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Antonella Valeria Penati *Editor*

In-Home Medication

Integrating Multidisciplinary Perspectives in Design-Driven Pharma Practices

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Research for Development

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In-Home Medication

Integrating Multidisciplinary Perspectives in Design-Driven Pharma Practices

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Chapter 21
Sensory Qualities of the Medicines: From Problems to Proposals

Dina Riccò

Abstract The text reviews the studies conducted on the sensory qualities of the medicines. It considers the medicine as a product, therefore as a project object of which to examine its tertiary qualities—the experienced object and therefore evaluates its visual (e.g., colour, shape, etc.), gustatory (e.g., bitter, sweet, pleasant, unpleasant, etc.), the qualities of the surface (e.g., smooth, rough, etc.), its consistency, etc., together with the connotations that these induce, noting the problems, the recognition in visual impairment and the incidence that these have on adherence to treatment and correct intake. Compare the sensory characteristics of the medicine with the formal/chromatic characteristics of the tablets in pharmaceutical production. It concludes by noting how the research carried out on the sensory characteristics the medicines is limited to studying these characteristics separately, not considering the interaction between them and the perceptual hierarchies, the prevalence that one can hold over the others. Very few studies address the issue of accessibility for people with sensory disabilities, the latter are addressed in the medicine packages by providing Braille text, but no indication allows communication and discrimination of the tablet for people with visual impairments.

21.1 Sensory Properties of Artifacts: Affordances and Proximity of Use

The concept of *affordance*, which Gibson introduced by referring to the studies of Gestalt psychologists, Koffka and Lewin in particular,[1] assumes that given properties of an object (such as shape, size, weight, texture, etc.) or an environment (sound

[1] Gibson (1999, pp. 221–222) coined the term affordance referring to the term *Aufforderungschrakter*, coined by Kurt Lewin, understood, and translated by some scholars as "character of invitation" (by

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fields, smell fields, etc.) become such only when they are perceived by a subject. An *affordance*, writes Gibson, is "at the same time an environmental fact and a behavioral fact. It is both physical and psychic" (Gibson 1986). Therefore, the *affordances*, and with them we could say more generically the sensory characteristics of the artefacts, since they are not proper to either the object or the individual, take place only in the interaction, in the relationship that is established between the individual and his environment. It is not so much the individual sensory characteristics, their recognizability and identification, that define these relationships and suggest their possible interactions, but rather a specific combination of them, as Gibson says, an affordance "is an invariant combination of variables" (Gibson 1986).

The sensory relationships that can be defined with the artefacts are first and foremost linked to the physiological limits of each perceptive system. A limited distance of use allows an artifact to solicit a sensory quantity/quality which, for obvious reasons related to the range of receptive capacities of our senses, are not possible for large distances. Therefore, already the mere definition of the *degree of proximity* of use necessary for an artifact, allows the designer to determine specific levels of involvement of the senses and which of these to privilege.[2]

Already in the sixteenth century, the physician and mathematician Gerolamo Cardano had formulated a classification of the senses which, precisely starting from the distance of objects from a perceiving subject, specifies three categories of objects: *distant objects*, *external close objects* and *internal close objects* to the body (Riccò 1999, pp. 32 et seq.).

In this context, drugs—like foods, with which we find great affinities in terms of possible sensory involvement and even with a different hedonistic purpose—can be classified as *close internal objects* that enter the body and which, considering the classification of artifacts in relation to the degree of proximity and the level of sensory involvement, we can include *pseudoscopic artifacts*, i.e. artifacts in which the visual component is active before use, while during use other sensations, such as tactile, proprioceptive, gustatory, become prevalent (Riccò 1999). In the following we will dwell on this passage in which the visual observation with its characteristics acts—taking an expression from Ulric Neisser—as a *perceptive anticipation* for other modalities, that is, it activates the formation of mental images that precede the perception of the object in all its characters.[3] This is what happens when we are in

Brown, in 1929) and by others as "valence" (by Adams, in 1931). It is the latter term that entered general use to mean a phenomenal fact conferred on the object by experience (Riccò 2004).

[2] The reference is to the studies on proxemics by the American anthropologist E. T. Hall (1966).

