

Unsuccessful Support of Holism

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ABSTRACT

D. Navon's article "Forest before the trees" (1977) presented the theory of global precedence in support of philosophy of *holism*, the "primacy of the whole" principle.

In this paper it will be shown that

- 1) the *global precedence* theory is built up from undefined notions (globality, locality, feature, element, and global structure),
- 2) each notions is assigned to many meanings,
- 3) the mathematical expressions are wrong,
- 4) the transformations of the mathematical formulas are illegal,
- 5) the logic of argumentation is broken.

Despite all this Narvon's article recruited dozens of followers, inspired hundred publications in top psychological journals, and is included in many textbooks and reviews. It is mentioned at 42,000 web sites. This paper also shows why Narvon's article was widely accepted as proof of the wrong principle "The whole before the parts". This phenomenon indicates that "something is rotten in the state of Denmark".

Key words: global precedence, whole/parts relations, holism, hierarchical structure.

INTRODUCTION

Relation between the whole and the parts is an old yet eternally young problem. The classic article by D. Navon "Forest before the trees" [1] presented the *global precedence* principle, which is classified by "The Oxford Handbook of Perceptual Organization" as "an issues of part-whole relationships". The article was widely accepted as proof of the principle "The whole before the parts" despite the main statement of *global precedence* - "*Global features precede local features*"- contains neither the term whole, nor the term parts. Even in 2015 in a student's handbook one can read: "What did Navon find? We often see the forest (global structure) before the trees (features)" [2].

There are a number of reasons why the psychological community got the wrong message:

- 1) in the article the word forest was not mentioned at all, and the reader perceives the title as a general statement: **the whole before the parts**;
- 2) the ambiguity of the terms introduced in the article: global, local, feature, element, and structure. None has a definition and to each term were ascribed several meanings. As a result, the reader substitutes the obscure terms with terms well known in Gestalt theory. For example, the article "Global precedence" in Wikipedia starts not with definition of the principle, but with redefinition of the basic terms: **local features** are explained as "**parts**", and **global** features as "**the whole**".
- 3) Gestalt psychology always positioned itself as a holistic philosophy, and promoted the dominance of the whole: "For atomists parts make the whole. We perceive whole not parts" [3]. It was widely accepted that "holism is a fundamental notion of Gestalt psychology" [4].

Navon wanted to present an experimental support for the holism, the "primacy of the whole" principle, which was never well founded. It was clear that in the paradigm of hierarchical

structure the absolute dominance of the whole over the parts is impossible: "There is no claim that the whole precedes its parts; such a claim would be quite meaningless" [5]. To achieve his goal, the author constructed a new hierarchy – the globality hierarchy, and used in experiments a very special stimulus – the compound letter, which is a big letter made up of small letters.

This paper presents a short analysis of the experimental and theoretical foundations of the global precedence theory.

WERTHEIMER'S ANALYSIS OF COMPOUND STIMULI

Perception of compound stimuli was analyzed by Wertheimer as early as 1923 (see Fig.1 and Fig. 2).. In his paper Wertheimer describes the dotted lines not as "lines of dots", but as "lines" [6]. Discussing Fig.1 he wrote: "the perceived grouping is quite clearly 'a horizontal line and a vertical line' ". Right after this, Wertheimer analyses a similar example – Fig. 2A and Fig. 2B.

