

## Chapter 2

# How Autistic Persons Understand Words (Cerebral Organization of Word Meaning and Autism)

Autists do not speak or when they speak, they repeat the same phrase many times meaninglessly. They say things that look nonsensical and irrelevant to others, because their utterances do not seem to have any connection to the situation in which they are voiced. Autists are unable to understand metaphors, irony, lies, and humor.<sup>1</sup>

Kanner and Asperger were the first to describe autism as a severe disorder of spontaneous speech. Yet it was Kanner who revealed metaphorical language in children with autism! And it was Asperger who emphasized that autistic children have a special creative attitude to language, a spontaneous way with words and can produce novel but particularly apt expressions.

To approach this paradox, we will discuss what areas are involved in word comprehension and these areas' specific functions that underlie internal representation of word meaning. After this discussion an attempt will be made at determining whether the autistic brain processes word meaning differently, and, if so, in which way cerebral organization of word meaning is different in people with autism. Would these differences account for the above contradictions about the speech of people with autism?

## 2.1 The *What* System and Its Major Player, BA37

Seemingly inseparable aspects of a word, sound and meaning, are processed and stored in two different areas of the cerebral cortex. This fact is demonstrated by the phenomenon of *double dissociation*: damage to the left superior–posterior area within the temporal lobe produces disorder of word sound, but not word meaning, whereas a lesion in the inferior–posterior area in the temporal lobe (bordering the occipital lobe) affects word meaning, but leaves word sound intact. In the historical development of the human brain, these two areas originated from different roots,

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<sup>1</sup> Multiple studies demonstrate this phenomenon.

auditory versus visual cortex. Thus, the region concerned with word meaning represents an evolutionary extension of the visual cortex. In the cortical map, this inferior–posterior area of the temporal lobe is designated BA37. BA37 is located between the visual occipital and auditory temporal areas. Anatomist Blinkov (1955) compared the brains of different species and established that, in the development of the human brain, the cortical zones, in which auditory and visual pathways terminate, move apart from each other, and the area between them enlarges.

Studying the primate visual system, Mishkin, Ungerleider, and Macko (1983) distinguished two cortical pathways: ventral and dorsal. The ventral visual pathway, which interconnects the occipital striate, prestriate, and inferior temporal areas, plays a crucial role in the visual identification of objects—the so-called *what* system. In the inferior temporal area, *form* is processed for the purpose of identifying the visual stimulus and assigning it with meaning (Mishkin et al., 1983). The inferior temporal region, considered a continuation of the visual system in primates, is homologous to BA37 in man. Using the terminology of the human cortical map, the visual ventral pathway can be delineated as a sequential flow of connections from the primary BA17, through the secondary BA18 and BA19, culminating in BA37. The tertiary cytoarchitectural field of BA37 projects to the tertiary areas within the prefrontal (BA46) and orbitofrontal (BA11) cortex.

BA37 is heterogeneous in structure. Its peripheral parts are transitional, retaining features similar to the bordering auditory and visual areas. Only the central, historically youngest part, the “nucleus” of BA37, is unique and specific to the human brain (Blinkov, 1938, 1955; Blinkov & Glezer, 1968). Considering the structural heterogeneity of BA37, containing both new and older phylogenetic formations, it has been proposed that the visual recognition of an object, a generic modality-specific function of the gnostic–praxic level, is connected with the posterior part of BA37,<sup>2</sup> whereas the human-specific “nucleus” of the field is connected with linguistic functions of the supramodal symbolic level (Glezerman, 1986; Glezerman & Balkoski, 1999). Recently, this hypothesis was supported by studies involving the new technique of transcranial magnetic stimulation (TMS). TMS can be applied to a small area in the brain, producing a transient and reversible “virtual lesion” in normal subjects and as such can support ideas about a given area being necessary for a particular type of processing. TMS applied over the posterior part of the left BA37 severely disrupted naming of everyday objects presented in pictures. The disorder induced by TMS was highly selective (Stewart, Meyer, Frith, & Rothwell, 2001).

Moore and Price’s (1999) imaging studies suggest the semantic subregion<sup>3</sup> of the left BA37 is positioned approximately 4 cm anterior to the subregion identified by the TMS study as important for object recognition in the left hemisphere.

<sup>2</sup>This part of BA37 borders the occipital cortex; it is usually characterized as a transitional area and is phylogenetically older than the nucleus.

<sup>3</sup>The “semantic subregion” corresponds to what in this book is referred to as the linguistic functions of the symbolic level in BA37.

## 2.2 Object Recognition, Topological Scheme of the Object, and Empirical Component of Word Meaning

Looking at a table, one does not just see its physical appearance. One knows what a table is for and the category of objects to which it belongs—one knows its *meaning*. The *whatness* of the table is grasped at once, but in fact this requires LH *sequential* processing in the left posterior–anterior brain system (from BA37 to prefrontal cortex), with parallel (simultaneous) processing in lower and higher functional levels.

At the sensory-motor level, concrete and concrete-situational signs are distinguished. Signs at this level are the “objective” features of *things*,<sup>4</sup> such as shape, size, color, and the like, but *things* are bound to their context. For example, the synthetic LH image of a cup at the sensory-motor level would be a metric and geometric image with the exact physical parameters of the cup, as experienced in the RH singular VSS. In other words, each cup is seen and recognized by its physical features in each particular situation, and no generalization is made regarding all cups as being the *same* things.

At the gnostic–praxic level, an object is analyzed by its functional signs. The functional signs of the object are those necessary to act with it. For a cup as an object for a particular use, neither height nor width, nor roundness nor squareness has substantial meaning. What is relevant at the gnostic–praxic level is the cup’s having solid sides, an unbroken bottom, and a handle (Bernstein, 1947, 1990). By these signs, every child will recognize a cup, even if he has never met a cup with this particular size, shape, etc. The combination of functional signs, as a result of LH synthesis, makes the LH synthetic image—the topological scheme of an object, according to Bernstein. A topological scheme represents not the object itself, but the rational aspect of acting with it. In other words, the topological scheme of an object is the visual representation that implies the object’s meaning as a tool. This visual image is “constructed” and stored in the left BA37.

### 2.2.1 Topological Scheme Is the Base for Object Action

A child’s world has already been shaped by human activity and is full of things designed by people to be used in human-specific activities. Children are introduced to this world of objects by the people around them. During interaction with a child, his parents and caregivers demonstrate the shared meaning of objects by drawing

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<sup>4</sup> At the sensory-motor level, there are not yet *objects* as such, just *things*, for the construct of an “object” arises from analysis as to the functional meaning of some “thing.” Such analysis begins at the gnostic–praxic level.

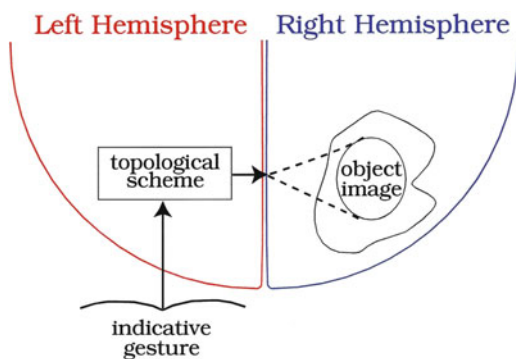
the child's attention to the object and then showing how it is used. In addition, other people's actions on objects also provide a model, not necessarily intentional, for the child to imitate. One important aspect of the child's developing sense of the meaning of things is the appreciation that most objects he encounters have a single, definite function. He then learns to use objects according to their established proper function. A child is capable of learning object use because his brain has an innate potential to analyze or "extract" functional signs and construct a topological scheme, which serves as inner programming for action. The time when children start using objects predictably coincides with maturation of those areas in the brain involved in LH processing at the functional level of abstraction.

Returning now to the left BA37, this region not only creates generalized visual—"functional" images of perceived objects, but also serves as the storehouse for their representations and, hence, for their later recognition. After mastering use of a cup in one particular situation, the child will be able to perform this object action in any situation and with any type of cups.

