimated from the sum of all behavioral performances of this group and similar groups with which a genetic or historical-social exchange of behavioral patterns would have been possible. The potential minimum range of expression in the three developmental dimensions – the so-called capacity for behavior – must be deduced from the sum of expressions in the different behavioral performances of the groups included. The cultural capacity, e.g., of *Homo heidelbergensis* cannot be directly observed, but must be deduced from the sum of quasi-contemporaneous performances seen in the record of material culture preserved at different archaeological sites associated with *H. heidelbergensis*. The potential cultural capacity of a group, a population or a species, is never completely exhausted by the particular individuals, groups, or populations; rather, different aspects of the capacity are used and expressed.

Tasmanian Cultural Performances in the Late 18th Century

The compilation of Tasmanian cultural performances at the time of the first contact with Europeans has been set up neither systematically nor in detail, and is biased by a focus on material culture. Betty Hiatt (1968) provides an overview that has widely been used as basis in the discussion about Tasmanian cultural simplicity. The discussions about the competence to produce fire (cf. Roth 1899; Hiatt 1968; Völger 1973; Gott 2002; Taylor 2008) or the use of scale

fish as part of the diet (cf. Hiatt 1967; Jones 1977, 1978; Allen 1979; Horton 1979; Bowdler 1980; Walters 1981; Bassett 2004; Taylor 2007) highlight the patchiness of our knowledge. Despite the insufficiency of the data, the Tasmanian case may well serve as an example for the assessment of a minimum set of cultural performances in the archaeological record with all its problems of preservation, discovery, documentation, and interpretation.

In his attempt to compare the complexity of behavior of Tasmanians and chimpanzees, William McGrew (McGrew 1987, based on Oswalt 1976) listed 13 items as parts of the tool kit used for food procurement:

- Stones to chop down trees, to notch or bruise the bark of living trees for footholds to make climbing easier (cf. Hiatt 1968:206). Jones (1977:197) mentions stone hammers in combination with a wooden tool used as a chisel to prize bark off trees.
- Wooden chisels to prize shellfish from underwater rock. The small wooden spatulas had been cut and smoothed (Hiatt 1968:209).
- Sticks to dig up roots (cf. Hiatt 1968:209), to dig out prey (cf. Hiatt 1968:206). A three feet long stick, a so-called 'spit' was used by women to catch birds from a hole in the ground (Hiatt 1968:208). It is unclear if this tool can be regarded the same as the combination tool of "digging stick-club-chisel used [by women] for a variety of purposes from digging up vegetable roots, ochre and killing game, to prising bark off trees, the latter being done with the aid of a stone hammer" as referred to by Jones (1977:197). Whether the digging sticks were actually unmodified as Oswalt (1976)/McGrew (1987) classify them is questionable.
- Stones as missiles for the hunt on ducks and swans (cf. Hiatt 1968:208). Jones (1977:197) characterizes them as small spherical pebbles used as missiles (Jones 1977:197).
- Throwing stick to knock prey out of tree.
- Wooden spear to impale prey. The thrusting spears were 10–12 feet long and had a maximum thickness of a man's middle finger. The points were sharpened with flint tools and hardened in fire (Hiatt 1968:205; Jones 1977:196). A picture of two wooden spears is given by C. A. Lesueur (1807/1811, reproduced in Jones 1977:199, Fig. 5).
- Torch to fire grassland to drive prey (cf. Hiatt 1968:212) and to smoke out prey from tree hollows (cf. Hiatt 1968:207).
- Plaited grass rope to climb trees (cf. Hiatt 1968:206). Jones (1977:197) mentions also ropes made from strips of animal fur.
- Tussocks of grass tied together to trip up kangaroos (cf. Hiatt 1968:206).
- Grass baskets to carry shellfish. Hiatt (1968:209) describes the containers as made from leaves of sedgy

plants, divided into strips and softened by fire, for collecting and carrying food items, ochre, stone, tinder, string. A picture of a basket is given by C. A. Lesueur (1807/1811, reproduced in Jones 1977:199, Fig. 5).

- Blind made from wood and branches to conceal a hunter.
- Baited blind to conceal bird catchers. Hiatt (1968:209) cites the personal notes of Robinson from 1833: "The natives erect a kind of hut with grass under which they place some fish, fastened by stone, and when the crows come to feed, they do nothing than put out their hands and haul them in. They adopt the same plan for catching ducks except that they bait them with worms."
- Set of spears implanted in the earth on kangaroo trail to stab prey. "The part of the stake stuck in the ground was burnt to prevent it from decaying" (Hiatt 1968:206).

