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ON BAR-HILLEL HYPOTHESIS

> Not in every actual communicative situation could every indexical sentence be replaced, without loss of information, by a non-indexical sentence; but there is, on the other hand, no indexical sentence which could not be replaced by a non-indexical sentence, without loss of information, in some suitable communicative situation (Bar-Hillel 1954: 369).

The statement is a conjunction of the following sentences:

(BH) There is a communicative situation and an indexical sentence, such that the sentence cannot be replaced, without loss of information, by any non-indexical sentence.

(1) There is no indexical sentence that could not be adequately replaced by a non-indexical sentence in some suitable communicative situation.

We call (BH) 'Bar-Hillel's Hypothesis'. In his article, Bar-Hillel considers some other semiotic issues as well, but – in our view – it is (BH) that deserves the title of a distinct and theoretically appealing hypothesis.

The aim of our paper is to expound (BH) and to consider arguments for and against it. In particular, we shall refine the notion of indexical expression and sketch a modest research project in connection with (BH).

1. The analysis of (BH) should begin with its precise formulation. To this end, we shall employ the concept of *substitutional set* introduced by Barbara Stanosz (1974). By "the substitutional set of an indexical sentence p" we mean the set of non-indexical sentences obtained by using the following method:

– We transform p into a sentential function by replacing the indexical expressions, occurring explicitly or implicitly in p, with variables.

– We transform the sentential function back into a sentence by substituting the variables with constants, or by binding the variables with existential quantifiers.

For instance, the substitutional set of the indexical sentence "He does not love her" will contain the following elements:

(2) Caesar does not love Cleopatra.
(3) Caesar does not love someone.
(4) Someone does not love someone.

The problem of eliminability of indexical expressions can be intuitively framed as follows: does the substitutional set of an arbitrary indexical sentence p, uttered in a situation s, contain a sentence that carries the same information as p? So formulated, however, the problem has a trivial negative solution. Imagine a situation in which someone utters the sentence "Look at this". As it happens, there is no constant term (no proper name) in the language that would stand for the demonstrated object. If we suppose that the sentence was uttered in a non-empty context, then no member of its substitutional set will contain a sentence carrying the same information as the indexical sentence did. For the indicated thing has no proper name in our language.[1]

Many things we talk about in ordinary language lack distinct names – we refer to them with the help of descriptions. Thus our specification of the ways of obtaining the elements of a substitutional set should be supplied with a method of obtaining a sentence synonymous to the initial indexical sentence via substituting definite descriptions for variables.

Let us call this new research tool a quasi-substitutional set of an indexical sentence p. Generally speaking, it is a set of (non-indexical) sentences obtained from p by means of the following method:

– We transform p into a sentential function by replacing the indexical expressions, occurring explicitly or implicitly in p, with variables.

– We transform the sentential function back into a sentence by substituting the variables with constants or definite descriptions, or by binding the variables with existential quantifiers.

For example, the quasi-substitutional set of the sentence "He does not love her" contains the following sentences:

(5) Caesar does not love Cleopatra.
(6) Caesar does not love the last queen of Egypt.
(7) The author of *The Gallic Wars* does not love the last queen of Egypt.

The notion of quasi-substitutional set allows us to reformulate (BH) as follows:

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[1] We regard general names taken in personal supposition as indexical expressions.

(BH') There is a communicative situation *s* and an indexical sentence *p*, such that the information carried by *p* in the context of *s* differs from the information carried by any sentence *q* belonging to the quasi-substitutional set of *p*.

2. For a complete analysis of (BH) it is not enough to translate Bar-Hillel's original formulation to a language containing the term "quasi-substitutional set": in addition, one must explain the nature of indexical expressions, communicative situations, and the information carried by a sentence. So long as these terms are not given a clear meaning, any attempt to determine the truth value of (BH) will be futile. In what follows, we shall limit ourselves to the task of elucidating the first of these concepts.

