

On the Lexicographical Definitions of Tool Nouns: from the Perspective of Qualia Structure

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ABSTRACT. This paper studies the importance of qualia relations for tool nouns' definitions. We collect 613 tool nouns from the Contemporary Chinese Dictionary (6th) and analyze their definitions from the perspective of qualia structure. The four qualia roles, TELIC, CONGTITUTIVE, FORMAL and AGENTIVE, ordered from the most to the least frequent, are all found in the definitions. This result is not hard to understand since tool nouns are typical artifactual types which contain concepts making reference to telic role (purpose or function). In addition, tools have different purposes which can distinguish them from each other. This new viewpoint reveals some problems in the definitions of tool nouns. This study will contribute to the compilation and revision of the Contemporary Chinese Dictionary.

Keywords: lexicographical definitions, tool noun, qualia Structure, Generative Lexicon

1. **Introduction.** There are many researches on lexicographical definitions, which cover a wide field, including the definition itself, classification, principles, requirements, meta-language of the dictionary definitions and sense demarcation. For instance, Fu [1] elaborates the definition pattern and how to discriminating the word senses of verbs, nouns

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and adjectives. Su [2] analyzes the principles and methods of the definitions in Chinese dictionaries and combines semantic components analysis with lexicographical definitions. Li [3] investigates the methods and procedures of the construction of the meta-language system in definition. More related works are done by Han [4], Sun [5], among others [6, 7].

Although there is considerable sum of researches with wide range, few have detailed discussion about certain subclass. On the other hand, we believe new lexical semantic theories should be applied in contemporary dictionary compilation so that they will throw much fresh light on this work. For this purpose, this paper tries to make a quantitative and qualitative analysis of the tool nouns' definitions based on the qualia structure, aiming to find out the frequent patterns and problems in these definitions.

The rest of this paper is structured as follows. Section 2 gives a brief introduction to the qualia structure. Next, section 3 demonstrates the qualia roles in the definitions of tool nouns. Subsequently, we point out three problems in definitions in section 4. Section 5 summarizes the paper.

2. Qualia Structure in Generative Lexicon. Qualia Structure proposed by Pustejovsky [8] is the most important component for representing the lexical semantics of a word sense in Generative Lexicon, which consists of four qualia roles [9, 10]:

- Constitutive role: The relation between an object and its constituents or proper parts; e.g. material, weight, parts and component elements;
- Formal role: That which distinguishes the object within a large domain; e.g. shape, color, orientation, magnitude, dimensionality and position;
- Telic role: purpose and function of the object; i.e. purpose that an agent has in performing the object and built-in function or aim which specifies certain activities.
- Agentive role: factors involved in the origin or “bringing about” of an object; e.g. creator, artifact, natural kind and causal chain.

Among these four qualia roles, telic role is the most noticeable one because it directly influences the construction of the semantic type system. According to Pustejovsky [11, 12], the domain of individuals can be structured into three, increasingly complex, conceptual types:

- Natural types: Natural kind concepts making reference only to Formal and Constitutive qualia roles; e.g. rock, water, woman, tiger and tree.
- Artifactual types: Concepts making reference to Telic (purpose or function), or Agentive (origin); e.g. knife, beer, husband and dancer.
- Complex types: Concepts making reference to a relation between at least two types from the other levels; e.g. book, lunch, university and temperature.

Given that qualia features capture how language speakers understand objects and relations in the world, it is not surprising to find them in sense definitions. Take “砂轮” [*shalun*] (*grinding wheels*) as an example.

(1) 砂轮: (~儿) 磨刀具和零件或切割金属和石材用的工具, 用磨料和胶结物质

混合后，在高温下烧结制成，多为轮状或片状。

[shalun: (~ er) modaoju he lingjian huo qiege jinshu he shicai yong de gongju, yong moliao he jiaojie wuzhi hunhe hou, zai gaowen xia shaojie zhicheng, duowei lunzhuang huo pianzhuang.]

(grinding wheels: A wheellike or flakelike tool used to sharpen cutters and parts or cut metals and stones, which is made by high sintering the abrasive materials and cementing materials together.)