Additional items were depicted in the literature, which were used by Tasmanians for procurement, transportation, and treatment of food, but which McGrew (1987) did not take into account:

- Waddy. A sort of club made from heavy wood and varying in length from two and a quarter feet to four feet (Hiatt 1968:208). Jones (1977:197) mentions these tools as straight to fusiform sticks used as throwing sticks and clubs. A picture of two waddies is given by C. A. Lesueur (1807/1811, reproduced in Jones 1977:199, Fig. 5).
- Stone pestles and mortars to soften vegetable food and to break long bones for marrow (Jones 1977:197).
- Possum-skin pouch bags for carrying valuables such as stone tools, ochre, and ashes of the dead (Jones 1977:197). A picture of a skin pouch bag is given by C. A. Lesueur (1807/1811, reproduced in Jones 1977:199, Fig. 5).
- Water containers made from seaweed (Hiatt 1968:210; Jones 1977:197). Different kinds of modification of the leaves are described (cf. Hiatt 1968:210): they were cut into circular pieces and formed into a purse with a string run through holes in the margin, or "bent together with a small pin of wood", respectively "skewered together at the sides". An oblong piece could be opened to form a flat bag.
- Sea shells used as drinking vessels. As material for the likely unmodified tools oysters and mutton fish/abalone shells are mentioned (Hiatt 1968:210; Jones 1977:197).
- Sea shells used as cooking device (Hiatt 1968:210).
- Wooden spits to support food against the fire (Hiatt 1968:210).
- Flat stones used to broil food (Hiatt 1968:210).

Stone tools certainly played a major role in the every-day life of Tasmanians, although they are rarely mentioned in detail (cf. Hambly 1931). Simple stone tools from the

ethnographic record have been depicted as knives, to take bark from trees, to make points to the wooden spears, to tap sweet sap from trees (Hiatt 1968:212), as scrapers and skinning tools (Hambly 1931:89), and as cicatrizing flakes (Jones 1977:197). The stone technology from the archaeological record has been reported as “being mainly composed of multiplatform and single platform cores, primary flakes, retouched flakes and various sized scrapers (Jones 1977). [...] there are additional items such as small denticulate flakes [...], delicate ‘thumbnail’ and end scrapers indicating a greater range of stone tool types...” (Cosgrove et al. 2014:180). While there is ethnographic evidence of the use of hammer stones for flaking (Hambly 1931:91), pressure flaked tools from the archaeological record (see e.g. Cosgrove et al. 2014:181, Fig. 14.2) indicate the use of punches probably made from organic material. It cannot be reconstructed from the available sources how the Tasmanians themselves grouped their stone tools in typological and functional classes. It was probably just because of the universal use of not very remarkable stone tools as cutting device that McGrew (1987) forgot to take stone knives on his list of tools for food procurement. Bark vessels (Meston 1935) are an artifact class not specifically associated to food procurement, but increasing the geographical range of it (cf. Vanderwal 1978). Watercraft made from rolls of bark fastened onto each other with straps of bark or tough grass and propelled by poles allowed crossing water between the mainland and islands and large waterways within Tasmania (Hiatt 1968:213–214; Jones 1977:197).

Fire played an important role as tool in the life of aboriginal Tasmanians. Beside the warming factor it was regularly used for cooking/food preparation (cf. Hiatt 1967), to improve the landscape for food supply (Hiatt 1968:212, 219), for hunting/driving prey (Völger 1973:62), for opening forest paths (ibid.), to alter the qualities of wood by hardening spear tips (Hiatt 1968:205) and to prevent stakes in kangaroo traps from decaying (ibid.:206), for softening leaves of sedgy plants to make baskets (ibid.:209), and for cremation of the dead (Hiatt 1969). Fire was carefully maintained; it was common to carry torches and glowing pieces of dry wood and bark rolls (Hiatt 1968:212; Völger 1973:62). The question if aboriginal Tasmanians not only maintained, but also produced fire, is impossible to be definitely answered (cf. Hiatt 1968:211–212; Völger 1973; Gott 2002; Taylor 2008). There are few and not fully reliable reports in the ethnographic record; it is obvious that fire making was not an every-day business. As a possible explanation for a low frequency of fire making Gisela Völger (1973:62) argues that this was normally avoided because of the difficulty to light fire in the wet and windy climate (cf. Gott 2002:653). It may also be that the primary and recurrent function of the frequently described lighted torches was to facilitate the movements of the people and as hunting tool.

As by-product they served to maintain fire: using a torch was much more comfortable than lighting fire again and again. Beth Gott (2002) and Rebe Taylor (2008) list the possible ways of lighting a fire for which the early colonial records on the life of aboriginal Tasmanians give some evidence: by percussion, by friction that is rubbing together two pieces of wood, with a fire drill, and with the stick-and-groove method (Roth 1899).