### 2.2.2 *Topological Scheme of an Object Is the Basis for Communicative Gestures*

When we point to a separate object, it is distinguished in our consciousness. Although the RH stores the whole object as perceived, objects in the RH VSS are trapped in their spatial-temporal context (VSS) and not distinguishable from it. Separating the object out of the visual scene-situation is achieved only if the object is analyzed and defined by its features via LH processing. Thus, when we point to an object, we in fact are indicating its topological scheme, not the object itself, and the part of BA37 involved with topological schemes of objects must be activated (Fig. 2.1).

**Fig. 2.1** Indicative gesture and topological scheme of an object. From *Language, Thought and the Brain*, (Fig. 7, p. 42), by T. Glezerman and V. Balkoski, 1999, Kluwer Academic/Plenum Publishers, copyright 1999; with kind permission from Springer Science + Business Media B.V



The topological scheme of an object in the LH is linked to the holistic object image in the RH. When the topological scheme is actualized, it “develops” the image of the corresponding object in the RH. Only in this indirect way, through the left BA37’s connection with the right BA37, can we perceive the whole image of the object that is stored within the RH VSS (Glezerman & Balkoski, 1999).

### 2.2.3 *Topological Scheme of an Object Is the Basis for the Empirical Component of Word Meaning*

In the history of language, before articulate speech appeared, communication was performed by means of gestures. Human communication took the form of action—theatrical-like demonstration including pantomime, imitative, and indicative gestures. It is supposed that humans’ first words had very broad and diffuse meaning (Blonsky, 1935; Ivanov, 1978), which reflects the RH visual-action-situation (Glezerman & Balkoski, 1999). For example, in a series of African nonwritten languages, one word, *ngu*, denoted the following: *this, I, to look, to know, nose, mouth, to drink, water, tooth, to bite, to eat, to speak, to listen, ear, hand, five, two* [Blonsky (1935) cited from Glezerman and Balkoski (1999)]. Here word meaning is diffuse and gives an image of whole visual-action-situations (“man and his activities”), however, at the same time we can also see an early sign in the emergence of separated-out objects in language by the use of *ngu* to mean “this.” “This” emerged along with the first words to appear and replaced the indicating hand with sound, allowing for reference to any object, but still dependent on context or situation.

The next step in the evolution of language comprised the arrival of words that designate a *separate object*. Again, people had spoken with their hands before they spoke with words. Many languages preserve this initial reliance in language on demonstration by their having the same roots denote *hand* and *speech*, and many more languages have the same or very similar words to mean *to speak* and *to show* (Latin *dico* speak, *indico* indicate, Russian *rasskasivatj* tell, *ukasivatj* indicate, *pokasivatj* show, etc). Here then is the chain of the hypothetical historical development: indicative gesture, replacement of indicating hand by “this,” and then word—name for the concrete, separate object. As noted earlier, constructing the topological scheme of an object is what allows the object to be separated out in consciousness. It can now be further postulated that the topological scheme of an object remained the common thread of what gets referred to in this evolution of language. Thus, the topological scheme is what was pointed to by gesturing in nonverbal languages, it was then what “this” referred to, and it also is what was referred to by words for separated-out objects (Glezerman, 1986; Glezerman & Balkoski, 1999). In linguistic terminology, word meaning includes an empirical component, or object reference, and a categorical component (Katznelson, 1972, 1986). We may conclude that the brain correlate for the empirical component of word meaning is the topological scheme of an object (which then refers to the whole object image in the RH).

### 2.3 Categorical Classification, Categorical Component of Word Meaning and Left BA37

To recapitulate, the LH constructs a visual world, and different versions of this world exist at each hierarchical level. The LH sensory-motor level's "synthetic" image of a *cup* evokes the visual and tactile sense of shape, color, and size of that particular cup from a single situation. *Cups* do not exist as such at this level, but only within the individual situation to which each cup belongs. At the gnostic-praxic level, a "synthetic" LH image of a *cup* evokes a separate object, with emphasis placed on action with the useful object. Here a *cup* exists as such, as a separate object, but without connections to other objects.

At the symbolic level, from a successive series of numerous signs and features of objects obtained during LH analysis (Fig. 1.2), one sign common to a given group of objects and differing this group from all others is distinguished. Such a sign is called a categorical one. Within each categorical group, subgroups are distinguished that possess their own distinctive signs—by a progressive distinguishing of specific categorical signs, ever more specific categories are formed from the more general. At the symbolic level, a *cup* belongs to the general category of objects and to the following subordinate categories: inanimate objects, things, man-made things (artifacts), things made for certain needs (instruments). At the categorical level, objects exist as such and also in their relation to other objects, as members of categories.

The categorical sign is an abstraction, a principle according to which signs of objects are organized into a set. For example, how can we imagine a category of living things, in particular the subcategory of animals? There must be some marker uniting such properties as "has legs," "has eyes," "can walk," "can breath," etc. These properties are not coded in the same section of BA37, and they may also have their equivalents represented in other modality-specific cortical areas. Although built upon the sensory-motor and gnostic-praxic levels, the LH symbolic (categorical) level cannot be reduced to either physical-sensory or functional-schematic (still modality-specific) representations (Glezerman, 1986; Glezerman & Balkoski, 1999). The idea that there are categorical representations in the brain independent from visual representations finds an empirical support in cases of brain-damaged patients who were intact in object recognition but had categorical deficits (Caramazza & Shelton, 1998). Also, in brain-damaged patients, category-specific deficits were observed; for example, categories of animals, plant life, fruits and vegetables, and artifacts were impaired independently from each other (Caramazza & Shelton, 1998). Anatomico-clinical correlations in patients with category-specific deficits and functional brain imaging of the different categories' processing in normal individuals revealed that the left temporal lobe is crucially involved in categorical processing, with the left inferotemporal area subserving the category of animals, while the left posterior middle and inferior temporal area is more important for tools (Damasio, Grabowski, Tranel, Hichwa, & Damasio, 1996). In addition, an important role of the

left frontal lobes is indicated for both categories (Martin, Wiggs, Ungerleider, & Haxby, 1996).<sup>5</sup> We will discuss the role of the prefrontal cortex later.

We can see that the visual representations with which BA37 (historically visual cortex) is concerned are transformed at the symbolic level into a categorical classification of the external world.<sup>6</sup> Indeed, BA37 serves as a “storehouse” for categories—this categorically “packed” world (semantic memory) lies dormant until called into play by the left prefrontal cortex (Glezerman & Balkoski, 1999).

As discussed in Chap. 1, the prefrontal cortex’s function can be thought of broadly as the representation of action. The left prefrontal region’s action, operating with categorical signs, is what leads to their sequential hierarchical organization from more general to more specific categories. If the left prefrontal region is damaged, the hierarchy of categorical signs is lost even though the stockpile of objects’ features in the posterior (temporal) region remains intact. The patients are unable to distinguish between supraordinate–subordinate categories. For example, the word “animal” may be used by such patients and it will be associated with words like “dog,” “cat,” “goat,” etc., but these words are not united into a common category. The words “animal,” “dog,” “cat,” “goat” are “located” in these patients at one and the same level of abstraction. “Animal” is perceived as one concrete animal at a time and not as a designation of a class.<sup>7</sup>

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<sup>5</sup> Despite these facts, most theories of how categories are organized in the brain are reductionistic. For example, the sensory/functional theory explains category-specific deficits being a result of selective damage to noncategorically organized visual or functional semantic systems (Warrington & Shallice, 1984). Another theory claims that because members of a superordinate category share many features in common, the bundles of interrelated properties are differentially distributed in the categories of living and nonliving things (Hills et al. 1995). For example, such categorical distinction as biological versus nonbiological motion is based on the particular types of nonoverlapping features, certain kinds of “stuff” (shape, texture, color, odor, etc.) that distinguish animate and inanimate objects. According to this theory, local damage to a region of semantic space will result in impairment to those categories whose members’ meaning depends on the affected semantic properties. This theory has some similarity with ours, for it considers representation of the category as a combination of interrelated properties (which is the LH processing). However, the discussed above theory remains reductionistic since it defines a category by the physical, sensory properties. Closest to my understanding of categorical representations in the brain is Caramazza and Shelton (1998) model. According to these authors, categorical knowledge has distinct brain organization within which specialized brain networks subserve different categories (specific domains). The authors even allude to the different levels of organization in the brain. Furthermore, criticizing reductionistic theories, Caramazza and Shelton (1998) argue that not only are there specific domains for categories in the brain, but that perceptual systems are sensitive to category distinctions. We can accept this last statement not literally, but in a sense of *top-down* regulation.