In this definition, “磨料和胶结物质”[moliao he jiaojie wuzhi] (the abrasive materials and cementing materials) expresses the materials of grinding wheels, thus it is the constitutive role of “砂轮” [shalun] (grinding wheels). “在高温下烧结制成”[zai gaowen xia shaojie zhicheng] (made by high sintering) is the agentive role explaining how grinding wheels are produced. “轮状或片状” [lunzhuang huo pianzhuang] (wheellike or flakelike) is the formal role describing the shape of grinding wheels. “磨刀具和零件或切割金属和石材用” [modaoju he lingjian huo qiege jinshu he shicai yong](to sharpen cutters and parts or cut metals and stones) is the telic role specifying the multiple uses of grinding wheels.

As a consequence, using qualia structure to analyze the definitions of tool nouns could provide a perspective insight about dictionary definitions.

3. Qualia roles in the definitions of tool nouns. In a broad sense, *tool* denotes anything necessary for doing one’s job. In a narrow sense, it refers to any instrument or apparatus such as axe, hammer, etc., held in the hands for doing special jobs. We use this term in the narrow reading.

In general, there are two common defining ways in tool nouns’ definitions: one is definition with synonym and the other is analytic definition. The former will not be discussed in this paper because it does not show any qualia information. The later tries to identify the intension of a word by providing a synonymous linguistic expression. A genus–differentia definition is a type of analytic definition that takes a large category (i.e. the genus) and narrows it down to a smaller category by a distinguishing characteristic (i.e. the differentia) [13]. For example, consider the above definition of the “砂轮” [shalun] (grinding wheels). The category tool includes many members like *grinding wheel*, *knife* and *scissors*. It is a superordinate. In this definition, “工具” [gongju] (*tool*) is the genus to which all grinding wheels belong to and the rest part is the differentia that distinguishes *grinding wheels* from *knife* and *scissors*. Apparently, qualia roles only lie in the differentia, for it expresses features of one sense which are quite distinct from the features of other members.

According to the different position, differentiae can be divided into front differentia, which is located in front of genus, and posterior differentiae which follows genus. They have different functions. While front differentia is to modify the genus by describing some essential attributes of the thing denoted by the defined sense, posterior differentia is the supplemental explanation that fits other attributes, which are usually specific to this thing.

For example, in the definition of “剪刀” [jiandao] (scissor), “器具” [qiju] (apparatus) is the genus, a superordinate of [jiandao]. “使布、纸、绳等东西断开的” [shi bu, zhi, sheng deng dongxi duankai de] (used to cut things such as cloth, paper and string etc) and “铁制” [tiezhi] (made of iron) are front differentiae. “两刃交叉、可以开合” [liangren jiaocha, keyi kaihe] (Its two edges cross and can be opened and closed) is the posterior differentia.

(2) 剪刀: 使布、纸、绳等东西断开的铁制器具, 两刃交叉、可以开合。

(front differentia) (class word) (posterior differentia)

[jiandao: shi bu, zhi, sheng deng dongxi duankai de tiezhi qiju, liangren jiaocha, keyi kaihe.]

(scissor : An apparatus made of iron, used for cutting things such as cloth, paper and string etc. Its two edges cross and can be opened and closed.)

We only take account of tool nouns which are defined analytically and collect 613 nouns from Contemporary Chinese Dictionary (6th) as our data, which contains 653 senses indicating tools.

3.1. **Overview.** Table 1 shows the distribution of four qualia roles in front differentiae and posterior differentiae respectively.

TABLE 1: THE DISTRIBUTION OF FOUR QUALIA ROLES IN FRONT DIFFERENTIAE AND POSTERIOR DIFFERENTIAE

<i>Qualia Role</i>	<i>In front differentia</i>	<i>In posterior differentia</i>	<i>Total</i>
<i>Telic Role</i>	366 64.1%	140 27.2%	506 46.6%
<i>Constitutive Role</i>	106 18.6%	238 46.2%	344 31.7%
<i>Formal Role</i>	86 15.1%	116 22.5%	202 18.6%
<i>Agentive role</i>	13 2.2%	21 4.1%	34 3.1%
<i>Total</i>	571 100%	515 100%	1086 100%