[3] Thus Neisser writes: "Imagining is not perceiving, but images are essentially derivatives of perceptive activity, in particular, they are *anticipatory phases* of this activity, schemes that the perceiver has detached from the perceptive cycle for other purposes". And again: "Our perceptual anticipations are so fully integrated that things can feel hard or rough or heavy (even if the definitive information about these properties comes from touch) and their greatness can be grasped (even if experiments have proved that in case of conflict the decisive information about size and position is usually of a visual nature). The perception of objects and events is the fundamental process, and it employs whatever information is available" (Neisser 1976, pp. 137 and 150, It. Ed.).

front of a food and we are preparing to taste it, to anticipate it, with the eyes even before the mouth, as chefs well know.

21.2 Sensory Aspects of Drugs and Adherence to Treatments

Colour and shape of medicines have clinically relevant effects, i.e. they can condition adherence to treatment (the *compliance*) (More and Srivastava 2009). A study performed by Kesselheim et al. (2014) at Harvard Medical School to detect tablet drug taking habits—conducted in the United States on more than 10,000 patients hospitalized between 2006 and 2011 following a heart attack—found that when refilling a prescription for drugs, in that case statins and beta-blockers, the pills of the generic equivalent drug change shape or colour, the probability that you stop taking it increases significantly: 34% when it is the colour that has changed and even 66% when it changes it is pill shape. This does not explain all the reasons for non-adherence to treatment—the researchers argue—but certainly these data are statistically and clinically significant.

The study concludes by inviting the FDA (Food and Drug Administration) to request the production of generic drugs that are also perceptually similar to the original brand drugs, inviting doctors to inform patients about the potential changes in shape and colour of the pills, reassuring them that that even if they are different in colour and shape, the drugs work in the same way.

21.2.1 Influence of Colour

There are numerous studies conducted on the effects produced by the colours of drugs (see the extensive review by Tao 2018) and testify how these can influence correct identification and adherence to treatments. Colour assumes particular importance for the correct discrimination of the drug when the drugs are small, therefore difficult to discriminate due to their shape, and for patients with impaired cognitive and memory functions.

We also consider that colour is processed in a pre-attentive perceptual phase, leading to automatic executions, therefore correct design assumes great importance.

However, in the large number of research, data and studies are not available, as far as we know, which quantify and justify the percentages of tablets that pharmaceutical companies produce in different colours. What are the most and least produced colours in the tablets? What colours do patients prefer? Are there differences between adults and children? An attempt has therefore been made here to collect and compare these data. By searching Drugs.com's *Pill Identifier*—a database that queries over 24,000 drug pills—we can detect the colour and shape prevalence of pills manufactured by the US pharmaceutical industry (we have not found an equivalent system relating to the distribution of European medicines).

Below we indicate the absolute numbers (of which we have calculated the percentages) of the data collected (Table 21.1).

The "Pill identifier" tool does not specify the range of colours included for each colour name—namely, we know that the name "red colour" includes different gradations of colour—moreover it does not specify the method used for the classification, namely whether the operators of the classification are being trained.

Added to this is a technical difficulty due to the display devices: on the screen, in print or live in a different environmental context we will have a different colour rendition. However, consulting the tool it is evident that a wide range of gradations have been inserted in the same colour name (Figs. 21.1 and 21.2) intends to exemplify the extremes of colour for each category.

Despite all the limits that this comparison can give us, the data still appear to be extremely interesting. Beyond the clear dominance of white pills (41.63%, which together with Beige and Yellow pills exceed 50%), one wonders: is there a reason that justifies the extremely low number of dark pills?