<sup>6</sup> The terms categorical classification of the external world and categorical representations used in this book are equivalents of categorical system and of semantic memory, the latter is often used in literature.

<sup>7</sup> Similarly, categorical deficits are observed in individuals with mental retardation (concrete thinking), except that in mental retardation the deficit is developmental.



Thus, formation of categorical classification is possible only with joint activity of the left BA37 and the left prefrontal cortex.<sup>8</sup> Indeed, functional brain imaging studies have consistently shown that categorization tasks<sup>9</sup> produce a large activation in the left hemisphere—the inferior prefrontal as well as the inferior–posterior temporal lobes (Devlin et al., 2002).

It was argued earlier that the empirical component of word meaning is connected with the gnostic–praxic level in the LH.<sup>10</sup> Now the categorical component of word meaning’s connection to the symbolic (supramodal) level in the LH can be discussed.

In linguistics, certain hierarchical sequences of categorical signs are thought to form the categorical component of word meaning, or concept. For example, the categorical component of the word *cup* includes the following linear sequence of categorical signs: *objectness—nonanimation—thingness—artifactness—instrumentality* (meant for certain needs); the categorical component of the word *waiter* would be *objectness—animation—person—agentivity* (acting person)—*occupationness* (Katznelson, 1972).

The categorical component of word meaning is implicitly contained within the categorical system. When we say or hear a word, *only at that moment* do categorical signs, characteristic for the particular word, gather together into the categorical component of word meaning. Thus, the categorical component of word meaning is realized as a result of joint activity in the left BA37 and the left middle and superior temporal region (BA22,42,21), responsible for word sound or the phonological code of the word (Glezerman & Balkoski, 1999).<sup>11</sup>

Our ability to think in categories and categorical component of word meaning are not one in the same; the categorical system is broader than the categorical component of word meaning that is based upon it.<sup>12</sup>

The categorical component of word meaning (existing only when connected with word sound) in the history of any particular language developed concurrently with

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<sup>8</sup> In the historical development of the human brain, powerful growth in two areas, corresponding to prefrontal and inferior temporal regions (BA37) in modern man, along with the formation of a massive bundle of connections between these two areas was the turning point toward brain “homimization” (Kochetkova, 1973).

<sup>9</sup> An example of a categorization task used in functional imaging studies is when subjects are shown a picture of three cue objects and then must decide whether a fourth (target) object belonged to the same category as the cue objects.

<sup>10</sup> In a previous work, two parallel lines in the phylogenesis of language were proposed (1) the articulatory praxic and empirical component of word meaning (gnostic–praxic level), and (2) the phonological code and categorical component of word meaning (symbolic level) (Glezerman, 1986; Glezerman & Balkoski, 1999).

<sup>11</sup> As alluded to at the beginning of this chapter, word sound by itself does not mean anything; it is literally a sound code of a word, the code that allows access to word meaning the “other side” of the same coin.

<sup>12</sup> Interestingly, in the history of the human brain, intensive growth in the area corresponding to modern man’s BA37 is registered at earlier stages than the development of the specifically human region responsible in modern man for word sound.



word sound development. In different languages, there are variations in the number of categorical signs for equivalent concepts. This phenomenon suggests that words-concepts do not have exactly the same meaning in different languages. Categorical representations are, on the other hand, nonverbal and universal. Patients who suffer from damage to the left temporal region, responsible for word sound, cannot grasp the categorical component of word meaning, but they do not lose a categorical attitude to the external world. Presented with a classification test, these patients unite objects into categorical groups, but cannot name the categories.

To conclude, BA37 is fascinating: it is complicated and not homogeneous in historical age, with an older transitional periphery and a young, specifically human central “nucleus”; as such, BA37’s generic function of object recognition is an evolutionary knot related to the development of an active attitude to the surrounding world (action with object tool), a new means of communication (language), and thinking (categorical classification). Categorical representations are “grown” from visual object perception, and the units of those representations, that is categorical signs, form the categorical component of word meaning. This evolutionary knot must be important for understanding autism, given autists do not use either objects or language in a conventional way.

## 2.4 Word Meaning and the Right BA37

The hard nucleus of an uttered word is spiritually accompanied by something like a halo of evaporation from images and strong affects merged together.

(Kretschmer, 1927)

The living word does not designate the object but freely chooses, as though for lodging, this or that object meaning, the dear body. And around this thing, the word wanders freely, as the soul around the cast off but not forgotten body.

(Mandelstam, 1921)

Does the RH have any influence on *how* we understand words? The neurolinguist Moscovitch (1983) indicates:

Hemispheric differences are large in processing syntactic or phonological properties of language; however...in processing semantic properties of language—hemispheric differences are likely to be smaller because each hemisphere contributes in its own way to the task (p. 94).

Moscovitch warns, however, “on verbal tasks, special techniques are required to free the right hemisphere from the dominance of the left to reveal its contribution to normal performance” (p. 103). To uncover RH contribution to word meaning, we must return to LH/RH differences and discuss in more detail the RH mode of information processing.

In our awake state we are subject to continuously changing impressions from the outside world. These moments of experience in the external world are perceived and directly stored by the RH as unchangeable, stationary wholes—visual scene-situations (VSS) (Glezerman, 1986; Glezerman & Balkoski, 1999). VSS was defined

in Chap. 1, and here it just needs reminding that VSS includes not only visual picture but also the emotion experienced at the moment it was perceived. In short, VSS is subjectively felt. VSS is a unit for RH operations just as discrete signs of objects are units for LH operations.

Objects in the right BA37 are perceived and stored as included into their spatial–temporal–emotional context, the VSS. It is in this form that the LH receives information about objects from the RH and then interprets the VSS according to its own cognitive mechanism. The LH distinguishes the signs of objects and “remakes” them as “synthetic,” separate-from-situation images. RH representations are primary, immediate experience. LH constructs are secondary and result from analyzing an object by its features, i.e., abstracting from the object itself, and then re-constructing a synthetic image as a combination of those features.

While the RH is a bearer of primary experience, the LH is always an interpreter of primary experience. Primary experience is not on the foreground of consciousness, but “covered” by LH interpretations.

### **2.4.1 RH Visual–Situational Level and Word Meaning**

The singular VSS is a whole that is idiosyncratic for the individual, having its own unique spatial–temporal context and saturated with emotion. Singularity means that the images of one and the same object represented in different VSSs are not connected to each other. VSS as a stage in RH cognition corresponds to the sensory-motor level in the LH. At the RH situational level, the image of the *cup* is incorporated in an infinite amount of singular situations: an image of the *cup* when you were meeting with a long-lost friend, an image of the *cup* when your daughter broke it in defiance of you, etc.

This step in RH cognition was termed *visual–situational thought* (Glezerman, 1986; Glezerman & Balkoski, 1999). RH visual–situational thought can be recognized in word meaning of so-called primitive nonwritten languages. For instance, in the Australian language Aranta there is no word “leaf,” instead, there are several words: “kanta”—round leaf; “ibala”—oval and fleecy leaves; “iana”—fleshy leaves. There is no word “hair” in Aranta but the following cluster of words: “panga”—long hair; “pantja”—long, trailing hair; “aratja”—straight hair standing upright. On the other hand, one word may mean more than one thing—visual situational association. For instance, in Aranta INTA means at the same time “stone” and “recumbent”; the word INKA means “foot,” “footprint,” and “steep” (cliff and mountain path) (examples taken from Katznelson, 1986, pp. 94–95).