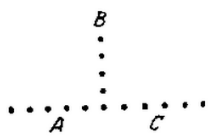


Fig. 1



Fig. 2

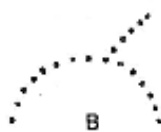


Fig. 3

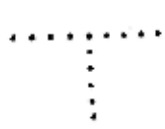


Fig. 4

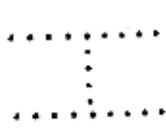


Fig. 5

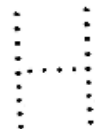


Fig. 6

His remarks on these figures were: "We are dealing now with a new principle which we may call *The Factor of Direction*. That direction may still be unequivocally given even when curved lines are used is of course obvious". It is remarkable that Wertheimer found it necessary to explain that not only straight lines but also curved lines have a direction, and at the same time he found it absolutely natural to apply the terms "line", "curve", and "direction" to Fig. 2A, which contains neither line nor curve – it contains only dots. It is obvious that at each point the arc AC on Fig. 2A has a direction but any black dot on Fig. 2B has no direction. Despite this we have no objections to Wertheimer's statement. The reason is that, according to Wertheimer, our percept of the whole (the Gestalt) of Fig. 2B consists of the same parts as our percept of Fig. 2A: "an arc and a line". Consequently, the hierarchical structure of Fig. 2A consists of whole and its parts (two lines – an arc and a straight line). For Fig. 2B the hierarchical structure has 3 levels: the whole (level 1), parts of the whole (an arc and a straight line) - level 2, and parts of the lines - separated equidistant dots (level 3).

Here is how Metzger describes a similar stimulus (Fig. 3): "The dotted pair of circles is hardly different from two regular circles. There are not forty-two dots, but rather two circles with dots on them. Gestalt laws work unchanged despite partition and interruption"

The Gestalt is always the description of parts of the whole and their spatial relations (level 2). Changes to level 3 don't disturb the Gestalt of the stimulus as long as the level 2 stays intact¹. Some particular arrangements of the parts have a name (like triangle or cross). The Fig. 4 is perceived similarly to Fig. 1 as a horizontal line and a vertical line, but in an experiment it will be reported as "T" because "T" is a symbol for two lines in this particular arrangement. In this

way Fig. 5 is perceived as three lines, and Fig. 6 is also perceived as three lines, but reported as character “H”.

How in our perception of Fig. 2B do a line and an arc appear? The answer is in the definition of Gestalt: “Gestalt is a short description of the procedure that creates the given stimulus” [7]. Fig. 2A was created as follows: the pen was moving along an arc, and then along a straight line. Fig. 2B was created similarly: the pen was moving along the arc and the straight line but **without touching the paper**, descending on the way in equal intervals (thus creating the dots). As a result we perceive these two images as the same Gestalt: “an arc and a straight line”.

NAVON’S ANALYSIS OF COMPOUND STIMULI

Navon used in experiments as visual stimulus a compound letter: big printed capital letter “H” (Fig. 7) consisting of small “S”. He found that in tachistoscopic experiments, after subjects recognize the big letter they can’t recall from which small letters (H or S) the big one was constructed. That was claimed as proof of certain Gestalt statement: “The whole is perceived first and then influences perception of parts”. Navon accepts that the perception proceeds from global analysis (perception of the whole and its parts) in more and more fine-grained analysis of the parts, subparts etc, and emphasizes the importance of low-resolution information. Consequently, the perception of the compound letter – the main experimental stimulus of the global precedence paradigm (Fig. 7) – is as follows.

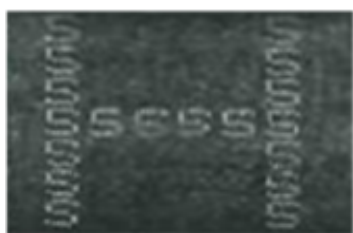


Fig. 7

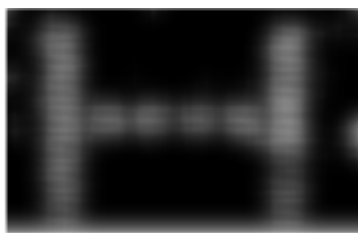


Fig. 8

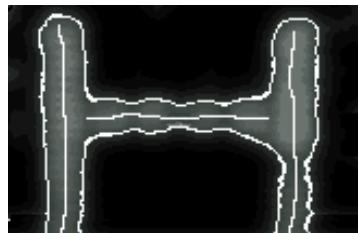


Fig. 9



Fig. 10



Fig. 11

At the first moment of perceiving the stimulus (Fig. 7), our fovea vision is focused on an arbitrary point of the stimulus. The rest of the stimulus we perceive by peripheral vision. This means that most of the image is blurred, and looks like Fig. 8.