Adding up the Black (33) and Maroon (75) pills, we arrive at only 0.4% of the total pills. This data appears to contradict some studies in which users perceive black coloured pills as highly effective drugs. According to a study by Tao et al. (2018)—on a sample of 224 Chinese participants who were asked about the expected

Table 21.1 The table indicates the distribution of pills in relation to the colour in distribution in the pharmaceutical market in the United States

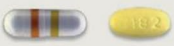
Pill color	Absolute number	% number
White	11,078	41.63%
Yellow	3348	12.58%
Blue (include turquoise)	2360	8.86%
Pink	2252	8.46%
Orange	1906	7.16%
Green	1536	5.77%
Brown	876	3.29%
Red	847	3.18%
Purple	648	2.43%
Peach	561	2.10%
Beige	413	1.55%
Gray	327	1.22%
Tan	169	0.63%
Clear (capsules with transparency)	145	0.54%
Maroon	75	0.28%
Gold	34	0.12%
Black	33	0.12%
Total	26,608	

The data was obtained by querying the "Pill identifier" of Drugs.com (data updated to March 5, 2023). The website claims to use a database with over 24,000 pills, without stating the exact absolute number. It should be considered that the absolute numbers relating to each colour include both single-coloured pills and two-coloured pills

White and neutral color

Pill color	Images	Absolute number
White		11078
Gray		327
Clear (capsules with transparency)		145
Total		**11550**

Yellow and gold

Pill color	Images	Absolute number
Yellow		3348
Gold		34
Total		**3382**

Light pastel colors

Pill color	Images	Absolute number
Beige		413
Orange		1906
Peach		561
Tan		169
Total		**3049**

Fig. 21.1 The figure exemplifies the pill colour categories listed in Table 21.1. The colour categories are grouped by similarity, thus defining six combinations of colours, ordered from lightest to darkest: White and neutral colours, Yellow and Gold, Light pastel colours, Saturated and cold colours, Saturated and warm colours, Black and Maroon

Saturated and cold colors

Pill color	Images	Absolute number
Blue (includes turquoise)		2360
Green		1536
Total		**3896**

Saturated and warm colors

Pill color	Images	Absolute number
Pink		2252
Purple		648
Red		847
Brown		876
Total		**4623**

Black and maroon

Pill color	Images	Absolute number
Black (also bicolor with black)		33
Maroon		75
Total		**108**

Fig. 21.1 (continued)

efficacy of pills of different colours—red and black were the first colours (Fig. 21.2). Similar results had previously been reported by Sallis and Buckalew (1984).

This apparent contradiction—between the small number of black medicines and the high efficacy perceived by users—could be explained by considering the underestimation of the influence of colour by pharmaceutical companies.

In fact, the reasons that lead to the attribution of a given colour to the pills are of a different nature, among which we indicate the following:[4]

[4] See: "The colouration of tablets and capsules", by Paul Smith (2004) from Sensient Pharmaceutical Technologies, a leading global manufacturer and marketer of colours, flavors, and other specialty ingredients, which develops specialized solutions also for pharmaceutical industries (https://www.manufacturingchemist.com/news/article_page/The_colouration_of_tablets_and_capsules/34905; https://www.sensient.com/). This diversification of functions only considers the colour component.

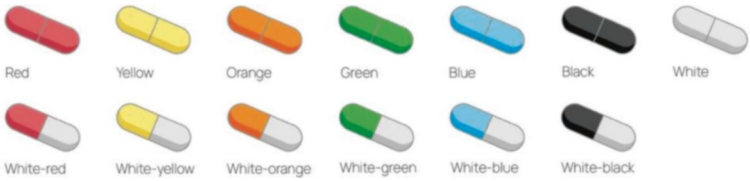


Fig. 21.2 The figure represents the 13 coloured capsules examined by Tao et al. (2018)

Table 21.2 Comparison of perceived therapeutic effects of coloured drugs for five population groups by Tao et al. (2016)

	Population Group				
Color	Chinese	Italian	White American	Black American	General American
Red	Stimulant	Stimulant	NA	NA	Stimulant
Yellow	Hallucinogenic	Stimulant	Stimulant	Hallucinogenic	Stimulant
Orange	Analgesic	Stimulant	Stimulant	Stimulant	NA
Green	Depressant	Depressant	Analgesic	Depressant	/
Blue	Depressant	Depressant	Depressant	/	Depressant
White	Depressant	Depressant	Analgesic	Stimulant	/
Black	Hallucinogenic	NA	Stimulant	Analgesic	/

Data for Italian from Sebellico (1989)
NA: data were not available

- Identification. Colour can help patients and pharmacists recognize different dosages of a drug;
- Flavour perception. The expectation in the perception of the taste of a tablet can be modified with the colour (for example from a red tablet I expect a cherry taste, and vice versa);
- Brand identification. It allows the manufacturer to stand out and be characterized in a highly competitive market;
- Quality perception. Colour can be used to add aesthetic value and with it characterize the perception of quality;
- Counterfeit prevention. Unique colour development, coupled with full colour printing, helps reduce the risk of drug counterfeiting.