### **2.4.2 RH Symbolic Level and Word Meaning**

Having used the term *thought* in the previous section, the organizing principle for RH associative processing should now be clarified. The LH establishes connections

between objects based on kinships of their properties, features, and signs. The RH is oriented toward perceiving the whole and identifies objects according to their appearance, even if their content is different. The mechanism of RH identification is simultaneous and instantaneous recognition of objects (in different situations) by the resemblance of their holistic forms. Examples of RH association by appearance would be: cat muzzle—sun—ball—apple—crown of the tree, see Fig. 1.3; ditch—plate; wall—sheet; suitcase—well. Simultaneous recognition of objects in different situations can be thought of as a form of pattern recognition. This association by holistic form in the RH roughly corresponds to the gnostic–praxic level in the LH.

Now let's return to the right BA37. In the VSS (sensory-motor level) objects are not functional objects, they are appearances devoid of content (meaning)—holistic forms. However, belonging to the VSS, they are saturated with the emotion of their situational context.<sup>13</sup>

Association by holistic form is also reflected in the word meaning of primitive languages. For example, in Aranta, *libala* means the oval or angular leaf but also bird's feather, bird's wing, and fin; another word designates knee, curved bone, bend of the river and earthworm (examples taken from Katznelson, 1986, p. 95).

In parallel with the described above “pattern recognition,” RH processing also entails identification of VSSs by common affect/emotion giving rise to its symbolic system (described in Chap. 1). It has been called visual situational-symbolic thought (Glezerman & Balkoski, 1999).

Identification, then, is the main organizing principle of RH processing. What exactly is *identification*? Or, what does it mean to be identified?

If A and B are identified, it is not that they are equal or similar, it means that they are identical, i.e., A remains A, but at the same time it is B and vice versa. The identified entities are interchangeable. Evidence for RH identification can be found in certain cultures, where RH associations are not only externalized but embodied in societal rules and ceremonies. For example, nineteenth-century observers of a native American tribe recorded that its members claimed to be human beings and red parrots at the same time (Levy-Bruhl, 1930). It is not that they would turn into red parrots after death. They believed they were birds with red feathers in the present. It was not the name or label they gave to themselves, and it was not that they were similar to red parrots: they *were* red parrots. It was not an analogy, not an association according to some common features, it was *identification*.

Identifications of multiple VSSs (and the objects within them) by common affect, and identification of objects from different VSSs by resemblance of holistic form, mark the next stage of RH cognition—visual object-symbolic thought where the object becomes a polysemantic symbol and individual VSSs once identified get left behind (Glezerman & Balkoski, 1999).

This visual situational-symbolic and visual object-symbolic thought can also be recognized in the word meaning of primitive languages. For example, in Aranta, we see singular images from alien domains are identified by similar affect and

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<sup>13</sup> We will see below how this is very important for our purposes because autists treat objects as forms (appearances), and it is form, not the meaning of the object, that holds emotion for them.

resemblance of holistic forms in word meaning: “aratja” means not only straight hair standing upright but also straight road; “pantja” means not only long, trailing hair, but also black night and deep; “alknanta” means both crimson flame and blood-thirsty man (examples are from Katznelson, 1986, p. 96).

## 2.5 Model of Cerebral Organization of Word Meaning

A word has become not a seven-barreled but a thousand-barreled reed, brought to life by the breath of all centuries at once.

(Mandelstam, 1921)

Now the model for word meaning (Glezerman & Balkoski, 1999) can be summarized. Word meaning (WM) is connected with BA37 in the LH, and it has two components—empirical and categorical. “Behind” these components are RH representations connected with word, we can call them RH equivalents of WM: VSS and the objects within it, RH situational-symbolic associations, and RH object-symbolic associations. RH representations get driven away to the periphery of consciousness, parallel to the development of the language system. As a result, the degree of awareness of RH “out-of-language” content of words (different in each individual) in general is marginal.

Different components and equivalents of WM represent “layers” in language history. The most ancient are the visual–situational and the visual situational-symbolic content of words, followed by the empirical component. More “young” are the categorical component and object-symbolic equivalent. Correspondingly, the cortical representation of word meaning includes regions of different phylogenetic age (Glezerman, 1986; Glezerman & Balkoski, 1999). The empirical component is related to the peripheral area of BA37,<sup>14</sup> bordering with the occipital lobe, whereas the categorical component is connected with the central subfield, the “nucleus” of the left BA37. The fact that BA37 subserves both sensory-motor/gnostic–praxic as well as the symbolic level implies these layers within BA37 have different interhemispheric connections.<sup>15</sup> The empirical component of WM in the LH would be connected with the whole object image within the VSS, while the categorical component of WM would be related to RH symbolic images (“individual sense” of word).

<sup>14</sup> This hypothesis was later supported by TMS studies (see the first part of this chapter) and also by imaging studies during memorizing concrete and abstract words. There was activation in the inferotemporal area (BA37) bilaterally with LH superiority in memorizing abstract nouns. When concrete nouns were being memorized, the bordering part of the occipital region was involved as well (Goldenberg, Podreka, Steiner, & Willness, 1987). The meaning of concrete nouns includes empirical and categorical components, whereas in abstract nouns the empirical component is reduced. The difference in localization between abstract and concrete words was attributed to the empirical component being related to the peripheral, temporal–occipital part of the left BA37, and the bordering occipital BA18,19 (Glezerman & Balkoski, 1999).

<sup>15</sup> Cortical connectivity is stratified, meaning connections exist between regions that developed together in phylogenesis (see Chap. 1 for details).

Interhemispheric interaction at the symbolic level is a constant in the development of WM. As in the gnostic–praxic level where the topological scheme on the left “develops” the whole object image within the VSS in the right hemisphere, so at the symbolic level, the categorical component “reveals” symbolic systems on the right.

## 2.6 Cerebral Organization of Word Meaning and Autism

Now we can move on to analyze WM in autistic individuals. The question will be: what is the composition of WM in autism and how are different components of that WM developed. Does any component/equivalent of WM (empirical or categorical, RH situational or RH symbolic associations connected with a word) prevail in autism? Is there any pattern of WM characteristic for people with autism, independent of age and degree of severity? Is there a pattern of WM characteristic for autism notwithstanding all variations in the clinical picture?

### 2.6.1 RH Situational Level and Word Meaning in Autism

Below are examples of LFA’s explanations of WM from Kanner’s material (Kanner, 1943).

Alfred, a 9-year-old boy: *balloon*: “[It] is made out of lined rubber and has air in it and some have gas and sometimes they go up in the air and sometimes they can hold up and when they got a hole in it they’ll bust up; if people squeeze they’ll bust” (p. 235). We can see here a specific definition behind which are the visual scene-situations (VSSs).

John, a 6-year-old boy: *dictionary*—“‘That’s where you left the money’.... [O]nce his father left some money in a dictionary and asked John to tell his mother about it” (p. 239).

For this autistic boy, the object (and word meaning) is part of the whole—VSS.

If we move to the HFA, we still see “exposure” of RH primary experience reflected in WM.

Here is an 8-year-old autistic boy’s performance on a “Similarity” test (e.g., “What is the difference between the words ‘tree’ and ‘bush’?”) from Asperger’s material.

The bush, that is where the branches grow straight off the ground, completely jumbled up, so that it can happen that three or four cross over each other, so that one has a knot in one’s hand. The tree, that is where there is first a stem and only then branches, and not so jumbled up, and rather thick branches. This happened to me once, that is where I cut into a bush, I wanted to make myself a sling, I cut off four branches and then I have an eight-part knot in my hand. This comes when two branches rub against each other, then there is a wound there, then they grow together (Asperger, 1991, pp. 53–54).