As shown in table 1, there are 571 entries with front differentiae and 515 entries with posterior differentiae in 653 senses indicating tools. All four qualia roles could be found in the definitions of tool nouns, but with different proportions. Generally, the rank on the basis of percentage from high to low is telic role>constructive role>formal role >agentive role. The leading role in front differentiae and posterior differentiae is telic role and constitutive role respectively. The percentage of telic role in the front differentiae is 64.1% and that of constitutive role in the posterior differentiae is 46.2% The percentages of agentive role are extremely low both in front differentiae and posterior differentiae. It is not hard to understand that the percentage of telic role is the highest, especially in front differentiae since tool nouns are typical artifactual types which are defined mainly by telic roles. Tools are usually made for certain purposes. Tools have various functions so that they are certainly different from each other in function. Therefore, telic role is the best candidate

which can distinguish a tool noun from other ones. The construction is to better achieve the function, and that is why constructive role is also frequent in differentiae, especially in posterior differentiae. Formal role usually describes some visible features of tools like shape, size and so on. Compared with other qualia, agentive role has a low percentage in the definition because how tools are made has little to do with their taxonomy.

Actually, one definition may contain more than one qualia roles. Considering (1) above, there are four qualia roles in the definition of “砂轮” [shalun]. From table 2 we can see that 51 percent of definitions have two or more qualia roles. One-role pattern is the most frequent, accounting for 42.1 percent, closely followed by two-role pattern, accounting for 36.6 percent. Closer examination reveals that if there is only role in one definition, it is most likely to be telic role. If there are two roles in one definition, they mostly are likely to be telic role and constitutive role. If it comes to be three, mostly they are telic role, constitutive role and formal role. This result is consistent with the rank above.

TABLE 2: QUALIA ROLES IN ONE DEFINITION

<i>The number of qualia roles in one definition</i>	<i>The number of definitions (senses)</i>	<i>Percent</i>
1	275	42.1%
2	239	36.6%
3	87	13.3%
4	7	1.1%
0	45	6.9%
<i>Total</i>	653	100%

3.2. **Four qualia roles in tool nouns’ definitions.** In this section, we will take a close look at the qualia roles in tool nouns’ definitions with examples.

Telic roles point out the specific purposes of tools. For instance, “筲箕” [shaoji] is used to wash rice, vegetable etc.

(3) 筲箕: 淘米洗菜等用的竹器, 形状像簸箕。

(Specific purposes)

[shaoji: taomi xicai deng yong de zhuqi, xingzhuang xiang boji.]

(a bamboo ware used to wash rice, vegetable etc., looking like a dustpan.)

Constitutive roles mostly describe the parts and materials of tools, only a few of them describe tools’ weights or other objects constituted by the tool. Consider the following example “台秤” [taicheng] (platform scale) in (4), the constitutive role indicates it is made of metal and has a metallic plate as a part. In (5), “比犁轻巧” [bi li qingqiao] (lighter than plough) specifies the weight of “砵子” [huozi]. In (6), “装在钳床上” [zhuang zai qianchuang shang] (packed on fitter’s bench) shows that “台虎钳” [taihuqian] (bench screw) is a part of “钳床” [qianchuang] (fitter’s bench).

(4) 台秤: 图①秤的一种, 用金属制成, 底座上有承重的金属板。也叫磅秤。
(material) (part)

[taicheng: cheng de yizhong, yong jinshu zhicheng, dizuo shang you chengzhong de jinshuban. Ye jiao chengbang.]

(platform scale: A kind of scale, made of metal, with metallic plate on its pedestal.)

(5) 耢子: 图翻松土壤用的一种农具, 比犁轻巧, 多用于耕种, 也用来开沟播
(weight)

[huo zi: fansong turang yong de yizhong nongju, bi li qingqiao, duo yongyu gengzhong, ye yonglai kaigou bozhong.]

(a farm implement used to turn the soil, lighter than plough, mostly used in cultivating, also used in furrow sowing.)