The next step is separating figure and background (Fig. 9). The figure is recognized as a linear drawing (because of elongated shape of the spots, and approximately parallel borders) created by a pen of definite width. The percept is transformed into a one-dimensional line – the path of the centre of the pen – the trajectory. By applying the “good continuation” principle, the trajectory is perceived as three lines (three movements), and then identified as the letter “H”. So, at this moment the subject’s task (responding with the name of the letter) was resolved without knowing that the stimulus contains many small “S”. That explains why in

tachistoscopic presentation subjects have difficulties answering the question: "From which small letters is the large 'H' constructed?"

The same scenario of perception can be applied to more complicated compound stimulus, such as the portrait of the "bearded man" (Fig. 10). The image in Fig. 11 is formed by peripheral vision, and will be interpreted as a face (the whole), and the spots will be identified as parts of the face – the eyes, the mouth, the ear etc. To perceive the details (structures of the parts) one will need further observation by moving the gaze to the informative spots (the parts).

It is clear that from Navon's general model of human perception the whole and its parts are perceived at early stages of perception but recognition of the inner structure of the parts (the details) takes more time. So, it is trivial that when perceiving the compound stimulus we first perceive the whole (i.e. the parts and their particular configuration), and then we perceive the details (the subparts) – the small letters. But Navon rejected this interpretation and built a theory of *global precedence*, which (as he hoped) will bring him to a very different interpretation of the same experimental results, which will support the holistic concept – dominance of the whole.

ANALYSIS OF "GLOBAL PRECEDENCE"

Navon introduced the *global precedence* principle in 1977. The main notion of his theory is that of the **global**, which the author describes as follows: "*The globality of a visual feature corresponds to the place it occupies in the hierarchy. The nodes and arcs at the top of the hierarchy are more global than the nodes and arcs at the bottom*" [1]. One can see that in this description:

1. Because the nodes of the hierarchical structure are occupied only with parts (except the top level – the whole), it is not clear what is the *visual feature*, which also occupies a node in the hierarchy. **This term was never defined** by the author, and the natural assumption is that the *feature* means *part*, but in different parts of the article it was associated with different meanings. This opens the possibility of different interpretations of the conclusions of the theory.
2. All arcs in the hierarchical structure are identical – they present the relation of inclusion between parts and wholes from the previous level. Each arc (relation of inclusion) connects two adjusted levels, and doesn't belong to any particular level. Therefore the characteristic ***global can't be applied to an arc.***

In a 1981 article, Navon explains the term global in details. He creates the globality scale for the compound letter, making a start from a 3-level hierarchical structure of its percept: the whole (level 1), the parts (level 2), and subparts (level 3) – see right part of the Fig. 12 [5].

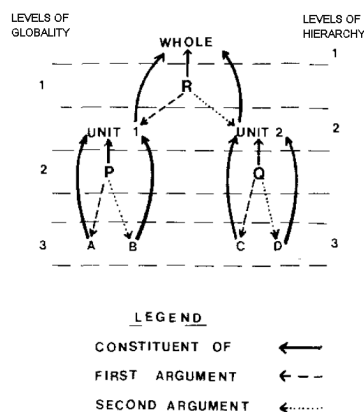


Fig. 12

For the compound letter “H” at the top will be the whole – the “H”, the second level will be occupied by its parts “two vertical lines and a horizontal one”, and level 3 is comprised of small letters “s” (subparts of three lines).

As we mentioned above in the paradigm of hierarchical structure the experiments with compound letters can produce only trivial results, and Navon decided “to rephrase (?) the logic underlying the usage of compound letters for testing global precedence” [5]. Here is how he did it following the schema in Fig. 12.