3. In this paper, we accept the following characterization of an indexical expression:

E is an indexical expression when some semiotic function of *E* depends on the context of use of *E*.

This definition differs from textbook formulations, which do not speak of contextual dependence of an arbitrary semiotic function, but of the dependence of the *extension* function. Such definitions are too narrow, since it is not only extension that can be determined by context. Let us consider the following utterances:

(8) "I am right, you are wrong" (uttered by Jakub Szymanik in a conversation with Tadeusz Ciecierski) means the same as "Jakub Szymanik is right, Tadeusz Ciecierski is wrong".

(9) "I am right, you are wrong" (uttered by Tadeusz Ciecierski in a conversation with Jakub Szymanik) means the same as "Tadeusz Ciecierski is right, Jakub Szymanik is wrong".

The shift of context (the speaker, the recipient, and the time) entails a change in the situation described by the sentence (the semantic correlate of the sentence).[2]
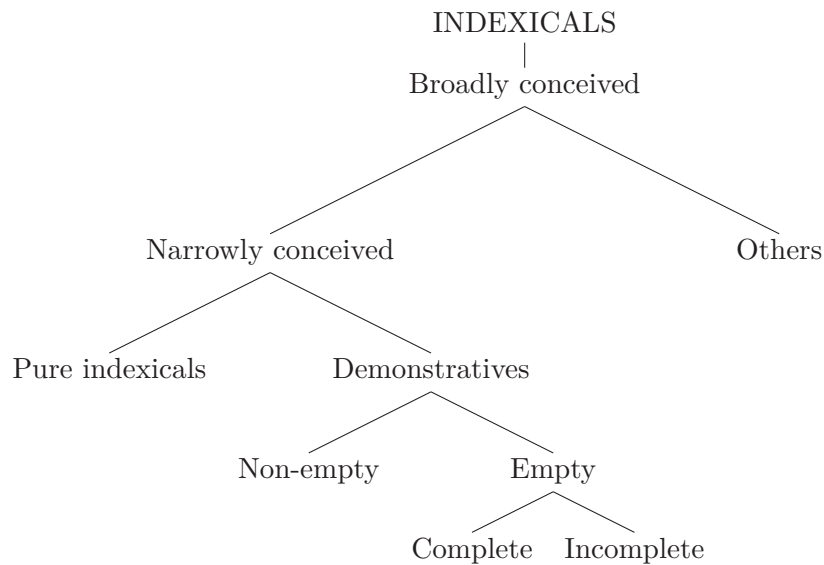
The above-mentioned definition is in accord with dividing indexical expressions into narrowly and broadly understood indexicals. According to the narrow sense, one may call 'indexical' any expression whose semiotic functions depend on context in a *regular* way, e.g. "I", "now", "here".[3] Indexicality in the broader sense includes,

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[2] We distinguish extensions of sentences from semantic correlates of sentences: the former are truth values, the latter – situations described by sentences. Also other semiotic functions, especially pragmatic ones, can depend on context. Furthermore, such definitions ascribe the property of indexicality only to names and sentences while denying it, e.g., to functors, which lack extension. Yet, if verbs are not the paradigm case of indexical expressions, then what is?

[3] That is to say, there is a rule linking the value of a semiotic function of an expression to the context, e.g. "I" always refers to the speaker (producer).

apart from the indexicals in the narrower sense, all expressions whose semiotic functions depend on the circumstances in an irregular manner.[4] Indexicals in the broader sense include, e.g., the proper name "Socrates", which could be used to refer to various people (consider the well-known Brazilian footballer from the eighties), whereas it is rather difficult to provide a rule associating the reference of "Socrates" with a context.

