The dual nature of technological concepts

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1. Three types of value statements

Value statements can be divided into three major groups according to how their criteria of evaluation are specified. The first of these groups consists of those value statements that are *unspecified* with respect to the criteria of evaluation. Here is one example:

> Her decision was very good.

The second group consists of the *viewpoint-specified* value statements. In these value statements, an explicit point of view is given, from which the evaluation is made. We often use adverbs such as "morally", "aesthetically" etc. to express this type of specification.

> Her decision was morally good.
>
> This way to construct a bridge is aesthetically better than most alternatives, but it is not at all good from an economic point of view.

The third group consists of *category-specified* values. Here, the value statement is specified in terms of some category that the object of value belongs to.[1]

This is a good pen.

She is a better pianist than her sister.

Here, an object is compared to the standards for a specified category that it belongs to. Since one and the same object may belong to several such categories, its evaluation may differ according to which category has been chosen:

She is a good engineer but a bad mother.

A major difference between the two types of specification is that viewpoint-specification indicates an evaluation according to a single dimension, such as ethics, aesthetics etc.[2] In contrast, category-specification indicates in most cases that several criteria, constituting the standards for the category in question, are being used. The list of your criteria for a good car, a good camera or a good teacher may be quite long. Probably it is also unfinished. Most people would not spontaneously include "does not leak toxic substances" on their list of criteria for a good camera, but if they encountered leaking cameras they would probably add this property to their list.

[1] The two types of specification are not mutually exclusive. The following value statement is specified in both ways: "She is a morally good banker." In this and similar examples, viewpoint-specification seems to dominate over categorical specification. Our morally good banker has to be (1) morally good and (2) a banker, but it is not equally clear that she has to be (3) a good banker.

[2] Each of these can of course be constructed as multi-dimensional. However, when viewpoint-specification is used, they are treated as one-dimensional.

Category-specified value statements have not received much attention in philosophical value theory, although a large proportion of the value statements that we actually make are category-specified.[3] In the philosophy of technology, category-specified value statements are particularly important, due to the central role that they have in evaluative discourse on technology and technological artifacts. When we say that one car is better than another, we use our full sets of standards for cars. Maarten Franssen (2002) convincingly shows how the theory of the dual nature of technological objects (Kroes and Meijers 2002) can be used to clarify this usage. The objects of comparison (in this case the two cars) are physical objects, but the comparison is made in terms of a functional category to which they both belong, namely the category of cars. Many if not most value statements about technology have this form, i.e. the objects of evaluation are specified as physical objects, whereas the criteria of evaluation are specified as a functional category of technological artifacts. The use of functional categories for value-specification is a central feature in evaluative and normatiave discourse on technology.

The purpose of the present presentation is to introduce a couple of fundamental issues in the theory of category-specified value statements. The treatment of these issues will be cursory, and all of them are worth a more thorough treatment than the one that I will offer here.

2. What categories can be used to specify value statements?

The range of categories that can be used for specifying value statements is surprisingly wide. We can talk about good chairs, bad priests, good hammers,

[3] Many unspecified value statements are best understood as implicitly category-specified. Our example above is a case in point. When we say that a decision is good, we typically mean that it is good *qua* decision.

excellent figs, and bad computer programs. However, there are at least two types of categories that cannot so easily be used to specify values.

The first type are the *unambiguously negative categories*. These are categories that have a standard or "ideal type" that we never want to see realized. A person who is good at killing other persons would not be called a "good murderer". Neither would we talk about a "good murder weapon", and if phrases like "a good accident" or "a good mistake" are heard, there are strong reasons to suspect equivocation. However, it is only positive evaluations that are excluded for this type of categories. Negative evaluations are fairly unproblematic; we may for instance speak of the worst murderer in the country or about a bad accident.[4]

A few technological terms belong to this group, i.e. they denote categories that we do not normally evaluate positively. The phrase "a good landmine" would not be used in civilized circles (but we have no difficult in understanding what war criminals and their accomplices mean if they use this phrase).[5]

The other type of categories that cannot be used to specify values are the *value-neutral* ones, those for which we have no standard at all. Franssen gives an excellent example: There are no good electrons, or bad electrons. Wild animals are another example. The farmer may have a good cow but the hedgehog in his farm is neither good nor bad, for the simple reason that we have not developed a standard for

[4] For words that denote unambiguously negative concepts, such as "murderer", "criminal", "accident", and "mistake" we use words on the negative side of the value scale to denote that an object conforms to a high degree with the criteria of meaning for the word in question. The worst murderer in the country satisfies the criteria for being a murderer to a very high degree, whereas the worst cook (or mayor, or policeman) satisfies the standard for their respective category to an unusually low degree. Similarly, bad mistakes and bad accidents satisfy the criteria for mistakes respectively accidents to a very high degree. This can be taken as a litmus test for a word to be unambiguously value-negative.