We can see here a visual image, very clear, exact, and factual, with all its physical features. There is a strict, photographic correspondence with real metrical parameters

that betrays the “most objective” level—sensory-motor. At the same time, the image above all is subjectively felt—it is a picture of situations experienced, the image of this autistic boy’s individual experience. This indicates RH situational thinking’s significant role in the above two words’ meanings.

Below are two more examples from Asperger of autistic children’s performance on the question: *In which way glass and wood are different?*

Glass is transparent. Wood, if you wanted to look through it, you would have to make a hole in it. If one wants to beat on a piece of wood then one has to beat a long time until it breaks, unless it’s a dry twig. Then it would break easily. With the glass you need to hit only twice and then it’s broken [eight-year-old boy with autism] (Asperger, 1991, p. 54).

Another boy, 7 years of age, answered the same question: “Glass breaks easily and wood doesn’t. Glass is a mass, wood is sappy and damp. It has marrow in the middle. Wood burns to ash, glass stretches apart and then melts” (Asperger, 1991, p. 62).

Neither autistic boy explicitly used left hemispheric analytic processing nor operated with the categorical component of WM. Instead, these boys gave very rich observations of glass and wood’s physical features. Their descriptions are experiential and very sensual, they convey visual, tactile, kinesthetic images (what they describe can be seen, its texture touched). These vivid and original descriptions are “expressions” of the right hemisphere at the situational (sensory-motor) level.

Thus, we can see that the cerebral organization of WM in these autistic boys is primarily right-hemispheric, and the functional level most pronounced is the situational (sensory-motor) level.

## 2.6.2 *Is the Empirical Component of Word Meaning Impaired in Autism?*

There are RH theories of autism, and they follow conventional logic: impaired development of the left brain with resultant right-brain compensation. In this case, however, one would first have to answer the question: *Is the LH impaired in autism?*

In this chapter, we considered word meaning connected with the major player of the *what* system, BA37. The neuropsychological syndromes specifically related to dysfunction of the left inferotemporal cortex include:

1. Visual object agnosia manifested by disorder of object naming.<sup>16</sup>
2. Ideational apraxia, loss of object meaning as a tool.

Recall that it is the topological scheme (an object’s “toolness”) of the gnostic–praxic level that is indicated when we point to or name an object (see above in this chapter). Thus, the above two disorders are both related to the gnostic–praxic

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<sup>16</sup> Patients with lesions in the right inferotemporal cortex misrecognize the objects due to fragmentation of the whole in visual perception (Kock, 1967).

level, the first includes deficit of empirical component of word meaning, i.e., disorder of naming in the visual modality.

3. Disorder of categorical recognition, failure to recognize the object as a member of a definitive category (Kock, 1967).

This disorder affecting the symbolic level includes in itself deficit of the categorical component of word meaning.

Children with autism do not have visual object agnosia caused by LH dysfunction. They can recognize objects and name them. Moreover, a recent study showed enhanced object picture naming in autists compared with controls (Walenski, Mostofsky, Gidley-Larsom, & Ullman, 2008). For contrast, I will give an example of one of my patients, an 8-year-old boy, P., with a learning disability, who had a specific neuropsychological syndrome corresponding to a dysfunction of his left BA37.

P. spoke fluently, was friendly, and motivated to answer examiners' questions. His specific deficit was expressed in difficulty naming objects. For example, he was shown the picture of objects and asked to name them: lily of the valley—"tulip"; fly-agaric—"I don't know"—[Examiner] Is it eatable?—"No"—[Examiner] Why?—"Too much poison"; and watch—"second" (Glezerman, 1983, p. 165). Whenever prompted by the first syllable of the word, P. was able to name the object. His errors were not by chance, but words similar to the target word by meaning, thus the target word and its replacement (paraphasia) were from the same semantic field. This type of paraphasia and ability to name the object by sound prompting suggests a problem in word meaning, not in word sound. Similarly paraphasias were observed in P.'s spontaneous speech:

Patient P: "Let's remove the compass" (it was a stop-watch),

Examiner: "It is not compass, what is it?"

Patient P: "I forgot... second..."

Patient P: "Aren't the pictures in the purse? [referring to an envelope]"

Examiner: "It is not a purse."

Patient P: "Where you put letters"

Examiner: "What is the name of it?"

Patient P: "I forgot." (Glezerman, 1983, p. 165).

Autists have no such difficulties as did this patient of mine. Nor do autists lack understanding of objects' toolness, that is, they do not seem to have apraxia.<sup>17</sup>

Even in Kanner's material on LFA (some of them mute) an understanding of the functional meaning of objects remained intact. One autistic 5-year-old boy did not communicate with the examiner, but he would go after objects and use them correctly.

He picked up a pencil and scribbled on paper that he found on the table. He opened a box, took out a toy phone, singing again and again: 'He wants a telephone', and went around the room with the mouthpiece and receiver in proper position. He got a hold of a pair of scissors and patiently and skillfully cut a sheet of paper into small bits, singing the phrase 'Cutting paper', many times (Kanner, 1943, p. 227).

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<sup>17</sup> Patients with lesions in the left posterior brain who have apraxia do not know what to do with objects: how to strike a match, how to use a spoon, what a needle is for, etc.



However, in life, children with autism do not use objects in a conventional manner (according to the object's established proper function). Instead, they might be pre-occupied with manipulation of certain objects, but this object use is not conventional but idiosyncratic, not functional but stereotypical.

### ***2.6.3 Is the Categorical Component of Word Meaning Impaired in Autism?***

What about the categorical component of word meaning? Because we are talking now about a higher level within the left hemisphere's BA37, it would be more appropriate to explore this question by studying HFA and gifted people with autism. Self-reports of HFA show that autists do not operate with abstract concepts, but instead achieve word comprehension indirectly, through visual associations. Let's look at one of Temple Grandin's accounts.

My concept of dogs is inextricably linked to every dog I have ever known... if I think about Great Danes, that's what emerges: Dansk, the Great Dane owned by the headmaster at my high school, I visualize Helga who was Dansk's replacement, my aunt's dog in Arizona, an advertisement for Fitwell seat covers that featured that kind of dog.... There is no generic, generalized Great Dane (Grandin, 1995, p. 28).

What is very interesting is that she has intellectual insight into her peculiarities.

Take also the example of a 9-year-old autistic boy from Kanner's material, performing on a test involving word definition: "Tiger—'is a thing, animal, striped, like a cat, can scratch, eats people up, wild, lives in the jungle sometimes and in the forests, mostly in the jungle. Isn't it right?'" (Kanner, 1943, p. 235). This autistic child could give an excellent answer, he used with ease categorical specifications of the word, but they are of little importance to him. What prevails in his mind, what his mind is preoccupied with, is the physical-sensual world. One wonders if this child used the words "thing" and "animal" not as a designation of a class (concept), but as a label, behind which is just another visual image of the singular animal. This possibility is supported by a recent study where subjects with autism showed significantly diminished differential fMRI activation to concrete versus abstract words compared to normal controls (Harris et al., 2006).

In her later publication, Grandin reveals how she was able to progress in her understanding of concepts. She continues to insist that words come secondarily to her. In order to understand both spoken and written language, she translates the words into visual pictures.

All my thoughts are in photo-realistic pictures.... To form a concept from many specific photo-realistic pictures I have stored in my memory, I sort them into categories. Categorization of my specific visual memories was the beginning of concept formation. When I was a child, I categorized dogs from cats by sorting the animals by size. All the dogs in our neighbourhood were large until our neighbours got a Dachshund. I remember looking at the small dog and trying to figure out why she was not a cat. I had to find a visual feature that she shared with big dogs. I had to create a new category in my mind to differentiate. All dogs, no matter how big or small, have the same nose shape. My concept is sensory based, not word based.

Other ways of sensory-based categorization would be sound (barking or meowing) or smell (Grandin, 2010, pp. 141, 143). *How Does Visual Thinking Work the Mind of a Person with Autism?* by Temple Grandin, in: *Autism and Talent*, U. Frith and F. Happe, eds., 2010, Oxford University Press, New York. By Permission of Oxford University Press.