(6) 台虎钳: 图钳工等用来固定工件的工具, 装在钳床上, 有较大的钳口, 用
(a part of parallel vice)

柄扳动螺丝杆旋紧。也叫台钳、老虎钳。

[taihuqian: qiangong deng yonglai guding gongjian de gongju, zhuangzai qianchuang shang, you jiaoda de qiankou, yong bing bandong luosigan xuanjin. Ye jiao taiqian, laohuqian.]

(bench screw: A tool used by bench worker to stabilize workpiece, packed on fitter's bench, with biggish vice jaw, tighten by using the lead screw. Also called bench clamp, vice.)

Formal roles describe the shape, size, length, diameter, width and smoothness and the like. In the example below, “形状像剪刀” [xingzhuang xiang jiandao] (shaped like scissors) illustrates the shape of “夹剪” [jiajian] and “头上较宽而平” [tou shang jiao kuan er ping] (with wide and flat top) describes its width and flatness. For the definition of “旋子” [xuanzi], “像盘而较大” [xiang pan er jiaoda] (looking like disk albeit larger) clarifies both the shape and size of “旋子” [xuanzi].

(7) 夹剪: 图夹取物件的工具, 用铁制成, 形状像剪刀, 但没有锋刃, 头上较
(shape) (width)

宽而平。

[jiajian: jiaqu wujian de gongju, yong tie zhicheng, xingzhuang xiang jiandao, dan meiyou fengren, tou shang jiao kuan er ping.]

(A tool used to pick up objects, made by iron, shaped like scissors, without blade, with wide and flat top.)

(8) 旋子: 图①一种金属器具, 像盘而较大, 通常用来做粉皮等。
(shape and size)

[xuanzi: yizhong jinshu qiju, xiang pan er jiaoda, tongchang yonglai zuo fenpi

deng.]

(A metallic appliance, looking like a disk and relatively larger, mostly used to make sheet jelly made from bean or sweet potato starch.)

There are clearly a few agentive roles describing the production of tools clearly in the definitions. For example, “编成” [biancheng] (woven) indicates “耨” [lao] is made by weaving cane or thorns plait.

(9) 耨: ① 图平整土地用的一种农具, 长方形, 用藤条或荆条编成。功用和
(production)

耙差不多, 通常在耙过以后用耨进一步平整土地, 弄碎图快。也叫耨或盖。

[lao: pingzheng tudi de yizhong nongju, changfangxing, yong tengtiao huo jingtiao biancheng. Gongyong he ba chabuduo, tongchang zai baguo yihou yong lao jinyibu pingzheng tudi, nongsui tukuai. Ye jiao mo huo gai.]

(A farm implement used to level soil, rectangle, woven by cane or thorns plait. Its function is similar to harrow, usually used for further land leveling after ba, cracking figure. Also called [mo] or [gai].)

Considering specific values contained in qualia roles, the application is the reason why a tool exists, so telic role is the basic characteristic. Constitutive role describes the components and the constituent of a tool, which pertains to the connotation of the tool term. Formal role describes the shape of a tool, which belongs to the tool's appearance. However, agentive roles are not so diverse and salient in the definitions. Most of them are verb phrases with quite general meanings, such as “制成” [zhi cheng] and “做成” [zuocheng], which mean ‘made of’. Moreover, agentive roles often go alongside with constitutive role, especially materials. A typical example is given in (10). Unlike “编成” [biancheng] (woven) in (9), in this case, “制成” [zhicheng] (made of) does not provide any specific information about how “笮子” [pazi] is made. Moreover, it occurs with the constitutive role, namely “竹子、铁丝等” [zhuzi、tiesi deng] (bamboo, wire, etc.). All in all, both low percentage and lack of diversity and independence show that agentive role is the least important qualia in the definitions of tool.

(10) 笮子: 图搂柴草用的工具, 有长柄, 一端有一排用竹子、铁丝等制成的弯钩。

[pazi: lou chaicao yong de gongju, you changbing, yiduan you yipai yong zhuzi, tiesi deng zhicheng de wangou.]

(A farm implement used to tick straw, having a long handle, with a hook at one end made of bamboo, wire, etc.)

3.3. Other contents in tool nouns' definitions. Besides qualia roles, definitions of tool nouns also contain some other information such as how, by whom, and under what circumstances a tool is used and how it works. The underlined part in the examples below specifies the user, situation, direction for use and basic principle respectively.