Two forms of huts were reported to give shelter. In the eastern part of Tasmania windbreaks were common. The semi-circular structures were built from stakes interwoven with strips of bark or fastened with leaves of grass and covered with bark (Hiatt 1968:201). From the west coast more substantial, larger and closed houses are reported. Their form resembled a circular dome with a small entrance and a cover made of bark (ibid.). Clothing seems to have been limited to kangaroo skins tied onto the shoulder for warmth (Jones 1977:197), a fact that supported the evaluation of Tasmanian culture as deficient. Vanderwal (1978:123), however, discusses the use of grease and ochre as equal to or even more effective than skin as body protection. The common use of ochre is also testified by reports on baskets and skin bags containing pieces of ochre (Hiatt 1968:209; Jones 1977:197).

The record of Tasmanian cultural life is completed by items which are at first sight not primarily related to subsistence: “In Tasmanian society, there was time for sky-larking, for gossiping, for fighting, for story-telling and dancing, for mourning the dead, for getting ochre, for making shell necklaces and as the rock carvings at Mount Cameron West and other west coast sites show us – for art” (Jones 1977:201). Necklaces from pierced and strung shells as represented by Lesueur (1807/1811, reproduced in Jones 1977:199, Fig. 5), different hair dresses, and patterns of cicatrices (body scars as shown by Copia 1817, reproduced in Davidson 2007:73, Fig. 6.4) were used as personal ornaments. It is unclear whether these items “were [...] markers of status, or group identity, as well as of individual difference” (Davidson 2007:73; cf. Brown 1991). Evidence of visual arts is found in rock paintings and engravings with hand stencils and lines/circles/speckled areas as motifs (de Teliga and Bryden 1958; Brown 1991:101–103) and in painted patterns of circles and lines on bark (de Teliga and Bryden 1958; Brown 1991:103–104). Figurative motifs painted on bark may be influenced by post-colonial contacts (Brown 1991:103). Performing arts are reported in the form of singing and dancing sessions up to several days long with representations of hunts, battles and other mythological or historical themes (Hiatt 1968:215; Horton 1979:32–33). Hiatt (1968:215) sees “a fairly well developed mythology [...] many of the stories are concerned with where the Tasmanians came from, how fire originated and so on [...]. These could well have been connected with

some form of totemic religion and associated ceremonies.” The common funeral form was the primary cremation of the dead. The burnt remains were covered by small mounds of grass and/or sticks and sometimes topped by structures of wooden poles, covered with bark and tied together at the top (Noetling 1908:36; Hiatt 1969:104–105). Alternatively, the remains were collected and carried in skin bags (ibid.:105). “The ashes of the dead were also used to smear on the body and face as assign of mourning” (ibid.). Bones were sometimes kept as relics. As another form of treating the dead the deposition in hollow trees is reported (ibid.:106).

The assessment of a simplification in cultural performances within the last 12 kyr is difficult. A comparison with the diverse record from the whole Australian continent (cf. Jones 1977:196) is problematic to define the original status of Tasmanian culture before separation by rising sea levels. As most of the material elements were made from perishable organics their development is hardly to be reconstructed. The archaeological record allows to identify only two reductions that occurred around 4000 years ago: as tools some form of bone points were given up (ibid.; Read 2006) as was the consumption of fish (Jones 1977:196; but see also Taylor 2007). Yet, the stone tool assemblages evolved by an increasing formalization of tool types with reduction of tool size and finer retouch and “a steady and increasing introduction of high quality exotic raw materials such as cherts, siliceous breccias, and spongolites brought in as ready made tools or at least as blanks, from quarries at 50 to 100 km away” (Jones 1977:194). The introduction of the bark canoe, characteristic for Tasmania and most likely an indigenous (re-)invention (Vanderwal 1978:121), allowed the expansion of geographical range in food procurement (Vanderwal 1978:123). The identification of the reasons of cultural changes and their characterization as adaptive or maladaptive is often a matter of perspective (cf. Read 2006). While Jones (1977, 1978; see also Henrich 2004) views the abandonment of fish as part of the diet as well as the cessation of bone point production and the, postulated, associated manufacture of clothing as a maladaptive and passive loss of skills and knowledge, other authors describe them as adaptive achievements (cf. Horton 1979). Allen (1979) points to the low fat content of the available fish and the need of a high-caloric diet in harsher winters, Walters (1981) suggests an optimization of the diet following environmental change. Vanderwal (1978:123) discusses the use of grease and ochre as equally or even more efficient than the use of skins and clothing. In any case, the aboriginal Tasmanians showed a well-developed ability to adapt to new circumstances. The dog was quickly accepted within the Tasmanian cultural setting after its introduction by Europeans (ibid.); post-contact experiences were easily incorporated in the traditional song and dance repertoire.

