A product designer may, however, attempt to control the selection process, by controlling the environment in which his products operate. He may for instance attempt to require or encourage that a certain type of product is only used in pre-specified contexts or by pre-specified users. He may also attempt to alter the contexts of use in which products operate, or alter the traits of users. He may for example offer training to users, or encourage such training, or he may recommend that adaptations are made to the environment in which the product is used. The designer's main ways of controlling the environment include the authoring of manuals and direct communication with suppliers or users. As such, a designer may project his forward-looking intelligence beyond the artifact itself to also influence the conditions under which selection takes place. His actions are like those of a parent who prescribes where his children can go and whom they can associate with, and who eliminates risks and dangers in the environment so that his children have the best chance of succeeding in the world.

In Basalla's and Mokyr's approach, I conclude, design can be understood as the process of creating variants in an evolutionary process of variation and selection. Designers use forward-looking intelligence in the creation of new variants, but new variants (artifacts) are not wholly determined by the designer's vision, but also by the everyday constraints under which designers operate. Designers and others may also use forward-looking intelligence in trying to influence the selection process. However, their efforts are ultimately part of an evolutionary process that cannot be controlled by any party.

By contrast, in Aunger's memetic theory of technological change, neither variation nor selection involve forward-looking intelligence, as he holds that even design, or innovation, involves random mutation of form. This is the result of a radical vision of cognition according to which cognitive processes are themselves processes of variation and selection of memes over which human beings have no real control, since they are subconscious processes driven by the laws of memetics. In the language of memetics, designers are "meme fountains": along with artists and scientists, they are people who happen to be good at producing new memes or integrating existing ones. The new memes they produce are designs of technical artifacts.

Let me finally come to an evaluative question: which perspective on design and technological innovation is right? Is it Aunger's radical approach, in which designers are mere pawns in an evolutionary process? Is it the traditional, non-evolutionary approach in which designs spring from the creativity and intelligence of designers? Or is it Basalla's or Mokyr's approach, located somewhere in between? I want to suggest that there may be more than one valid conceptual framework in which to analyze design and innovation. If the purpose is to explain the presence of certain features or functions in an artifact, then it may be most useful to highlight the intentions of designers. For example, it can be explained that the panhandle is curved because the designer wanted the pan to have an easy grip. This kind of explanation is called an *intentional explanation*, as it explains things or events as the product of human intentions. If the purpose is to explain technological change, then too many constraints are at work besides the intentions of designers or innovators, and one should resort to a *causal* (or *structural* or *functional*) *explanation* that references to structural features or mechanisms at work in producing such change (Little, 1991). The claim of evolutionary theorists of

technology are that such mechanisms are evolutionary, in a broad sense, and should inherit part of the vocabulary and laws of evolutionary biology.

In Basalla's and Mokyr's approaches, the resulting evolutionary explanations are underpinned in part by intentional explanations: they are macro-analyses that can be related to micro-analyses which include individuals such as designers and users who have intentions, desires and beliefs, and act on them. In Aunger's approach, however, the micro-level of analysis includes no intentional agents but agents with minds that are themselves subjected to blind variation and selection. Put differently, Basalla and Mokyr still treat the mind as an *intentional black box* (Haugeland, 1981), an entity that has intentions and generates ideas and requires no further explanation, whereas Aunger, correctly or incorrectly, reduces the mind to a non-intentional, non-forwardlooking process of meme variation and selection.

7 Conclusion

In this chapter, I aimed to examine whether the evolution of technical artifacts is radically different from the evolution of biological species, and whether designed artifacts are best explained as resulting from the purposive intelligence of designers or instead from a process akin to biological evolution. I discussed evolutionary theories of technology by George Basalla, Joel Mokyr, and Robert Aunger, and examined whether they qualified as genuinely evolutionary theories. I concluded that on Basalla's account, technological innovation and change are weakly analogous to biological evolution, whereas on Mokyr's and Aunger's account, they are strongly analogous.

Although I have not demonstrated the validity of evolutionary approaches to technology, I hope to have convinced the reader that such approaches are worth taking seriously. Evolutionary approaches to technology present us with a vision of design in which the intentions and beliefs of designers and others are at best only part of the explanation of processes of technological innovation and change. They yield a conception of designers as initiators of new variants that then undergo selection in society. Designers are agents of mutation and recombination in the production of new variants. They have partial, but no complete, control over this production process. The success of the variants they produce in the subsequent selection process, or their fitness, can only be predicted or controlled by designers to a very limited extent. This perspective on design and innovation is worth developing further, as it may help us better understand the role of designers in technological innovation and the conditions under which technological innovation is successful.

References

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