To fully appreciate what stands behind Grandin's experience, we need to clarify the term *category*. *Category* is understood as the categorical level of abstraction (see above in this chapter), where objects are related by common (categorical) signs. *Concept* is the verbal equivalent of category. Concept is an abstract, linear hierarchical sequence of categorical signs, which represents the categorical component of word meaning. It seems that in the literature *category* is sometimes understood as any grouping, which could be based on perceptual, functional, or categorical features. I believe (as was shown in beginning of this chapter) that the brain (LH) spontaneously "constructs" the world in parallel at concrete, functional, and categorical levels of abstraction. Categorical representations may be historically connected with modality-specific representations,<sup>18</sup> but cannot be reduced to the latter.

Grandin's extraordinary capacity to "see" and build a memory of innumerable visual combinations simultaneously ("my thinking is totally nonsequential"), with these RH representations being on the surface of her consciousness, allows her to closely approach something which is an equivalent to a concept at the lower brain levels. Still, the pattern she "extracts" is vicarious. Her compensation is likely achieved by the RH/LH interaction at the sensory-motor level, but what about abstract words that do not have corresponding visual representations in the brain? Interestingly, to understand abstract words, she uses RH visual situational thinking and even rudiments of RH visual situational-symbolic thinking. For example, for *peace* "an Indian peace pipe, or TV or newsreel footage of signing of a peace agreement" is called to mind; for *honesty* "an image of placing one's hand on the Bible in court...[a] news report describing a person returning a wallet with all the money in it provided a picture of honest behavior"; and for *power and glory* "a semicircular rainbow and an electrical tower" (Grandin, 1995, p. 33).

Now let's see what the literature says about the ability to categorize in autistic subjects.

Tager-Flusberg (1985) examined categories using pictures of common objects and reported children with autism do not have a specific cognitive deficit in categorization. She suggests children with autism have categorical representations but are unable to make efficient use of them.

More recent studies show sorting preferences in subjects with autism for concrete over abstract categories (Alderson-Day & McGonigle-Chalmers, 2011; Ropar & Peebles, 2007). Several studies found that in free recall autistic subjects did not group items to be recalled according to semantic-conceptual relations (Bowler, Gaigg, & Gardiner, 2008; Minshew & Goldstein, 1993). This is in accordance with Hermelin and O'Connor's (1967) earlier findings that autistic children fail to use

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<sup>18</sup> For example, the supramodal temporal cortex, responsible for the phonological code of words, is historically built upon the auditory cortex, while the supramodal inferotemporal cortex responsible for word meaning is built upon the visual cortex.

semantic information to facilitate memory. Some studies have found that autists use semantic-conceptual associations if specifically cued to do so (explicit task) (Gaigg et al., 2008), and existing research shows some sensitivity to categorical recognition in autistic people, although such sensitivity is not as strong as that of the normal population. Toichi and Kamio (2001) found conceptual relationships for simple common words to be intact in autistic young adults, but suggest that semantic processing in subjects with autism might be qualitatively different from that in controls. The last statement is important, because all the above authors indicated that, instead of grouping recalled items using a preexisting semantic-conceptual network (the usual strategy to aid memory in normal people), autistic individuals grouped items idiosyncratically.

The neurophenomenological analysis conducted in this chapter “de-coded” what is called perplexing and idiosyncratic in autism and found it all to be a manifestation of RH associations at the sensory-motor (situational) level in the brain.

At the clinical-behavioral level, Toichi and Kamio (2001) come closest to this book’s formulation.

[A]lthough both groups showed similar performance in [the] task, the two groups might have employed different strategies. For example, individuals with autism may be more dependent on nonverbal strategies, such as visual imagery, which results in manipulating language differently from individuals without autism (p. 488).

All authors agree that concept formation, or the spontaneous generation of categories, is in some way abnormal in autism.

Thus, in autism, there is not a specific deficit (known neuropsychological syndrome) that can be attributed to a dysfunction of the left inferotemporal cortical area, BA37, and yet, the left BA37 is clearly not functioning properly.

## 2.7 Cerebral Organization of Metaphors and Autism

### 2.7.1 *Metaphorical Language of Children with Autism Is of RH Origin*

Kanner (1946) noted that the seemingly irrelevant and nonsensical utterances of autistic children are metaphorical expressions. However, their language becomes meaningful only if connection is established between the child’s situational and emotional experience and his metaphorical utterance. Here is one of the examples Kanner gave.

Paul G., while observed in our clinic at five years of age, was heard saying: ‘Don’t throw the dog off the balcony’. There was neither a dog nor a balcony around. The remark therefore sounded irrelevant. It was learned that three years previously he had thrown a toy dog down from the balcony of a London hotel at which the family was staying. His mother, tired of retrieving the toy, said to him with some irritation: ‘Don’t throw the dog off the balcony.’ Since that day, Paul, whenever tempted to throw anything, used these words to admonish and check himself (Kanner, 1946, p. 242).

From the point of view of brain mechanisms, this observation can be explained as an exposed RH visual scene-situation, an indivisible whole including visual picture, action, and emotion. The utterance is part of the original visual scene-situation and becomes its emotional marker. When the child has that same feeling, the situations are identified, and the utterance reemerges. In other words, a singular situation experienced in the past and the currently experienced situation are identified by their common affect. Here is another example from Kanner's material.

Jay S., not quite four year's old, referred to himself as 'Blum' whenever his veracity was questioned by his parents. The mystery of this 'irrelevance' was explained when Jay, who could read fluently, once pointed to the advertisement of a furniture firm in the newspapers, which said in large letters: 'Blum tells the truth'. Since Jay told the truth, he *was* Blum (Kanner, 1946, p. 243).

In metaphors, things from alien (remote) domains are usually joined together. In the above examples of autistic children's speech, metaphors are created by connecting alien domains through their instant identification. Kanner indicates that in case of Jay S., "analogy between himself as a teller of the truth and Blum does not differ essentially from the designation of a liar as Ananias, a lover as Romeo, or an attractive lad as Adonis" (p. 243). But in cultural symbols, according to Kanner, the listener is familiar with the analogy or "if the metaphorical reference to Ananias, Romeo or Adonis is not understood, dictionaries, encyclopedias or informed persons can supply the understanding" (p. 243). In contrast, to understand the metaphorical language of autistic children, one needs to know the source of the metaphor, which is an original and unique emotional-situational experience. For Kanner, the main distinction between autistic children's metaphorical expressions and cultural symbols is that the former are idiosyncratic (unique for each individual's experience). I would think that *any* metaphor has an idiosyncratic component. Cultural symbols are learned, but we understand them because we have an internal mechanism (right hemispheric) for symbol formation—identification. Not only in their creation but also in the process of their comprehension are metaphors perceived not just "logically" but also included into one's own emotional experience (and this is why and how we enjoy them), passing through the hearth of RH cognitive mechanism. This phenomenon is illustrated when LH dominance is weakened, and RH associations are revealed as a result. For example, if damage occurs to the left temporal region, responsible for word sound (phonological code of the word), LH word meaning of object reference and concept cannot be decoded, while RH associations, including aspects of figurative meaning from powerful emotionally loaded individual symbols, emerge on the surface. A patient of mine who suffered a lesion in the left temporal region (sensory aphasia) gave explanations of word meaning that illustrate the above point. When asked to define *resist*, he answered "Spartacus," and for enormous, "Gulliver" (Glezerman & Balkoski, 1999). We can see the patient's responses are far from direct explanations of word meaning, but instead they convey emotionally saturated visual images that are equivalents to these words' meaning. This example is also interesting because it shows that in the formation of individual symbols (RH equivalents of WM) cultural symbols as part of experience can be used.

RH content is idiosyncratic, because it is primary experience. In a way, each individual creates cultural symbols anew, although degree of idiosyncratic component varies significantly among individuals, as in the RH equivalent of WM.