(11) 试电笔: 检测电源相线是否带电或电气设备是否漏电的工具, 形状像自来水笔, 笔尖接触电源相线或电气设备上一点, 并使试电笔和人体形成一个回路, 如小灯泡亮了, 就证明其带电或漏电。也叫电笔。

(direction for use)

[shidianbi: jiance dianyuan xiangxian shifou daidian huo dianqi shebei shifou loudian de gongju, xingzhuang xiang zilaishuibi, bijian jiechu dianyuan xiangxian huo dianqi shebei shang yidian, bing shi shidianbi he renti xingcheng yige huilu, ru xiaodengpao liang le, jiu zhengming qi daidian huo loudian. Ye jiao dianbi.]

(test pencil: A kind of tool used to check if the position of powerline and electrical equipment is electric leakage, looks like a fountain pen, contact the top of the pen with a point of the power line or the electrical equipment, forming a loop, if the bulb lights, it proves the leakage. Also called [dian bi].)

(12) 拐: 下肢患病或有残疾的人走路拄的棍子, 上端有短横木便于放在腋下

(user)

下拄着走。

[guai: xiazhi huanbing huo you canji de ren zoulu zhude gunzi, shangduan you duan hengmu bianyu fangzai yexia zhu zhe zou.]

(walking stick: A stick used by someone whose lower limbs are disable, with a short bar on the top for convenience.)

(13) 抿子: 妇女梳头时抹油等用的刷子。也叫篦子。

(situation)

[minzi: funv shutou shi moyou deng yongde shuazi. Ye jiao minzi.]

(a kind of brush used by women to smear oil on the hair. Also called [min zi]).

(14) 复印机: 利用某些导体对光有敏感反应的特性和静电特性, 将文件、

(basic principle)

图片等照原样重印在纸上的机器。

[fuyinji: liyong mouxie daoti dui guang you mingan fanying de texing he jingdian texing, jiang wenjian, tupian deng zhao yuanyang chong yinzai zhishang de jiqi.]

(duplicating machine: A kind of machine utilizing the photosensitive characteristic of some conductor, reprinting files and pictures on the paper.)

Context of use is the most common, followed by methods of use. User and basic principle rarely appear. On the whole, these information is rarely found in the definitions of sense denoting hand tools, while it is very common in those denoting mechanic, apparatus, equipment and such like. Perhaps these tools are too complex to operate and this information can help readers to better understand them.

4. **Disadvantages in tool nouns' definitions.** From the view of qualia structure, we find out some disadvantages of tool nouns' definitions in Contemporary Chinese Dictionary (6th): underspecified qualia roles, absence of qualia roles and absence of important information in qualia roles.

4.1. **Underspecified qualia roles.** From the above analysis, we can conclude that telic role is the core role in tool nouns' definitions. However, some telic roles in differentiae are underspecified. In 653 definitions, there are 35 ones whose telic roles fail to clarify the specific uses of the tools. Look at the definition of “推子” [tuizi](clippers), although “理发工具” [lifa gongju] (a tool used for hairdressing) indicates hair clippers are used for hairdressing, it is too general to distinguish hair clippers from scissors, which can also be used to cut hair. In the other case of “唢呐” [suona], “管乐器” [guanyueqi] (wind instrument) implies that “唢呐” [suona] has one telic role *play*, but it is inherited from its hypernym “管乐器” [guanyueqi] (wind instrument). It is non-exclusive role of “唢呐” [suona] but shared by many other words like *piano* and *violin*. The definition of “推子” [tuizi] (clippers) can be improved by adding some statement like “用于剃光头、平头等发型” [yongyu ti guangtou, pingtou deng faxing] (mainly used in shaving heads, crew haircut, etc.), which can point out the specific use of “推子” [tuizi] (clippers).

(15) 推子: 图理发工具, 有上下重叠的两排带刃的齿儿, 使用时上面的一排齿儿左右移动, 把头发剪下来。使用电力的叫电推子。

[tuizi: lifa gongju, you shangxia chongdie de lianpai dai ren de chier, shiyong shi shangmian de yipai chier zuoyou yidong, ba toufa jianxialai. Shiyong dianli de jiao diantuizi.]