Assessment of a Minimum of Cultural Capacities from a Set of Cultural Performances

As mentioned above, the cultural capacity of a population (referring to the range of problem-solution-distances that are applied in the set of cultural performances, see below) can be deduced from the set of cultural performances associated with this population and its range of expression in the three developmental dimensions (evolutionary-biological, historical-social, and ontogenetic-individual). The more complete the set of cultural performances is covered, the closer the cultural capacity can be approached. It has to be kept in mind, however, that the reconstructed cultural capacity of a population is always only a minimum one. To get a more detailed picture in the Tasmanian case, the list of performances given by McGrew (1987) with an incomplete focus on subsistence tools has been extended by other performances as given in the literature. This set of cultural performances from the Tasmanian ethnographic record can now be used to assess the cultural capacities at the time of contact in the 18th century AD and to evaluate the postulated deterioration of the mind.

The EECC model of the expansion of cultural capacities in human evolution offers a gradual scheme of development based on the different types of information that is socially transmitted (Haidle and Conard 2011; Haidle et al. 2015). As key character to categorize socially transmitted information and thus cultural performances, the problem-solution distance was chosen, an attribute first mentioned in Wolfgang Köhler’s (1926) comparative studies of chimpanzee behavior. An extended behavioral route from perceiving a problem or need to its solution or satisfaction, together with possible loops or sidetracks, is identifiable in all sorts of tool behavior and can be studied in archaeological as well as ethological and ethnographical data; as a basic feature of very different manifestations it can serve as an approach to test for behavioral potential as Renfrew (1996) claimed. In tool use, a goal is not approached directly as when a hungry zebra starts to eat grass, but by moving away from the target object (e.g., a nut) to reach satisfaction (feeding) via an intercalated tool (e.g., a hammer). Haidle (2009, 2010, 2012), Lombard and Haidle (2012) extended the concept of the problem-solution distance and developed a method to systematically assess levels in their complexity by coding them in cognigrams and effective chains. Applying this method, problem-solution distances in tool behaviors in living animals, ancient hominins, and recent humans can be compared directly. An extended problem-solution distance is not exclusive to tool behavior, but inherent also in social behavior. Thus, the capacities to solve a problem identified in tool behavior represent the minimum cultural capacity available to perform all types of cultural

behavior. Additional data from non-material cultural behavior can sharpen the picture.

Eight different grades of cultural capacities based on different types of socially transmitted information have been identified so far (Haidle et al. 2015). The grades do not represent an evolutionary ladder on which, by climbing up, the lower stages are left behind. Instead, the grades express a gradual extension of options of action. With increasing potential problem-solution-distances the possible variability and flexibility of actions expands, including the range of options already achieved in earlier stages. The basic four grades ('social information', 'social learning', 'tradition', and 'basic cultural') have been documented in some animal species, while the subsequent four ('modular', 'composite', 'complementary', and 'notional') have, thus far, only been identified in the course of human evolution. Originating in the analysis of tool behavior, they are distinct in the different effective concepts through which attention foci are linked to each other. Up to basic cultural capacities the individual acts on a problem focus directly or with the help of a tool picked up or modified by the subject, but always with the concentration on the central target. With modular cultural capacities as first detected so far in early human manufacture and use of stone tools the problem-solution distance is extended to effective chaining.

Modular cultural capacity is characterized by the effective chaining of independent cultural units which can be combined in different ways to act on and modify one another. A tool can now not only be used to solve a basic problem like the exploitation of food resources, but can also be used to solve secondary problems as the manufacture of tools with the help of another tool (Kitahara-Frisch 1993). As cultural behavior is increasingly decoupled from basic needs, intermediate targets become independent. A hammerstone is not only meant to serve as a knapping device for a special stone artifact to work on a specific food item. Rather it can be used in different situations like stone knapping or operating a chisel or opening a nut. The socially transmitted information extends to behavioral units that are not exclusively bound to specific and acute problems. Instead, the elements of behavioral units (stimulus, concept of solution, goal) are increasingly abstracted from specific purposes and become applicable in different contexts. The execution of modular cultural capacities can occur on various technological levels based on differing knowledge and skills: knapping stone tools directly with simple flake technique, bifacially, following the Levallois scheme, or in an Upper Paleolithic way of blade production does not require more than modular cultural capacity as does the manufacture of a simple wooden spear (Haidle 2009, 2010). The complexity of knowledge and skill and thus the technological standard can be enormously raised without a fundamental change in cultural capacities.