[5] In contrast, we would have no difficulty in saying that "a good screw" or "steel of excellent quality" was used in the landmine. These objects are then treated in isolation, and judged according to general criteria for their respective category.

hedgehogs. If we started to eat hedgehog meat, we would soon develop a standard for good and bad hedgehogs.

I have not been able to find a clear example of a technological category among the value-neutral ones. All the words that we use to denote categories of technological objects seem to be asociated with some standard that can be used to assess the objects in question. This applies not only to technological devices with specialized and well-defined uses, but also to objects that are intended for a wide variety of uses, such as planks and steel wire.

I propose, therefore, as an empirical hypothesis, that the categories that we use to specify technological objects are always associated, not only with (1) a definition for determining whether or not a particular physical object is included in that category, but also with (2) a standard or set of criteria that can be used to determine its quality as a specimen of the category in question. Hence, just as technological artifacts, technological concepts have a dual nature; they are associated both with criteria of inclusion and criteria of quality.

3. Functional categories?

Many but not all of the value-specifying categories are functional, i.e. they consist of objects that have a certain function in common. Most of the value-specifying categories that are used to assess technology are functional. Tools are a particularly clear example. It is the intended function of a tool, the way in which it is intended to be used, that determines which category of tools – hammer, screwdriver, etc. – it belongs to.

There are many design criteria for a technological object such as a hammer. We want it to be useful, cheap, aesthetically appealing etc. When we talk about its

function, only some of these criteria are included. How do we distinguish beween functional and non-functional characteristics?

Stan Godlovitch (1990) has proposed a defintion of functional superiority that can be used as a starting-point when trying to answer this question. His definition is as follows:

> "Any given tool O_2 is functionally superior to O_1 (F-superior for short) iff:
>
> (1) *Yield Condition*:
>
> O_2 yields intended results R at least to the same extent as O_1
>
> (2) *Facility Condition*
>
> O_2 is more facilitative of R than O_1
>
> (3) *Risk Condition*
>
> O_2 has no worse unintended results than O_1"

The term facilitative is intended to represent an open-ended disjunction "more cost-efficient or easier to use or less awkward to master or more efficient or…"

In my view, this definition is on the right track, but it needs some reworking. The first criterion (yield) is of course the central one. In order to specify what is meant by a hammer, and what is meant by a good hammer, we have to specify what a hammer is intended to be used for.

Godlovitch's second condition (facility) contains several components. One of these is the cost of the object. The inclusion of cost as a component of function is, however, quite contrary to common usage. It is more natural to say "This is a good hammer, but it is too expensive" than to say "This is not a good hammer since although it is excellent for driving nails it is too expensive". Another part of

Godlovitch's facility criterion, namely "easier to use or less awkward to master" is much more reasonable. It should be retained, but it can be made part of the yield condition.

The third criterion, absence of unintended effects, is clearly an important part of what we normally mean by technological function. As an example of this, a motor that vibrates too much is a malfunctioning motor even if it rotates at the speed required.[6] This criterion is open-ended, and its application will depend on what options are available. Hence, if somebody designed a hammer that never hits the thumb of its user, we would certainly regard it as better then the old-fashioned hammers that do not have a thumb-avoidance mechanism.

Summarizing this, I propose that we modify Godlovitch's criterion and define functional categories of technical objects in terms of (1) what the objects are supposed to do when operated on adequately (the positive criterion)[7], and (2) the absence of unintended effects (the negative criterion)[8].

As I just mentioned, technological concepts have a "dual nature"; they are associated with both criteria of inclusion and criteria of quality. In most cases, the negative conditions will have a larger role in determing the criteria of quality than in determining the criteria of inclusion. A leaking pen is still a pen, and a CD player that tends to explode is still a CD player, but they are certainly bad specimens of their respective category.