The class of narrowly understood indexical expressions can be divided in various ways – we have decided to employ David Kaplan's classification put forward in "Demonstratives" (Kaplan 1989). We shall distinguish, therefore, between pure indexicals, whose semiotic functions are dependent on the contextual parameters (the speaker, the addressee, the time, etc.) and demonstratives, whose semiotic functions depend on the accompanying demonstration. Demonstratives, in turn, divide into empty and the non-empty ones. The empty demonstratives have no referents, either due to the lack of an associated demonstration or due to the referent's non-existence (e.g. "this Pegasus"). Following Kaplan, we call the former 'incomplete' and the latter 'complete' (but vacuous) demonstratives. The classification can be illustrated by the graph:

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                        INDEXICALS
                            |
                      Broadly conceived
                       /            \
            Narrowly conceived        Others
              /          \
      Pure indexicals   Demonstratives
                         /        \
                  Non-empty      Empty
                               /      \
                        Complete    Incomplete
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[4] Our understanding of the phrases "broad indexical" and "narrow indexical" differs from what is customary in the literature, see Perry 1979.

The discussion so far has shown that we deal, in fact, with at least two versions of (BH) – the broader one and the narrower one:

(BHB) There is a broadly understood indexical sentence p, and a context s, such that the information carried by p in s differs from the information carried by any sentence q belonging to the quasi-substitutional set of p.

(BHN) There is a narrowly understood indexical sentence p, and a context s, such that the information carried by p in s differs from the information carried by any member of the quasi-substitutional set of p.

It is worth stressing that if the narrower version of Bar-Hillel's hypothesis is true, then also the broader one is true (and falsity of (BHB) entails falsity of (BHN)).

4. The rules determining the dependence of semiotic functions on the context must involve a variety of elements that affect those functions: the time and place of the utterance, the object demonstrated by the speaker, and so on. These elements constitute what may be called 'the maximal pragmatic context'. We reserve this label for a somewhat artificial entity – the set of all parameters which affect the semiotic functions of a narrowly understood indexical utterance. In accordance with tradition such contexts may be represented by sequences of parameters. For instance, the sentence "You bought a Porsche, not a Mercedes" is associated with a context consisting of the sequence of parameters:

(10) $<$the speaker: x_1, the recipient: x_2, the time of utterance: $x_3 \ldots >$

The ellipsis represents all remaining parameters which describe the communicative situation but have no impact on the semiotic functions of the utterance in question. The maximal pragmatic context is an abstract entity that enables the analysis of any narrowly conceived indexical utterance.

A context is, briefly, the material circumstance of an utterance from which a participant of the communicative situation decodes semiotic properties of the utterance which are relevant to communication. Of course, the context is not identical with the material circumstance of the utterance – in particular, two identical utterances used in different material circumstances may take place in the same context, e.g. when we point at John during a football match and say "he", the context is the same as in the case of indicating John during a basketball game. Hence the crucial meaning of the concept of *the language user selecting relevant elements of the material circumstance of an utterance* for the notion of context. The context of the two utterances in our example is identical, since the same element is isolated from different material circumstances.

The idea according to which a language user creates a context by picking out certain elements from the material circumstance of the utterance might suggest

that the context is constituted by some proper part of information available to the participants of communication.[5] This hypothesis calls for some clarifications. First, among the context-dependent expressions one may discern those which select their reference automatically and those which fix it intentionally. The first class includes all expressions whose reference does not depend on intentions or beliefs of the speaker,[6] e.g. if for some reason we are convinced that today is the 19th of February, while in fact it is February the 18th, the word "today" uttered by us refers, despite our conviction, to the 18th, not to the 19th of February. The semiotic functions of intentional expressions are dependent on our attitudes.[7] If I point at an object and say "This picture is beautiful", it is easy to tell which picture I have in mind. It is the object which *I intended to indicate* that should always be considered the proper referent of my demonstration.[8]

The existence of expressions automatically dependent on the context seems to be a strong argument against the hypothesis identifying contexts with information. For, if the context's operation is sometimes independent from our beliefs, it cannot be identified with a certain fragment of those beliefs. The problem could be solved by introducing the notion of *an ideal observer of a communicative situation*, namely, an individual whose knowledge of the parameters of the context is complete. The actual participants of a communicative situation have contextual beliefs; however, they need not be either true or relevant to the semantic features of the expressions constituting the utterance. Thus we can easily define intentional indexicals as those affected only by parameters whose value must be agreed upon by the actual and the ideal participants of the communicative situation.