The Tasmanian assemblage of material culture shows evidence of a number of tools manufactured in a modular way by the use of other tools. Spears, waddies, digging sticks, and wooden chisels are made with the help of stone tools produced with hammer stones. And spears, waddies, digging sticks, and wooden chisels are also used in a modular way as they are not made for, and in the course of, a specific event and thrown away when the event finished, but are continuously used in recurrent settings. The modular way of thinking and organizing cultural items refers to processes and actions instead of specific end-products. Chimpanzees also use bark, grass, and twigs, yet as direct raw material for specific tools. The Tasmanians (as other humans with modular capacities) instead could use unmodified or modified modules in the process of solving several secondary problem settings: bark, tough grass, leather straps, and sinews served as binding material, stone tools as cutting devices, pins of wood were used to fix something, and hammer stones to apply punctual force on other items.

With *composite cultural capacity* a new concept of solving problems enters the stage. The problem-solution distance can be extended to a combination of different cultural modules with specific qualities that are fused to form composites with new qualities. While tools made out of many pieces of the same kind, like piles of boxes to be used as a ladder as documented for chimpanzees (cf. Köhler 1926) or the sophisticated baskets of the Tasmanians (cf. Jones 1977:199, Fig. 5), escalate only the properties of the basic element, composite tools show a new combination of different qualities. The socially transmitted information exceeds that of modular cultural capacities through combining separate information on the basic elements of the composite "that may be obtained at different times and in different places" (Ambrose 2010:S139) with information on the newly created functional unit which may be assembled much later (ibid.). Hafted tools and compound adhesives are typical material examples of such composites.

Within the Tasmanian record several items based on composite cultural capacity can be identified. Lighted torches are composites consisting of (at least) portable sticks and fire. The pouch bags and some water containers combine pieces of skin or seaweed pierced at their margins with skin strips or string run through to tighten them. An alternative way of forming composite water containers out of seaweed was performed by fixing it with wooden pins. Shell necklaces represent a combination of pierced shells and string, and the bark canoes were shaped and fastened with straps of bark or grass. The different huts were composed of different materials for building the frame, for filling the interspaces, for binding, and for covering.

Complementary cultural capacity extends the possibilities to solve a problem with a new concept. This allows to develop and to use complementary sets of cultural modules

as acting entities with two or more interdependent and exchangeable parts. Bow-and-arrow, needle-and-thread, screw-and-screwdriver, key-and-lock are only some examples of the symbiotic relation of two discrete, but concerted elements working together to fulfill a common task (Lombard and Haidle 2012). The elements of a complementary tool set must be developed in complementary correspondence with each other. The socially transmitted information expands: Different from composite cultural capacity, not only information has to be transmitted about the individual components involved, but also key formal information about the whole concerted system is required. An example of a complementary tool set used by aboriginal Tasmanians was the bark canoe (in itself a composite item) propelled with a wooden pole. The baited blind can also be considered as a complementary set consisting of a sort of grass hut to blind the bird hunter (in itself a composite item) and the bait fastened by a stone. To attract different sorts of prey, different sorts of bait were applied: pieces of fish for crows, worms for ducks.

With *notional cultural capacity* also notional concepts can be developed and used as cultural modules to solve a problem. These notional concepts can be (a) symbolic links (e.g., cross, crescent, and Star of David as symbols of religions), (b) normative definitions (e.g., metric and value systems), or (c) virtual beings (e.g., angels) and characters (e.g., protecting capacities of an amulet). The socially transmitted information exceeds that of all former capacities. It is now based on non-observable concepts, which can be manipulated only in the mind or through imagination, and their effects on real or other notional modules. Notional concepts can stand alone as independent modules, but can also be integrated in composites or act as parts of a complementary set. Material expressions of notional cultural capacity are information carriers. In aboriginal Tasmanian life the hand stencils and geometric patterns engraved and painted on rock and pieces of bark may well have been such information carriers. The well developed mythology was another, though immaterial, expression of the notional cultural capacities.

Conclusions: Lessons from Tasmania

As discussed in the EECC model of the expansion of cultural capacities, the range of cultural performances of different groups has widened out over the course of human evolution coherent with the development of new cultural capacities (Haidle and Conard 2011; Haidle et al. 2015). Nonetheless, a single cultural performance in an advanced grade of cultural capacity may be simpler than another performance in an earlier grade, since different aspects of the full cultural potential can be applied selectively (Hovers and Belfer-Cohen 2006; Lombard and Parsons 2011). The Tasmanian example shows

this in an impressive way. The range of pre-colonial Tasmanian performances is rated as very simple based on the scarcity of cultural expression in material objects and the artless appearance of the few recognized manifestations. Yet, although only fragmentarily conveyed the cultural repertoire of aboriginal Tasmanians clearly gives evidence of full cultural capacities in all modular, composite, complementary, and notional aspects. At first glance, the artifact assemblage may appeal as simple and reduced, but the examination should not stuck in assumptions based on more or less subjective perceptions of the accessible record. The assessment of cultural capacities based on the analysis of problem-solution distances of the broad spectrum of cultural performances offers a more systematic approach. However, the examination of only a segment of the repertoire like McGrew's (1987) focus on technology used for food procurement may be misleading, and in this case even applying the problem-solution distance approach would yield a distorted image and underestimation of the cultural capacities behind. Both chimpanzees and humans (e.g., Tasmanians) use tools to access food. But humans (and as such also Tasmanians) developed cultural performances for purposes beyond those documented for chimpanzees so far. Excluding the data of cultural performances beyond food procurement from the analyses means to exclude a complete field of possible differences which were sought for.