As briefly mentioned in the beginning of this chapter, it is a well-known fact that children with autism are unable to understand metaphors. On the other hand, as discussed earlier, Kanner (1946) showed autistic children produce metaphorical expressions. In order to approach this contradiction we must first analyze how metaphors are processed in the normal human brain.

2.7.2 Cerebral Organization of Metaphors in the Norm

Neuropsychological studies have shown both cerebral hemispheres to contribute in characteristic ways to metaphoric competence. Winner and Gardner (1977) compared comprehension of metaphors in patients with unilateral, LH and RH lesions.<sup>19</sup>

All test subjects were presented with several sentences containing a simple metaphoric expression (e.g., “a heavy heart can really make a difference”). Each sentence was presented simultaneously with four pictures: one of the pictures represented the appropriate meaning of the metaphoric sentence (e.g., in the above case of heavy heart, a crying person was depicted); one was a literal representation of the sentence (a person carrying a large red heart and staggering under its weight); one depicted an object whose salient quality was described by the adjective (a five hundred pound weight); and one illustrated the noun (a red heart). Subjects were asked to point to the picture most fitting the sentence. After a pictorial choice had been made, the pictures were removed and subjects were asked for a verbal explanation of the metaphorical phrase contained within the sentence (e.g., “What does it mean to say a heavy heart?”).

Table 2.1 shows that *double dissociation* was observed between patients with LH and RH lesions. Patients with the LH lesions could perform the nonverbal part of

Table 2.1 Comprehension of metaphors in patients with unilateral brain lesions (Winner & Gardner, 1977)

Heavy heart	Patients with left hemisphere lesion (intact right hemisphere)	Patients with right hemisphere lesion (intact left hemisphere)
Picture choice	A crying person	A person carrying a large red heart and staggering under its weight
Verbal explanation of metaphor	“It’s heavy, the heart, a lot of weight”	“He’s got many troubles”

<sup>19</sup> There were also two control groups in this study: patients with dementia (diffuse, bilateral brain damage) and normal subjects.

the test. When they were given a choice of four pictures to match with metaphoric sentence, they chose the appropriate picture. However, when they were presented with the same metaphorical phrase not accompanied by a picture, they gave a literal verbal explanation. Patients with RH lesions were able to give verbal explanation of the metaphorical phrase, but when they were given a choice of four pictures to match the phrase, they chose a literal pictorial interpretation of the metaphor. Unlike any other group in this study, patients with RH lesions did not find the literal depiction amusing or absurd.

Such experiments show that our ability to process metaphors is provided by complementary interaction of the two hemispheres, each having its specific contribution.

Metaphor itself, where usually remote terms are joined in a single figure of speech, is based on RH symbolic thinking. RH symbolic content is expressed through visual image, and, in RH thought, there is no content (meaning) without form (visual image). For example, in the metaphoric expression “heavy heart,” a psychological condition is expressed through the physical image. However, the image (form) preserves its own value, so that RH symbol is always polysemantic. When the RH is damaged, polysemantics is lost. The patient perceives the object image as such—a red, heavy heart. On the other hand, the RH cognitive mechanism is limited. Within the RH symbolic system, objects (and situations) having different content are identified and are equipollent facets of an indivisible whole, with visual form and content making a single integrated representation. It is only through interaction with the LH that the symbol’s components parts can be “dissected” and one can know that an object symbolizes another but is not that other. For example, in a poem line “A lonely sail gleams white in the blue mist of the ocean,” we understand the image *sail* symbolizes a man through the metaphor *lonely sail*, and yet we also understand the sail is not a man. For RH thought, sail and man are interchangeable, identical in meaning. LH analysis of the words *sail* and *man* reveals that the categorical meanings of these words have only one categorical sign in common: objectness. Thus, these two perspectives are not confused, and we comprehend both literal (i.e., the image itself retains its meaning) and figurative meanings (Glezerman & Balkoski, 1999).

Figuratively speaking, the RH creates metaphors, but does not understand them. Isn’t it characteristic for the metaphorical expressions of autistic children?

### ***2.7.3 Autistic Children Create Metaphors but do not Understand Them***

Let’s return to case of Jay S., the 4-year-old autistic boy, who referred to himself as “Blum.” Here, in a very condensed form (“Blum”), an emotionally saturated idea of truth, telling the truth, and who is telling the truth, are all expressed. Behind “Blum,” there are situations, which are identified by affect becoming the symbolic system of meaning—an indissolvable whole. The example reflects not just polysemantic

meaning, but also the undifferentiated wholeness of RH cognitive mechanism. I agree with L. Despert's conclusion about Jay S. (see discussion part of the Kanner article, p. 245).

I wonder, however, whether the autistic child is not himself enmeshed in his own symbols, for while 4-year old Jay refers to himself as Blum, he does not say, and probably cannot say, "I am Blum" or "I am Blum because."

"Raw" RH associations of autistic children's metaphors are not really what we call metaphor. Although creative, their "raw" RH associations are not complete. Thus, metaphorical expressions of autistic children lack LH participation. This is why they are idiosyncratic, not directly communicable.

Is the RH needed at all for communication? I should say so, for without the RH, communication is severely impoverished, even prohibited. The LH organizes information into categories, the LH puts together linear sound sequences to make the phonological form of the word, and the LH combines words into sentences and phrases (grammar, syntax). On the other hand, knowledge about the world as primary experience is stored in the RH. How would the LH communicate, without the RH's experience? It was noted that when the RH is temporarily inactivated,<sup>20</sup> patients become very convivial (sociable) and verbose, and, although their speech is grammatically correct, it lacks substance and is full of unnecessary, repeated details—all of this is uncharacteristic for these patients and disappears after recovery (Balonov, Barkan, & Deglin, 1979).

The above examples of metaphor comprehension in patients with unilateral brain damage showed that patients with RH damage gave satisfactory verbal interpretation of the metaphorical phrase: heavy heart—"He's got many troubles," but chose a literal pictorial interpretation (a person carrying a large red heart, staggering under its weight). Direct connection between metaphorical phrase and its verbal explanation as a cliché is preserved (a product of LH verbal memory), but the RH polysemantic symbol, where meaning is expressed through an emotionally saturated visual image, is gone. Something similar can happen to cultural symbols. A visual image, singled out by the LH and connected with a LH monosemantic interpretation, can become a cliché LH sign (e.g., the dove as a conventional sign of peace). To remain polysemantic, cultural symbols need to be rooted in one's unique experience.

Now we are better able to resolve the proposed contradiction: severe disorder of spontaneous speech (8 out of 23 children from Kanner's material remained mute) coexistent with a *creative attitude* toward language in autistic children. Asperger noted autistic children "are able to express their own original experience in a linguistically original form" (Asperger, 1991, pp. 70–71) and gave us several examples of such language use. One autistic boy (7-year-old) defined the difference between stairs and ladders as being "[t]he ladder goes up pointedly and the stairs go up

<sup>20</sup> Findings come from Balonov et al.'s (1979) examinations of depressed patients during recovery after unilateral ECT, when the involved hemisphere is inactivated for a short period of time.



snakedly” (Asperger, 1991, p. 71). Another 11-year-old autistic boy responded to a requested task: “I can’t do this orally, only headily”; he described his sleep pattern as “long but thin” (p. 71); and once shared he did not like “the blinding sun, nor the dark, but best I like the mottled shadow” (p. 71). All these expressions are metaphorical, where physical, sensory, and visual–sensual characterizations refer to psychological aspects of experience.

To conclude, Kanner’s observation that only digging out singular, original *situations* from an autistic child’s past experience may give the key to the meaning of that child’s metaphorical language is of extreme importance for understanding brain mechanisms in autism. It is not enough to say that in autism RH associations are on the foreground of consciousness. It is the situational level within the RH that gets exposed in autism.

Visual thinking of children with autism is visual–situational, not visual-symbolic. At the visual–situational (sensory-motor) level, situations are not united into symbolic systems, but remain “single.” At the same time, the singular situation is a whole world in itself and all things inside the situation are identified based on common feeling.