1. The main objects of perception – the whole and the parts of the whole (Unit1 and Unit2) were excluded from the globality scale. That means that the global precedence is no longer a whole-part problem.
2. The relation R between the parts of the whole (level 2) is not present in the initial hierarchical structure (which consists only of wholes, parts and relations of inclusion between the levels), and therefore couldn’t be assigned to any level of globality, which is demanded by definition of globality (see above).
3. Relations P and Q between the subparts of the whole (level 3) were separated from their arguments a, b, c, and d, and moved from level 3 to level 2. The subparts a, b, c, and d were assigned to level 3. As a result, levels 1 and 2 were populated only with phantoms, i.e. relations without arguments, and level 3 was populated only with subparts, while their parents (parts of the whole) disappear from the new structure altogether.
4. It was not specified which level in the hierarchical structure of the whole has to be identified with the local level.

All of this together shows that the notion of *globality* is poorly defined, internally contradictory, and arbitrarily constructed. Not a single conclusion based on this concept could be understood and accepted. After this the author presented the algebraic part of his theory. It starts with the statement:

“A **stimulus** is defined by its **elements** and their spatial relationship; e.g.,

$$\text{Whole} = R(\text{Unit } 1, \text{Unit } 2)", \quad (1)$$

It raises three objections:

- 1) The *whole* (an object of the psychological domain) is not a *stimulus* which is an object of the physical domain.
- 2) The *whole* is not a *relation*. The correct way to mathematically represent the meaning “is-defined-by” is to define the whole as a triplet $W\{R, \text{Unit}1, \text{Unit}2\}$.
- 3) The term *element* is not defined.

After this the author tries to get rid of the parts. The fact that the perceived whole of the compound letter doesn’t depend on which small letters were used, was presented by the expression:

$$A = R(\text{anything}, \text{anything}) = R(a, a),$$

where A is the whole, and a is a local element, i.e. a small letter. It means that the **whole** is defined not by its parts (objects of level 2) and their relationship, as was claimed in “equation” (1), but by its **elements** (small letters, objects of level 3), and **wrong** spatial relationship R, which is a relation among **parts** (objects of level 2). The desired result was achieved: after a chain of illegal operations, level 2 containing the parts of the whole was arbitrarily wiped out. Now the details from level 3 (small letters) were declared parts of the whole, and no doubt it

will be found in the experiment that they will be perceived after the whole. The global precedence paradigm is ready

Because of chaotic use of terms, the author produces many declarations of global precedence including this one: “**Features of a high-level unit precede the features of a lower-order one**”. It shows that after 30 pages of constructing the notion of *globality*, and after using the word *global* more than 200 times, the notion *global* was found by the author **to be redundant**.

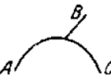
GLOBAL AND LOCAL CONTRADICTIONS

1. The general goal of global precedence was the investigation of whole-part relations, but the solution – the theory of global precedence - doesn't include the notions of *whole* and *part* at all.
2. The main notion of global precedence is the globality-locality relation, but the main claim of the theory is presented by the author without even mentioning the terms global and local: “Features of a high-level unit precede the features of a lower-order one”.
3. The term ‘feature’ (mentioned above) denotes a set of inconsistent notions: the part, the relation, the subpart, the structure, the frequency component, and the geometrical object.

The contradictions exist not only on the global scale, within the theory of global precedence as a whole, but in every ‘local’ piece of text. For example here is a quote: “The elements are not the features of the global form. They are constituents on their own, like an eye is within a face. How can that advantage tell us anything about global precedence in a stimulus (like the letter H) that unlike a face has no separate local constituents, just features (e.g., the horizontal bar) that make up the whole?” [5].