The chromatic choices of pharmaceutical companies evidently consider other factors as priorities, underestimating the importance that these cover in the perception of use by patients (Table 21.2).

As Spence (2021) points out, sometimes it becomes a priority for the pharmaceutical company to define colour to support the personality of the brand or avoid counterfeiting, and not to encourage correct identification or adherence to treatment on the part of the patient.

Other aspects of interest to consider in the applications of colour—but which we have not found to be applied in pill drugs—are the *colour codes* which allow to

facilitate discrimination and avoid errors. They are applied for example in the drugs used during anaesthesia,[5] and in the topical ophthalmic medications.[6]

21.2.2 Influence of Shape and Size

The same "Pill identifier" tool indicated above allows us to query the database, also in relation to the shape of the pill. There are 18 categories of shapes, as shown in the Table 21.3. As could be expected, the Capsule/Oval and Round category are largely dominant, while the other shapes are secondary and, together, represent only 4.2% of the total. However, it is interesting to note the variety of pills: polygons with different number of sides, characterized by angularity or roundness, with symbolic shapes, and also the attempt to design affordances that suggest and favor divisibility, as is the case with the shape Fig. 21.3—"8 shaped".

Shape and size of pills are less studied than colour, we have a limited number of studies in this regard, Spence (2021) summarizes the current state of knowledge well. Different product forms and methods of administration constitute different degrees of desirability and efficacy for patients. Not only if we compare methods of different invasiveness—injections versus oral administration—but also within the same mode of administration: pills of different shapes are evaluated differently by patients.

Shape A study conducted by Hussain (1972, in Spence 2021) found that the shape in which a drug is presented can influence the outcome of the treatment. The study conducted with 44 outpatients treated for anxiety found better efficacy of the drug when presented in capsule form, instead of tablets. Other studies confirm that patients find capsules stronger than tablets (Buckalew and Coffield 1982, in Spence 2021).

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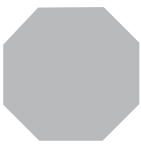
[5] See: BS EN ISO 26825 (2022): "Tracked Changes. Anaesthetic and respiratory equipment. User-applied labels for syringes containing drugs used during anaesthesia. Colours, design and performance".

[6] See: *Guidance for Industry. Container Closure Systems for Packaging Human Drugs and Biologics* (1999, p. 27).

Regarding topical ophthalmic medications, the colour coding of the pharmaceutical classes recommended by the AAO (American Academy of Ophthalmology) are presented using the pharmaceutical class, the colour name, and the Pantone Code Number, as follows:

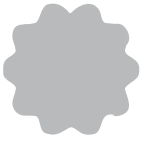
- Anti-Infectives/Tan (467);
- Anti-Inflammatories-Steroids/Pink (197, 212);
- Mydriatics and Cycloplegics/Red (485C);
- Nonsteroidal Anti-Inflammatories/Gray (4C);
- Miotics/Green (374, 362, 348);
- Beta-Blockers/Yellow or Blue, Yellow C (290, 281a);
- Adrenergic Agonists (e.g., Propine)/Purple (2583);
- Carbonic Anhydrase Inhibitors/Orange (1585);
- Prostaglandin Analogues/Turquoise (326C).