## 2.8 Uniqueness of Right-Hemispheric Prevalence for Language in Autism

Current research, including functional neuroimaging (Boddaert & Zilbovicius, 2002; Garreau et al., 1994; Malisza et al., 2011; Muller et al., 1999; Ring et al., 1999), quantitative neuroimaging (De Fosse et al., 2004; Herbert et al., 2002, 2005; Rojas, Bawn, Benkers, Reite, & Rogers, 2002), and neurophysiological studies (Bruneau, Roux, Adrien, & Bartelemy, 1999; Dawson, 1988), gives overwhelming support for RH prevalence in autism. I will give a few examples concerning the area of interest in this chapter, BA37. Muller et al., 1999 fMRI study found the main difference in brain activation during sentence comprehension to be in the middle temporal area, roughly corresponding to BA37. Left middle temporal activation was four times less in autistic group than in controls, while right middle temporal activation was double in the autistic group compared to control. While sentence comprehension activates mostly two areas in the LH, the inferotemporal region, BA37 (comprehension of single words) and the inferior prefrontal region (comprehension of syntactic structure), in an autistic group, decreased activation in the LH and increased activation in the RH was mostly pronounced in one target area, which was BA37. Moreover, when autistic and control subjects were imaged while performing sentence generation task (more specific test for syntactic structure), activation in the left inferior prefrontal region was strong in both groups. Increased activation in the right occipital cortex (BA18,19) extending to BA37 was also observed in autistic subjects compared to the control group in fMRI studies during complex tasks of object recognition (Malisza et al., 2011; Ring et al., 1999).

Reversed lateralization in autism was not limited to visual modality related areas; it was reported as well in response to nonverbal and verbal auditory stimuli (Boddaert et al., 2000; Boddaert et al., 2001; Bruneau, Roux, Adrien, & Barthelemy, 1999; Garreau et al., 1994).

While these findings are important, they are not specific to autism. Reverse dominance of the cerebral hemispheres was found in other psychiatric disorders, such as schizophrenia, ADHD, dyslexia, SLI (specific language impairment), etc.

In this regard, the neurophenomenological analysis of word comprehension in autistic people conducted in this book turns out to be crucial for knowing what RH prevalence in autism means. While word meaning has complex cerebral organization, with separate representations of categorical and empirical components (LH), situational context, and visual image and visual-symbolic associations connected with a word (RH), for autistic people WM is reduced to its RH content. Moreover, WM for the autistic is relegated to a deep historical level—the situational level. WM is situational-experiential, a word is not separable from an autistic’s unique experience. The RH situational (sensory-motor) level being the *only* one connected with WM is specific to autism, distinguishing autism from all learning disabilities. It also differs autism from schizophrenia where, I believe, RH *symbolic* level predominates. RH predominance in children is usually interpreted as compensation for early LH damage. The described above consistency with which children with autism use the RH situational level for word comprehension presents a problem for the interpretation that the RH prevalence in autism is secondary, a *compensation* for the primary LH deficit (in addition to there being no demonstrable specific neuropsychological LH deficit in autism).

Reorganization of brain functional systems as a reaction to the primary deficit can go only along “beaten tracks,” established in evolution, of brain networks underlying human behavior. However, within this evolutionarily fixed pattern of cortical connectivity, each brain “chooses” its strongest link, the most well-developed region, to use for compensation, resulting in an individual-specific response. Considering the enormous individual variability of cortical regions in the brain (individual neuropsychological profile), many different responses are expected. Patients with LH lesions still may use intact zones in the left for compensatory measures, if their premorbid neuropsychological profile is such that their strengths lay in the LH, whereas others would have assets in RH that would rise up to make up for deficiencies in the LH. For example, in an fMRI study of children with early LH lesions, numerous compensatory functional reorganizations were observed with postlesion activation in response to language task showing lateralization to the RH as well as transfer to a perilesional area within the LH, in the left frontal area anterior to the lesion, and bilaterally (Liegeois et al., 2004).

If the RH is used for compensation, any level can possibly prevail: visual situational, visual situational-symbolic, or visual object-symbolic, depending on their

prominence in the patient's premorbid neuropsychological profile.<sup>21,22</sup> Autism's specificity to *situational level* predominance is strong evidence against its being a compensatory phenomenon.

## 2.9 Conclusion

The paradox presented in the beginning of this chapter has been elucidated. The cerebral organization of word meaning presented here consists of LH empirical and categorical components while the RH contribution to WM are visual scene-situations and visual symbolic associations connected with the word. We found that autistic's word comprehension is based mostly on the RH contribution to WM. Furthermore, it is the RH situational (sensory-motor) and not RH symbolic level that plays a leading role in word comprehension in autistic people. Knowing the RH origin of word meaning, one can explain idiosyncratic language in autism: RH associations are individual-specific. A lack (or deficiency) of LH participation in autistic's cerebral organization of metaphors explains the dissociation between their creating metaphors, but not being able to understand them.<sup>23</sup>

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<sup>21</sup> To illustrate reorganization of brain functional systems as a response to the primary, local deficit, I will use an example of *sensory aphasia* and contrast it with autism. Sensory aphasia is caused by a focal lesion in the left temporal region responsible for the phonological code of the word. Its primary deficit, therefore, is in word sound. When word sound becomes unstable, word meaning cannot be decoded as a result, and word comprehension is impaired. However, even though word sound has quickly slipped away, the instant it was heard an object image related to the word's meaning can still be evoked in the RH. The visual image, without support of word sound, is subject to RH rules and brings to the fore a particular group of associated holistic forms. Any one of a roundabout of images, similar in appearance but different in content, may come forth and push out a word sound. For instance, instead of the word "ditch" a patient may say "plate," instead of "wall" he might say "sheet," instead of "suitcase" he might say "well" (examples are taken from Bein, 1961).

Other patients with sensory aphasia may use different "layers" of the RH visual thinking to "compensate" for the primary deficit, such as visual-situational associations or even RH visual-symbolic thinking; in the latter, there is a peculiar narrowing of word meaning where the basic meaning of the word—concept and object reference—is lost, but figurative meaning remains intact. For example, a patient defined the meaning of "pipe" as "peace pipe," "dwarf" as "pygmean soul," "sharp" as "unpleasant, sharp tongue, everybody is afraid of it." Still another patient with sensory aphasia can still rely on his LH, and here the target word would be substituted under the rules of LH cognitive mechanism. For example, the concrete word "notebook" can be replaced by a word in a more abstract category: "stationary." Another such example is one patient's answer of "science" instead of "economics" (examples are taken from Bein, 1961).

<sup>22</sup> Applying the term premorbid neuropsychological profile to autism, a supposed neurodevelopmental disorder, means the particular individual's hypothetical brain as it would exist if the autistic disorder were removed.

<sup>23</sup> For the autistic himself it is not metaphor but his primary experience.

What remains to be solved is why the left BA37 is not functioning properly in autism, when no specific dysfunction in this area can be found. Autism presents a unique developmental disorder in which language and emotional deficit are intrinsically tied in a specific pattern. It brings to mind the phylogenetic stage in the primate brain where communication, emotion, and cognition were one and the same whole. Is the deficit in autism coming from this deep root in the human brain's history? Is the left BA37 just a "performer" whose cognitive role in the expression of an active attitude toward the surrounding world cannot be realized in autism?

In this regard, the work of Ungerer and Sigman (1987) should be mentioned. These authors showed that while knowledge of perceptual and functional attributes of objects is a prerequisite for language development in normal and mentally retarded children, there was minimal correlation between the ability to sort out objects by color, form, and function and the development of language in young autistic children. In contrast, there was a significant correlation between verbal and gestural (pretend play) symbols in autistic children. The authors conclude that autistic children's disability is inherently cognitive and social and cannot easily be reduced to a singular dysfunction in either domain. We will explore this problem further in the following chapters.

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