Let us divide this passage into simple statements:

1. *The eye is a constituent of the face.* It means that the eye is a part of the face (the whole).
2. *A face has separate local constituents.* In the image, hair is not separated from the ears, and the mustache is not separated from nose and from mouth.
3. *Letter H (not the compound letter) has no separate local constituents.* It is absurd.

According to Wertheimer, the stimulus  is perceived as two parts – an arc and an appendage – despite the fact that they are not separated. Navon's mistake here (as well as in many other places) is that he doesn't differentiate the objects of the physical world from objects of our perception. In the physical world “H” as geometrical object is one figure (a connected set of points), but we perceive it as three parts.

4. *The letter H has just features (e.g. the horizontal bar).* If the horizontal bar is a feature, we can consider that the two vertical bars are also features of “H”.
5. *The features make up the whole.* Taking into consideration the previous point (4), we get: “Two vertical bars and the horizontal bar **make up the whole**”. This disavows Navon's description of compound letter as “large letter **made up** of small ones”.

CONCLUSION

From the experiments with compound letters can be made only one conclusion: the whole (the big “H”) is perceived earlier than the details (small letters), which is trivial. To avoid the triviality the author proposed a theory of *global precedence* based on the new hierarchy – the globality hierarchy, which is ambiguous and inconsistent. To each of the terms introduced by the new theory (globality, locality, feature, element, and global structure) were ascribed several meanings. Based on these variables the author presented some inadequate mathematical constructions, applied to them illegal operations, and make illogical

transformations producing in the end the formula of the *global precedence*: “Global features precede local features”. This statement can’t be reasonably interpreted, and it is not a wonder that many readers transformed it into the understandable “The whole before the parts” – prompted by the author himself with the title of his paper: “Forest before the trees”.

Drawing illogical conclusions from these poorly defined terms, the author came up with five different formulas for the *global precedence*. The biggest paradox is that one of the formulas suggested by Navon doesn’t contain the terms *global* and *local* at all: “Features of a high-level unit precede the features of a lower-order one”.

For experimental proof of the global precedent principle, the author used mainly one stimulus – the compound letter. Navon describes the percept as a 3-level hierarchical structure: the whole, the parts, and the subparts (see Fig. 12). He arbitrarily identifies the local level of globality structure with the subparts level, the global level with the whole, and gets in the tachistoscopic presentation the foreseen result: the perception of the whole precedes the perception of details.

As the sense of the statement “Global structure precedes local features” wasn’t clear, many readers transformed it into the understandable “The whole precedes the parts”, despite the author himself rejecting this interpretation. Why did this happen? One reason is the ambitious title of the article: because in the article the word forest was not mentioned, readers perceive the title as a general statement: the whole before the parts.

The second reason was the ambiguity of the terms introduced in the article. As a result the reader substitutes the obscure terms with terms well known in Gestalt theory. A representative example is the article “Global precedence” in Wikipedia. It starts not with definition of the principle, but with redefinition of the basic terms: “Images and other stimuli contain both local features (details, parts) and global features (the whole)”.

The third reason was that Gestalt psychology always positioned itself as a holistic philosophy, and promoted the dominance of the whole: “We perceive whole not parts”.

In general Navon’s paper suffers from two methodological mistakes – one experimental, and one theoretical:

1. The paradigm implicitly supposes that from the very beginning the percept of the stimulus is available in all details and our perception is free to decide what will be processed first, the global picture or the details. In the described tachistoscopic experiments after the first 100 msec only the blurred image is available. This is enough for perceiving the whole (the big “H”), but no details are available. Only later, when our attention shifted the gaze to the salient objects, the fovea vision can deliver the details.
2. In the paper, characteristics of objects belonging to the psychological domain are mistakenly applied to objects of the psychological domain.

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Captions:

Fig. 7 Bearded man

Fig. 8 Bearded man in peripheral vision

Fig. 9 Compound letter H made up of small s's

Fig. 10 Blurred stimulus

Fig. 11 Perceived lines (parts of H)

Fig. 12 Levels of hierarchy and globality