(clippers: A tool used for hairdressing, with two rows of overlapping blade teeth, the upper blade teeth shifts from left to right when it was used to clip the hair. It was called electrical hair cutter if it utilizes electrical power.)

(16) 唢呐: 图管乐器, 管身正面有七孔, 背面一孔。

[suona: guanyueqi, guanshen zhengmian you qikong, beimian yikong.]

(A kind of wind instrument, with 7 holes on the front of the pipe, one hole on the back.)

4.2. **Absence of qualia roles.** Although telic roles are the most important for tool nouns, constitutive roles and formal roles should not be ignored. Nowadays, with the rapid development of society, there are more and more tools with various materials and different shapes. Not all the related information can be listed in the tool nouns' definitions, but main materials and shapes could be stated to make tool nouns' definitions more clear. In the following cases of “稿” [gao] and “夹子” [jiazi] (clamp), only telic role appears, it would be better to add constitutive role or formal role, as shown in (18') and (19').

(18) 稿: 图刨土用的工具: 鹤嘴稿|一把稿。

[gao: paotu yong de gongju: hezuigao/yi ba gao.]

(A kind of tool used to dig the soil.)

(19) 夹子: 图夹东西的器具: 头发夹子|讲义夹子|把文件放在夹子里。

[jiazi: jia dongxi de qiju: toufa jiazi/jiangyi jiazi/ ba wenjian fangzai jiazi li.]

(clamp: A kind of appliance used for clamping stuff.)

(18') 稿: 图刨土用的工具, 一般由木制的柄和金属镐头制成: 鹤嘴稿|一把稿。

[gao: paotu yongde gongju ,yiban you muzhi de bing he jinshu gaotou zhicheng: hezuigao/yi ba gao.]

(A kind of tool used to dig the soil, generally composed of a wooden handle and metal pickaxe.)

(19') 夹子: 图夹东西的器具, 种类多样, 材料有塑料的、不锈钢的、木制的等: 头发夹子|讲义夹子|把文件放在夹子里。

[jiazi: jia dongxi de qiju, zhonglei duoyang, cailiao you suliao de、buxiugang de、muzhi de deng: toufa jiazi/jiangyi jiazi/ba wenjian fangzai jiazi li.]

(clamp: A kind of appliance used to clip things, made by plastic, stainless steel and wood etc.)

4.3. **Absence of important information in qualia roles.** As mentioned in section 3.3, qualia roles in tool nouns' definitions contain various values. However, some important characteristics have been omitted out in a few cases, which confuses readers. In the case of “瓢” [piao], bottle gourd and wood are the traditional material of gourd ladle. In modern society, it is mainly made of stainless steel and plastic, but this information is absent in the definition.

(22) 瓢: (~儿) 图用来舀水或撮取面粉等的器具, 多用对半剖开的匏瓜做成, 也有用木头挖成的。

[piao: yonglai yaoshui huo cuoqu mianfen deng de qiju, duoyong duiban poukai de paogua zuocheng, ye you yong mutou wacheng.]

(A kind of appliance used to scoop water or flour, mostly made by semi-cutaway bottle gourd, some made by wood.)

5. **Summary.** In terms of qualia structure, we investigate the qualia role in tool nouns' definitions. It turns out that all four qualia roles exist in the definitions, but they have different frequencies of occurrence. The rank, based on the percentage from high to low, is telic role>constitutive role>formal role>agentive role. Telic role is the highest in the ranking for two reasons. Firstly, tool nouns are typical artifactual type in which telic roles are indispensable. In addition, tools have different purposes (e.g. to cut, to hit, to clip) distinguish them from each other. Although agentive roles are also type-defined

information for artifactual types, they are usually general so that they have little impact on taxonomy. More than half definitions contain two or more qualia roles. Apart from qualia roles, more additional information is provided to clarify how, by whom, and under what circumstances a tool is used and how it works.

In short, qualia structure provides a wide view and a new angle to the study of lexicographical definitions. This special perspective reveals that tool nouns' definitions can be improved in three aspects. On the other hand, this work can help us better understand artifactual types and the different roles of four qualia features in taxonomy.

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