This approach has several advantages. First, it allows us to regard contexts as something independent from the language user – our ideal observer together

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[5] Such a set of beliefs (information) would contain sentences about identity of certain objects with values of context parameters; e.g. "The current speaker = John Smith", "The time of utterance = 7.45 p.m.", etc. Below, we shall call the set of such beliefs 'contextual knowledge' or 'contextual beliefs'.

[6] The class of those beliefs is not easy to determine; it should certainly include those mentioned in the previous footnote. But not all of them: for instance, when I use the intentional expression "he", I denote an object which I have somehow pointed at, even if the indicated person is not the person I believe I have pointed at. In such situations intentions must be distinguished from the above-mentioned contextual beliefs.

[7] With the qualification mentioned in the previous footnote.

[8] It may be objected that by making the reference dependent on intention, i.e., by saying: "*A* refers to *O* by means of *E*", rather than "*E* refers to *O*", we give up talking about the truth conditions of a sentence. That does not seem right to us – the intention determines only what is talked about (in the case of names) and what is said (as regards sentences), the two latter elements constitute (in the first case) the truth conditions of sentences (i.e. situations that would make the sentences true if they occurred) or are simply sets of such conditions.

with all his knowledge is an entity isomorphic to the set of the parameters of the context. Second, representing context as a set of propositional attitudesallows us to easily compare the knowledge of users to the actual state of the world. By giving autonomy to the context, we free ourselves from the problem of the automatic indexicals, and, furthermore, we are able to compare the actual and the ideal sets of contextual beliefs.

5. Arguments for (BH):

The existence of essential indexicals. Let us consider the sentences:

(11) It is 4.30 p.m. now.

(12) The entrance to the museum is here.

(13) 4.30 p.m. is 4.30 p.m.

(14) The entrance to the museum is the entrance to the museum.

Are (13) and (14) adequate paraphrases of (11) and (12), respectively? We intuitively object to such a solution. In certain situations a person who accepts (11) or (12) will behave quite differently than a person accepting (13) and (14). The simplest explanation of this fact is that the informational content of (11) and (12) substantially differs from the content of their eternal[9] translations – in particular, it contains information about the spatiotemporal location of the language user.

Indexicality of many seemingly non-indexical expressions. If we consider the broadly understood indexicality, it turns out that a lot of expressions commonly regarded as non-indexical, e.g. proper names, are indexical in character. If that is the case, the possibility of any procedure translating indexical sentences into the non-indexical ones becomes dubious.

Language acquisition. Plenty of words we use were explained to us by means of ostensive definitions. Each ostensive definition is an indexical sentence, so the ability to employ certain non-indexical expressions depends on our ability to use indexicals.

The knowledge of language users. Consider the sentence:

(15) It is raining now.

and its 'eternal' counterparts:

(16) It is raining in Warsaw on the 10th of January 2003, at 5.30 p.m.

(17) It is raining in the city at the geographical coordinates (21E, 52N) on the 10th of January 2003, at 5.30 p.m.

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[9] In Quine's sense (1986: 13–14).

First, if the user does not know the date, she might ascribe a different truth value to the sentences. Second, the eternal sentences, e.g. (16), sometimes contain pieces of information which do not belong to the content of indexical sentences.

Impossibility of selecting the adequate translation. When we replace indexical sentences with non-indexical ones we can substitute an indexical name with various non-synonymous, yet coextensive, descriptions, as we did in (16) and (17). We have no criteria for determining which one forms the accurate translation of (15).

6. The arguments listed above do not seem decisive to us, so we shall put forward some remarks that may become a point of departure for a critique of (BH). They are tips for declared opponents of (BH): sketches of possible lines of argumentation rather than solid objections. Naturally, all the following remarks apply only to the narrowly accepted (BH).