Table 21.3 The table indicates the distribution of the pills—in distribution in the pharmaceutical market of the United States—in relation to their shape

Shape		Absolute number	% number
	Capsule	14,586	52.51%
	Oval		
	Round	12,007	43.22%
	4 sided	265	0.95%
	Rectangle	234	0.84%
	3 sided	186	0.66%
	5 sided	120	0.43%
	6 sided	103	0.37%
	Egg	82	0.29%
	8 sided	59	0.21%
	U shaped	57	0.20%

(continued)

Table 21.3 (continued)

Shape		Absolute number	% number
	8 shaped	31	0.11%
	Barrel	25	0.09%
	Character	6	0.02%
	Heart	6	0.02%
	7 sided	4	0.01%
	Kidney	3	0.01%
	Gear	2	0.007%
	Total	**27,776**	

The data was obtained by querying the "Pill identifier" of Drugs.com (data updated to March 5, 2023).[a] The website claims to use a database with over 24,000 pills, without stating the exact absolute number. It should be considered that the search for Capsule and Oval, while representing two different categories, return the same number of drugs

[a]The Drugs.com Drug Database contains over 24,000 drugs, including both prescription and non-prescription drugs. The sources of information, as stated on the site, are supplied by various independent suppliers such as: *American Society of Health-System Pharmacists, Cerner Multum* and *IBM Watson Micromedex*. Individual drug (or drug-class) content compiled by these sources is peer reviewed and delivered by Drugs.com. See: https://www.drugs.com/pill_identification.html

Angular vs. Curvy Diamond-shaped pills are perceived to be more difficult to swallow than round or oval pills (Wan et al. 2015). Three studies conducted by Blazhenkova and Dogerlioglu-Demir (2020) using three different types of stimuli—abstract drawn shapes (Fig. 21.3), 3D-printed mockup pills and photographs of the existing pills—reveal that angularity is associated with an energizing effect, while the roundness to a calming effect (Fig. 21.3). Furthermore, the congruence between the design of the pill and the expected benefit of taking the drug increases the perception of efficacy.

Size The size of the pills is obviously very important to facilitate swallowing. The active ingredient in a pill constitutes only a small percentage of its total, this allows pharmaceutical industries to define the size in relation to other factors (e.g., brand or acceptability), but the choice is strongly influenced by the ease of swallowing perceived by patients. In fact, many attempts to scale up generics have been rejected for that very reason (Spence 2021).

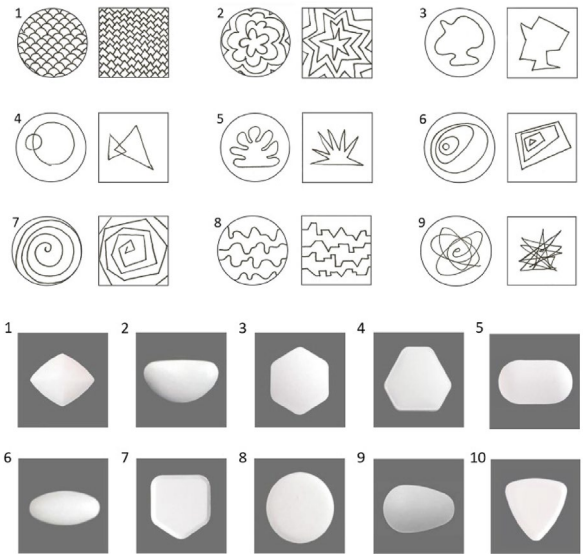


Fig. 21.3 Above: Angular vs. curved drawn pill stimuli; below angular vs. curved photograph pill stimuli used in study 1 and 3 of Blazhenkova and Dogerlioglu-Demir (2020)

In all of the correspondences reported above between the characteristics of the shape and the expected efficacy, two factors must be considered: on the one hand, the studies were carried out over a very long period of time, from 1970 to today, which means that the same experiment proposed 50 years later it could give different results because the consumer experience is different; and at the same time the perceived character/effect association can be the result of learning, of the experience acquired through use (Spence 2021).

The pills are distributed in a container and this also affects the use. Changes in the format of the packaging, or making it more difficult to open the package, have been shown to affect the amount of pills ingested, in particular it has been shown that just changing the format of the container –from the bottle to the single blister— have reduced the incidence of people who attempt suicide with analgesic overdose (Chan 2000). For this reason, legislation was introduced in the UK (in 1998) to limit the size of packs of over-the-counter analgesics (Hawton et al. 2004).

Overall, the associative factors specific to the shape and distribution formats of the drug appear to be perceived as more constant and universal than those of colour.