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[6] Maarten Franssen (2002) seems to disagree. He claims that a leaking pen, although it is a bad pen, is not a malfunctioning pen.
[7] This corresponds to Godlovitch's first condition and parts of his second condition.
[8] This corresponds to Godlovitch's third condition. His term "risk condition" is unfortunate since negative effects that are certain to appear should be included.

4. Categories and subcategories

The categories that we use to specify values can be more or less general. A compass saw is a saw, and a saw is a tool. A Mazda is a car, and a car is a motor vehicle. A heart surgeon is a surgeon, and a surgeon is a physician. An amateur flutist is a flutist, and a flutist is a musician. How do our evaluations in subcategories relate to our evaluations in the more general categories in which they are included? Is a good compass saw a good saw? Is a good amateur flutist a good flutist? In order to discuss this we need to clarify more precisely what is meant by a subcategory

To begin with, it is important to note that we are dealing with categories, not sets. Categories are intentionally defined.[9] A *subcategory* of a category C is a category C' such that any (actual or possible) object satisfying the criteria for inclusion in C' must also satisfy the inclusion-criteria for C. There are many ways to construct subcategories of, for instance, the category "saw". We have the subcategories "German saw", "cheap saw" etc. However, since "saw" is a functional category, a particularly interesting type of subcategories are those that specify the function more precisely than the original category. Given a functional definition of a saw, we can define "compass saw", "chainsaw" etc. by adding further specifications of its function. These are *functional subcategories*. In the same way, "surgeon" is a functional subcategory of "physician", and "flutist" a functional subcategory of "musician".[10]

[9] For each category C, there is a unique set that consists of all members of that category. This set can be denoted $|C|$. Hence, if C is the category of chainsaws, then $|C|$ is the set of all chainsaws. (There may be non-intentional ways to specify $|C|$, such as listing all its elements.)

[10] If a category is non-functional, i.e. not defined in terms of the functions of the elements it contains, then it has no functional subcategories.

I will use the notation $\mathfrak{Z}$ to denote subcategories and $\mathfrak{Z}_{\mathbf{f}}$ to denote functional subcategories, hence:

$\mathcal{A}\mathfrak{Z}\mathcal{B}$ $\mathcal{A}$ is a subcategory of $\mathcal{B}$.

$\mathcal{A}\mathfrak{Z}_{\mathbf{f}}\mathcal{B}$ $\mathcal{A}$ is a functional subcategory of $\mathcal{B}$.

The following value-theoretical inference pattern seems to hold for functional subcategories:

X is a good $\mathcal{A}$
$\mathcal{A}\mathfrak{Z}_{\mathbf{f}}\mathcal{B}$
$\therefore$ X is a good $\mathcal{B}$

For concreteness, let $\mathcal{A}$ denote "compass saw" and let $\mathcal{B}$ denote "saw". Or let them denote "zoologist" respectively "scientist". The corresponding relationship does not hold in general for non-functional subcategories, i.e. it does not hold in general if we replace $\mathfrak{Z}_{\mathbf{f}}$ by $\mathfrak{Z}$. A good cheap saw need not be a good saw.

Interestingly enough, the corresponding property does not hold at the other end of the value scale, i.e. the following property does not hold:

X is a bad $\mathcal{A}$
$\mathcal{A}\mathfrak{Z}_{\mathbf{f}}\mathcal{B}$
$\therefore$ X is a bad $\mathcal{B}$

A bad flutist may at the same time be a good harpist, and in that case she is not a bad musician. A multi-purpose saw may be a bad hack-saw but nevertheless a good saw since it is a good compass saw.

In conclusion, category-specified value statements are worth a careful investigation, both from an informal and a formalized (logical) point of view.[11] Technological value-statements provide an excellent starting-point for such investigations.

References

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H Moulin (1985) "Choice Functions Over a Finite Set: A Summary", *Social Choice and Welfare*, 2: 147-160.

[11] A well-developed theory is available for the relationships between evaluative statements that refer to different *sets*, namely the theory of choice functions. (For an excellent introduction, see Moulin 1985.) One example of the properties referred to in this theory is that if $A \subseteq B$, and x is both an element of A and one of the chosen (best) elements of B, then x is one of the chosen elements of A. The corresponding property does not hold for functional categories. Even if one of the world's best musician is a pianist, she may not be one of the world's best pianists. (She may be an outstanding violinist who doubles on the piano.)