Obscurity of formulations. The notions crucial to formulating Bar-Hillel's hypothesis: *the communicative situation* and *the information* carried by a sentence, have not been sufficiently examined. As mentioned above, context can be conceived in two ways: as a material circumstance of the utterance (the external context) or as the beliefs of the language users (the internal context). It remains unclear how to interpret the concept of a communicative situation in (BH), although – as we have pointed out – context rather always is a mixed entity.

The notion of information carried by a sentence, though it has been given a great deal of attention, is not the clearest one as well. The classic studies trying to define the concept of information were written by Bar-Hillel and Carnap (1953), Dretske (1982), Barwise and Perry (1983), and Devlin (1991). These conceptions differ from each other with respect to, among other things, the degree of sensitivity to the phenomenon of intensionality. According to the simplest extensional account, the semantic information carried by a given sentence can be identified with a class of models in which it is true.[10] Of course, if a concept of information is to be plausible from the point of view of pragmatics, it must take into account the intensional aspects of natural language.

Examples. As we have noted at the very beginning, (BH) is an existential sentence, which means that, to justify it, it is sufficient to give at least one example of an indexical utterance which cannot be translated to an informatively equivalent eternal sentence. The onus of proof, then, lies with the advocates of (BH), while the skeptics can merely criticize the offered examples and wait for better ones.

Unfortunately, it is difficult to find decisive examples in the works devoted to indexicality. Instead, in the studies on pragmatics, one can encounter remarks similar to those by Marek Tokarz (1993: 116):

criticisms of the universal translatability view seldom appear now.

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[10] Or, in a nonequivalent formulation, with a class of possible worlds in which the sentence is true, or with the class of state descriptions to which it belongs.

Apparently, the students of pragmatics believe that this position is fundamentally mistaken.

In our opinion, the most interesting examples in support of (BH) are sentences containing essential indexicals, but even they do not settle the matter. The sentences can be paired with eternal counterparts that apparently carry the same information. The procedure of this assignment is based on the method of describing contexts which has been propounded by Bar-Hillel. The method reveals that the following are informatively equivalent:

(18) I am here.

(19) The person who utters a token of the sentence "I am here" on the 10th of January, at 5 p.m., at the geographical coordinates (21E, 52N), is at the Institute of Philosophy of the University of Warsaw.

(20) <the token of a sentence: "I am here", the speaker: Jakub Szymanik, the location: the Institute of Philosophy of the University of Warsaw, the time: January 10th 2003, 5 p.m.>.

as well as:

(21) It is 4.30 p.m now.

(22) <the token of the sentence: "It is 4.30 p.m. now", the speaker: Tadeusz Ciecierski, the location: Warsaw, the time: January 10th 2003, 1.30 p.m.>.

Admittedly, such choices for the eternal translation may be criticized as artificial and arbitrary, but, until the notion of *informational equivalence of sentences in a communicative situation* is not precisely defined, the method should not be dismissed. On certain construal of (BH), the method could probably form a good counterargument against Bar-Hillel's intuitions, yet, on the other hand, it might not be the case with regard to all interpretations.

Seeming indexicality. Each opposition to (BH) lies on the assumption that there are non-indexical expressions. Otherwise (BH) would be trivially true. The assumption seems justified at least in the case of the narrowly understood indexicality. There is a difference between general names, such as "dog", and indexical expressions, such as "I". The reference of the former consists of the set of objects satisfying given conditions, whereas the reference of the latter depends on the context (is a function from the contexts to the universe of discourse). We may treat names as logical constants and the narrowly accepted indexicals as variables.

Language acquisition. Although using ostensive definitions involves employing indexicals, this fact alone does not bear evidence to the truth of (BH). On the contrary, infallible use of indexical expressions in order to indicate objects we talk

about may be regarded as evidence for the thesis that in a specific situation we are able to 'de-indexicalize' those expressions. When I point at a dog and say "This is a dog", I know that the indexical expression "this" in this particular situation corresponds to the noun "dog". If an English-speaking person points at a dog and utters the sentence "This is a dog", nobody doubts that in this particular situation she identifies the reference of "this" with the reference of "dog".