21.2.3 Influence of Flavour

Drugs with a more pleasant taste can improve adherence, especially in children, to drug therapy. More than 90% of pediatricians report that the greatest barriers to completing treatment are their own taste and palatability (Milne and Bruss 2008, in Mennella et al. 2013). Many active ingredients of drugs have a bitter taste, which is why they are unwelcome to adults and to children who are more sensitive to the bitter taste, this creates compliance problems for both. An effective method to avoid the unpleasant taste is encapsulation, which however cannot be applied for children before the age of 6–8, when liquid formulations are needed. Another possibility is the application of flavor masking techniques: sugars, acids, salt, and other substances reduce the perception of bitterness (Mennella et al. 2013). The addition of sucrose, sweeteners, flavourings, acids to medicines reduce, but do not eliminate the bitterness of medicines, furthermore sweeteners create other problems (e.g., dental caries).

In addition to taste, other sensory attributes contribute to compliance, such as consistency, acidity, or bad smell. People speak of taste actually meaning the *flavor* which is instead composed of a perceptive integration, therefore of a set of gustatory, olfactory and trigeminal sensory characteristics (Mennella et al. 2013). The visceral system is also involved if we consider that the ingestion of bitter compounds can act in the intestine and cause nausea, or salivation triggered by some acids (e.g., lemon).

As is the case with food, pharmaceutical companies also apply sensory analysis methods to evaluate and improve the aromatic-gustatory profile of their products, above all to limit the bitter taste, particularly when the drugs are aimed at children.

Compared to studies of sensory analysis of food, the sensory analysis of drugs collides with the difficulty of recruiting panelists, with the risks of drug toxicity,

with the difficulty of quantitative measurement.[7] The detection of the subject's behavior and the subject's facial expression are among the most used methods. We point out the interesting study conducted by Hofmanová et al. (2020), in which researchers recorded negative facial expressions (e.g., pursed lips, wrinkled nose, disgusted voice, lowered eyebrows and head snake) to gauge aversion to a pill. The study evaluated the acceptability of 7.5 mm round tablets with five different coatings in both children and adults. However, the ability to swallow tablets was independent of the coating applied. Instead, other correlations were observed, in particular:

- the more bitter the tablet, the less liked;
- the more unpleasant the aftertaste, the less liked;
- the smoother the tablet, the more slippery;
- the more bitter the tablet, the more unpleasant the aftertaste.

In summary, women are more sensitive to taste, and rated the tablets more bitter than men. Furthermore, although the palatability between adults and children was similar, children perceived the tablets as more bitter, smoother, less sticky, and less palatable than adults. In particular, the researchers note that there is a direct correlation between the palatability and aftertaste, smoothness, and slipperiness of the tablets. It is therefore necessary to analyse the palatability of the medicinal product as a multifactorial attribute, and not a simple hedonic factor (Hofmanová et al. 2020).

21.3 Medication Error Risk for Visually Impaired Population

Evaluation of the sensory qualities of drugs cannot exclude the necessary requirements for drugs for use by people with sensory impairments. Visually Impaired Population are particularly at higher risk for experiencing a medication error (Zhi-Han et al. 2017; Alhusein et al. 2018).

A study conducted by Ling Zhi-Han et al. (2017) identifies which are the main difficulties encountered in the self-administration of drugs concerning both the discrimination of the packaging and of the drug itself. The study was conducted on 100 subjects, including 62 blind and 38 visually impaired (with visual acuity <6/60; ≥3/60). According to the study, the greatest difficulties lie in the impossibility of differentiating the various types of pharmaceutical forms (tablets/capsules) and in forgetting to take them within the prescribed times.

A study by Alhusein et al. (2018)—which it believes to be the first to address the pharmaceutical care needs of older people with sensory impairment—reports that

[7] Mennella et al. (2013) indicate among the types of psychophysical tools used to assess bitter taste and medication palatability in pediatric populations: Facial reactivity, Brief-access tests, Suckling response, Suprathreshold taste thresholds, Scaling methods.

medicines are difficult to identify, particularly when they change their name, shape or colour.

McCann et al. (2012) reports that almost 30% of the visual impairment subjects interviewed (BCVA 6/18 to 3/60) needed daily help to take the prescribed drugs, even using optical aids, with difficulty distinguishing the drugs and difficulty in opening packages. The knowledge we have on medication self-management in people with visual impairment, compared with sighted peers (BCVA 6/9 or better), is limited.