The mechanisms of cultural development can be compared with a ratchet (Tomasello 1999) or better with the act of mountaineering (Lombard 2012, 2016). Cultural development is path dependent: the track used so far determines the possibilities of the future route. It is possible to proceed up to a more sophisticated level of performance, but also to move to the side to variations on the same level or down to simpler performances. In cultural development it is even possible to return to an earlier point and to proceed by retracing and then following other routes. Or a hook fixed by another group can be used to continue as shown by several items quickly included in the Tasmanian repertoire which were adopted from the European set of performances brought in by colonists. "Using the mountaineering metaphor, cumulative cultural capacity does not only include those cultural efforts that are built upon the highest level achieved, but also recursions following on seemingly more advanced solutions. Advanced cultural capacities are not necessarily accompanied by a progressive line of ever more sophisticated and complex solutions built on earlier ones, but allow increasing technological, cognitive, and behavioral flexibility from very simple to highly complex solutions depending on changing environmental constraints and cultural decisions. Thus, although the range of cultural performances expands with increasing cultural capacity, cultural evolution is not always linearly progressive. The development of cultural capacity is a systemic process involving the co-evolution of the three

dimensions outlined above, and their interactions with the specific functional environment” (Haidle et al. 2015: 51). To understand the evolving system not only single elements which are perceived as interesting should be examined, but as many elements as possible including their interdependencies with and relevance for other elements. As the organism of a fungus cannot be understood by studying mushrooms which appear at the surface for limited time, the examination of specific blade technology or parietal art and their occurrence or absence is not sufficient to define and to explain the behavioral capacities of *Homo sapiens* (Haidle 2014; cf. Renfrew 1996). The Tasmanian cultural record is a perfect example that apparently simple performances cannot be easily equated with archaic or non-modern behavior. “To really comprehend the process of changing humanity, we need to uncouple the ‘simple’ to ‘complex’ social evolutionists’ paradigm and understand the archaeological record in terms of its cultural variability that reflects the wide range of responses to solving similar social and environmental problems that our species is capable of” (Cosgrove et al. 2014:188). The presumptive abandonment of fish consumption and bone point production in the Tasmanian record can be easily explained without any basic loss of intellectuality which, by the way, cannot be traced in the comprehensive assessment of the cultural capacities on the basis of problem-solution distances in Tasmanian tool behavior.