It would be interesting to carry out psychological research into the capabilities of using indexicals among infants, children, and adults, and to compare the results. Such a research might prove stimulating for the logical theory of indexicals and, consequently, would help verify (BH). One can also regard (BH) itself as an empirical thesis and conduct psycholinguistic research into the ways of understanding indexical sentences and their eternal translations in certain situational contexts. Nevertheless, in order to do this research reliably, a precise conceptual analysis is in order that will clarify the meaning of (BH).

The beliefs of language users. Knowledge (including logical knowledge) of language users is never perfect, but this fact does not seem particularly significant for the theory of language. It is important that the eternal translation of an indexical sentence should be informatively equivalent. Some language users do not regard the following sentences as equivalent:

(23) It is not the case that I both passed the exam and wrote the program.
(24) I failed the exam or I did not write the program.

Similarly, the majority of language users do not consider the following as equivalent:

(25) For every family of non-empty and mutually exclusive sets, there is a set which shares precisely one element with each member of the family.
(26) The Cartesian product of any family of non-empty sets is non-empty itself.

However, we know that from the logical point of view (25) and (26) carry the same semantic information, namely, they are true exactly in the same situations. The beliefs of language users have no impact on the logical relations between sentences and, likewise, they should not affect their informational content. In light of this fact, the arguments invoking knowledge of language users appear unconvincing.

Translation. What weighs in favour of (BH) is the lack of exact and unambiguous rules for translating the indexical sentences into the language of eternal expressions: the last word belongs to a competent language user, who decides whether two sentences are equivalent. Yet a situation of this kind is characteristic of all investigations within the framework of the theory of language. A linguist

does not have a choice: the only way to assess her theories is to confront them with the communicative behaviour of members of the linguistic community. This situation is forced by the object of linguistic study, which, to a considerable extent, is a social entity. Consequently, the problems with translating indexical sentences do not fundamentally differ from the problems of arbitrariness, which we encounter in other fields of linguistic theory, for instance in the analysis of propositional expressions or in the conversational logic.

7. In this paper we have tried to analyse Bar-Hillel's Hypothesis. The conclusions we have reached can be summarized as follows:

– It is possible to translate Bar-Hillel's Hypothesis into a formula involving the notion of a quasi-substitutional set; such a translation shows that there are two (interesting) techniques of translating indexical sentences into non-indexical ones: the first one consists in substituting the indexicals with names, and the second one – in substituting them with descriptions.

– The concept of *indexical expression* can be understood broadly or narrowly; accordingly, Bar-Hillel's Hypothesis has two versions.

– A communicative situation (pragmatic context) has an external and an internal component: both can be coherently represented by introducing the notion of *an ideal participant of a communicative situation*. By means of this notion one can define other useful pragmatic concepts: *an intentional indexical* and *a communicative misunderstanding*.

– The arguments cited in favour of Bar-Hillel's Hypothesis, in our view, do not settle the controversy regarding its truth. Among them, one can find very weak reasons, such as those invoking the knowledge of language users, but there are also several appealing arguments such as the ones invoking essential indexicals or language acquisition with the help of ostensive explanations. The final verdict, however, should be postponed until the concept of information carried by a sentence is sufficiently elucidated.

The less important results of this paper include the following:

– We have shown the inadequacy of the definition of indexicals which assumes that the extension of an expression is the only semiotic function that is determined by context.

– We have offered a classification of indexicals.

– We have put forward a simple modification of the concept of *substitutional set*.

In the future, we would like to propose a refinement to the notion of semantic information. Let us hope that if this project succeeds, then pairing its results with the theory of indexicality and context sketched above will allow us to determine the truth value of Bar-Hillel's Hypothesis.

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