The conclusions are evident: greater attention is needed by researchers to detect the specific needs of people with sensory disabilities, and at the same time greater attention also by pharmaceutical companies to the requirements necessary for drugs to avoid errors in taking them by of visually impaired people. The characteristics that we have indicated above are mainly visual, they concern the colour, the shape intervenes as a discriminant only to a limited extent, 52.51% of the pills are capsules or oval-shaped tablets, the incisions and signs of tactile discrimination are equally limited. For blind people, self-administration of medication carries a high risk of errors.

21.4 Conclusion

Despite the difficulty of defining generalizations, both for technical reasons and for gender and cultural differences (Tao et al. 2018), many studies demonstrate the influence that colour exerts on the expectation of efficacy of a drug, with important implications for adherence to treatment. We know that the study of colour—not only when applied to drugs—presents difficulties related to constancy, the phenomenological yield in relation to the devices, the print and screen in which it is represented, the names of the colours, the culture. In addition, many of the studies on the colour applied to drugs detect only the "name of the colour", therefore the tint, without specifying the colour composition.[8]

To the colour are added other perceptual characteristics that influence adherence to the treatment such as shape, size, texture, aroma (Tao et al. 2018) or that favor the error due to phonosymbolic factors of the name not congruent with the properties of the drug (Spence 2021), the so-called "Look-Alike/Sound-Alike" (LASA) drugs.[9]

Despite the multifactorial nature, most of the research carried out on the sensory characteristics of drugs is limited to studying these characteristics separately, not considering the interaction between them and the perceptual hierarchies, the prevalence that one can hold over the others. That is, as Spence (2021) points out, it is not

[8] An exception is the study by Tao (2016) which specifies the CMYK composition of the colours being tested.

[9] They are the drugs that can mislead and mistaken for phonetic, graphic or packaging similarity (https://www.salute.gov.it/portale/sicurezzaCure/dettaglioContenutiSicurezzaCure.jsp?lingua=italiano&id=2459&area=qualita&menu=sicurezzasicurezzaterapie).

currently clear which of the attributes of the product (colour, shape, sound symbolism, etc.) dominates in the coexistence of factors.

Charles Spence (2021)—head of the Crossmodal Research Laboratory at the University of Oxford—presented an extensive and up-to-date review of the literature related to the sensory qualities of drugs that we can only join in his call for a multifactorial approach that consider the perceptual complexity to reduce the cognitive dissonance between the patient's expectations and the properties of the drug, to reduce errors and illogical behaviors.

As Hofmanová et al. (2020) argues, there is also a need to analyze desirability as a multifactorial attribute rather than a simple hedonic parameter.

In summary, we must therefore consider that the information offered synchronously on different sensory registers interact, and not always in the expected or desired direction. In the presence of a perceptual "disagreement" the overall character of a piece of information is transformed and, at the same time, leads to the formation of hierarchies among the pieces of information, namely imposes the need to choose which of these to give priority to. In some conditions the visual, the colour or the shape may be prevalent, but the opposite can also happen. As Shams, Kamitani and Shimojo (2000, p. 788) write and demonstrate, it can happen that "you see is what you hear",[10] namely the visual perception of an event is influenced and marked by the characters of an audio event concomitant. An artifact can therefore change the characters and intentions that led to its *visual project*—amplifying or reducing the communicative effectiveness—also because of *non-visual* perceptive factors.

Finally, we note the insufficient attention to communicative accessibility, to allow the recognition of the drug to people with visual impairments. Very few studies address these aspects, if not applied to drug packages, by law in Italy provided with Braille text, but no indication allows communication and discrimination of the tablet for people with visual impairment.

The design of the totality of sensory qualities and their congruent relationships would allow addressing these aspects as well.

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[10] Shams; Kamitani; Shimojo (2000), describe a case, which they discovered, of sound-induced visual illusion: when a single visual flash is accompanied by multiple auditory beeps, the visual flash is not perceived correctly, but as a function of the number of acoustic beeps.

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