References

- Allen, H. (1979). Left out in the cold: Why the Tasmanians stopped eating fish. *Artefact*, 4, 1–10.
- Ambrose, S. (2010). Coevolution of composite-tool technology, constructive memory, and language. *Current Anthropology*, 51, S135–S147.
- Bassett, E. (2004). Reconsidering evidence of Tasmanian fishing. *Environmental Archaeology*, 9, 135–142.
- Beall, C. M. (2006). Andean, Tibetan, and Ethiopian patterns of adaptation to high-altitude hypoxia. *Integrative and Comparative Biology*, 46, 18–24.
- Bowdler, S. (1980). Fish and culture: A Tasmanian polemic. *Mankind*, 12, 334–340.
- Bowern, C. (2012). The riddle of Tasmanian languages. *Proceedings of the Royal Society of London B*, 279, 4590–4595.
- Brown, S. (1991). Art and Tasmanian prehistory: evidence for changing cultural traditions in a changing environment. In P. Bahn & A. Rosenfield (Eds.), *Rock art and prehistory: papers presented to Symposium G of the AURA Congress, Darwin 1988* (pp. 96–108). Oxford: Oxbow Books.
- Burger, J., Kirchner, M., Bramanti, B., Haak, W., & Thomas, M. G. (2007). Absence of the lactase-persistence-associated allele in early Neolithic Europeans. *Proceedings of the National Academy of Sciences of the USA*, 104, 3736–3741.
- Cosgrove, R., Pike-Tay, A., & Roebroeks, W. (2014). Tasmanian archaeology and reflections on modern human behavior. In R. Dennell & M. Porr (Eds.), *Southern Asia, Australia and the search for human origins* (pp. 257–264). Cambridge: Cambridge University Press.
- Davidson, I. (2007). Tasmanian aborigines and the origins of language. In J. Mulvaney & H. Tyndale-Biscoe (Eds.), *Rediscovering Recherche Bay* (pp. 69–85). Canberra: Academy of the Social Sciences in Australia.
- de Teliga, S. & Bryden, W. (1958). A note on Tasmanian aboriginal drawings. *Papers and Proceedings of the Royal Society of Tasmania*, 92, 191.
- Enquist, M., Ghirlanda, S., Jarrick, A., & Wachtmeister, C. A. (2008). Why does human culture increase exponentially? *Theoretical Population Biology*, 74, 46–55.
- Fisher, S. E., & Ridley, M. (2013). Culture, genes, and the human revolution. *Science*, 340, 929–930.
- Gamble, C. S. (1992). Archaeology, history and the uttermost ends of the earth – Tasmania, Tierra del Fuego and the Cape. *Antiquity*, 66, 712–720.
- Gott, B. (2002). Fire-making in Tasmania: Absence of evidence is not evidence of absence. *Current Anthropology*, 43, 650–656.
- Haidle, M. N. (2008). Verschiedene Welten. Umweltwahrnehmung und Umweltgestaltung im Laufe der menschlichen Evolution. In T. Knopf (Ed.), *Umweltverhalten in Geschichte und Gegenwart. Vergleichende Ansätze* (pp. 30–41). Tübingen: Attempto.
- Haidle, M. N. (2009). How to think a simple spear? In S. A. de Beane, F. L. Coolidge, & T. Wynn (Eds.), *Cognitive archaeology and human evolution* (pp. 57–73). New York: Cambridge University Press.
- Haidle, M. N. (2010). Working memory capacity and the evolution of modern cognitive capacities – implications from animal and early human tool use. *Current Anthropology*, 51, S149–S166.
- Haidle, M. N. (2012). *How to Think Tools? A Comparison of Cognitive Aspects in Tool Behavior of Animals and During Human Evolution*. Cognitive perspectives in tool behaviour Vol. 1. urn:nbn:de:bsz:21-opus-60146. Retrieved June 6, 2014.
- Haidle, M. N. (2014). Examining the evolution of artistic capacities: Searching for mushrooms? In C. Sütterlin, W. Schiefenhövel, C. Lehmann, J. Forster, & G. Apfelauer (Eds.), *Art as behaviour. An ethological approach to visual and verbal art, music and architecture* (pp. 237–251). Oldenburg: Bis-Verlag der Carl von Ossietzky Universität Oldenburg.
- Haidle, M. N., & Conard, N. J. (2011). The nature of culture – Summary report on an interdisciplinary symposium held in Tübingen, Germany, 15–18 June 2011. *Mitteilungen der Gesellschaft für Urgeschichte*, 20, 65–78.
- Haidle, M.N., Bolus, M., Collard, M., Conard, N.J., Garofoli, D., & Lombard, M., et al. (2015): The nature of culture – An eight-grade model for the evolution and expansion of cultural capacities in hominins and other animals. *Journal of Anthropological Sciences*, 93, 43–70.
- Hambly, W. D. (1931). Types of “Tronattas” or stone implements used by the Aborigines of Tasmania. *American Anthropologist*, 33(1), 88–91.
- Henrich, J. (2004). Demography and cultural evolution: How adaptive cultural processes can produce maladaptive losses – The Tasmanian case. *American Antiquity*, 69, 197–214.
- Hiatt, B. (1967). The food quest and the economy of the Tasmanian aborigines. *Oceania*, 38(2), 99–133.
- Hiatt, B. (1968). The food quest and the economy of the Tasmanian aborigines (continued). *Oceania*, 38(3), 190–219.
- Hiatt, B. (1969). Cremation in aboriginal Australia. *Mankind*, 7, 104–119.
- Horton, D. R. (1979). Tasmanian adaptations. *Mankind*, 12, 28–34.
- Hovers, E., & Belfer-Cohen, A. (2006). “Now you see it, now you don’t” – Modern human behaviour in the Middle Palaeolithic. In E. Hovers & S. Kuhn (Eds.), *Transitions before the transition. Evolution and stability in the Middle Paleolithic and Middle Stone Age* (pp. 295–304). Heidelberg, New York: Springer.
- Jones, R. (1977). The Tasmanian paradox. In R. V. S. Wright (Ed.), *Stone tools as cultural markers: Change, evolution and complexity* (pp. 189–204). Canberra: Australian Institute of Aboriginal Studies.

- Jones, R. (1978). Why did the Tasmanians stop eating fish? In R. Gould (Ed.), *Explorations in ethnoarchaeology* (pp. 11–48). Albuquerque: University of New Mexico Press.
- Jones, R. (1995). Tasmanian archaeology: Establishing the sequences. *Annual Reviews of Anthropology*, 24, 423–446.
- Kitahara-Frisch, J. (1993). The origin of secondary tools. In A. Berthelet & J. Chavaillon (Eds.), *The use of tools by human and non-human primates* (pp. 239–246). Oxford: Clarendon Press.
- Köhler, W. (1926). *The mentality of apes*. New York: Harcourt, Brace & Co.
- Ledón-Rettig, C. C., Richards, C. L., & Martin, L. B. (2013). Epigenetics for behavioral ecologists. *Behavioral Ecology*, 24, 311–324.
- Lombard, M. (2012). Thinking through the Middle Stone Age of sub-Saharan Africa. *Quaternary International*, 270, 140–155.
- Lombard, M. (2016). Mountaineering or Ratcheting? Stone age hunting weapons as proxy for the evolution of human technological, behavioral and cognitive flexibility. In M. N. Haidle, N. J. Conard, & M. Bolus (Eds.), *The nature of culture* (pp. 135–146). Dordrecht: Springer.
- Lombard, M., & Haidle, M. N. (2012). Thinking a bow-and-arrow: Cognitive implications of Middle Stone Age bow and stone-tipped arrow technology. *Cambridge Archaeological Journal*, 22(2), 237–264.
- Lombard, M., & Parsons, I. (2011). What happened to the human mind after the Howiesons Poort? *Antiquity*, 85, 1433–1443.
- Malafouris, L. (2010). Metaplasticity and the human becoming: Principles of neuroarchaeology. *Journal of Anthropological Sciences*, 88, 49–72.
- McGrew, W. C. (1987). Tools to get food: The subsistants of Tasmanian aborigines and Tanzanian chimpanzees compared. *Journal of Anthropological Research*, 43, 247–258.
- Meston, A. L. (1935). Observations on visits of the Tasmanian Aborigines to the Hunter Islands. *Papers and Proceedings of the Royal Society of Tasmania 1935*, 155–163.
- Murray, T., & Williamson, C. (2003). Archaeology and history. In R. Manne (Ed.), *Whitewash: On Keith Windschuttle's fabrication of Aboriginal history* (pp. 311–333). Melbourne: Black Inc Agenda.
- Noetling, F. (1908). A native burial ground on Charlton estate, near Ross. *Papers and Proceedings of the Royal Society of Tasmania 1908*, 36–43.
- Oswalt, W. H. (1976). *An anthropological analysis of food-getting technology*. New York: Wiley.
- Petanjek, Z., & Kostović, I. (2012). Epigenetic regulation of fetal brain development and neurocognitive outcome. *Proceedings of the National Academy of Sciences of the USA*, 109, 11062–11063.
- Porr, M. (2014). Essential questions: ‘Modern humans’ and the capacity for modernity. In R. Dennell & M. Porr (Eds.), *Southern Asia, Australia and the search for human origins* (pp. 257–264). Cambridge: Cambridge University Press.
- Read, D. (2006). Tasmanian knowledge and skill: Maladaptive imitation or adequate technology? *American Antiquity*, 71, 164–184.
- Renfrew, C. (1996). The sapient behaviour paradox: How to test for potential? In P. Mellars & K. Gibson (Eds.), *Modelling the early human mind* (pp. 11–15). Cambridge: McDonald Institute for Archaeological Research.
- Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.
- Roth, H. L. (1899). Tasmanian Firesticks. *Nature*, 59, 606.
- Ryan, L. (1981). *The Aboriginal Tasmanians*. St Lucia: University of Queensland Press.
- Sollas, W. J. (1911). *Ancient Hunters and their modern representatives*. London: Macmillan.
- Taylor, R. (2007). The polemics of eating fish in Tasmania: The historical evidence revisited. *Aboriginal History*, 31, 1–26.
- Taylor, R. (2008). The polemics of making fire in Tasmania: The historical evidence revisited. *Aboriginal History*, 32, 1–26.
- Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge: Harvard University Press.
- Vanderwal, R. L. (1978). Adaptive technology in Southwest Tasmania. *Australian Archaeology*, 8, 107–127.
- Völger, G. (1973). Making fire by percussion in Tasmania. *Oceania*, 44 (1), 58–63.
- Walters, I. (1981). Why the Tasmanians stopped eating fish: A theoretical consideration. *Artefact*, 6, 71–77.
- Woollett, K., & Maguire, E. A. (2011). Acquiring “the knowledge” of London’s layout drives structural brain changes. *Current Biology*, 21, 2109–2114.

The Nature of Culture

Based on an Interdisciplinary Symposium 'The Nature of Culture', Tübingen, Germany

Haidle, M.N.; Conard, N.J.; Bolus, M. (Eds.)

2016, X, 151 p. 38 illus., 11 illus. in color., Hardcover

ISBN: 978-94-017-7424-6