Three Alternatives on Contexts[1]

Carlo Penco
Dipartimento di Filosofia, Università di Genova
penco@unige.it

Context is a concept used by philosophers and scientists with many different definitions. Since Dummett, we speak of the "context principle" in Frege and Wittgenstein: "An expression has a meaning only in the context of a sentence". The context principle finds an extension in some of Wittgenstein's ideas, especially in his famous passage where he says that "to understand a sentence means to understand a language" (*Philosophical Investigations*, §199). Given that Wittgenstein believes that "the" language does not exist, but only language games exist, we should conclude that he is speaking of the need always to consider a sentence in the context of some language game.[2] This general attitude is certainly attuned to the contemporary tendency to place contextual restrictions on the interpretations of our sentences. However, we find so many kinds and forms of restrictions that such a general attitude does not suffice to provide us with a viable tool to find an order in the web of the many different theories of context. To look for an order, or at least for some clarification, we may start with two contrasting theoretical paradigms: the "objective" theory of contexts, where a context is a set of features of the world, and the "subjective" theory of context, where a context is a speaker's or agent's cognitive background with respect to a situation.[3] We have here not only two different ways of using the term 'context', but also two different

[1] I would like to thank the many people who commented on this paper: Horacio Arló Costa, Margherita Benzi, Paolo Bouquet, Gilles Fauconnier, Marcello Frixione, Michael Green, Diego Marconi, Marina Sbisà. Special thanks to the Pittsburgh Center for Philosophy of Science, where I first presented the schema of this paper, and to the Giunchiglia research group in Trento, which set up the great opportunity for discussing such topic at *Context 99*.

[2] Penco 1998 and 1999a provide an interpretation of Wittgenstein's remarks in this direction.

[3] We have to take into account another general distinction given by Perry 1997, among presemantic, semantic and postsemantic context (the term "presemantic" is used by Kaplan 1977, par.XXII). The presemantic context is what gives an ambiguous epression its linguistic meaning (in "I saw her duck under the table" we have to decide whether "her" is a pronoun or an adjective, or whether "duck" is a noun or a verb). The semantic context is what gives the evaluation of the terms once their linguistic role has been disambiguated ("her" is a particular person – "if" a pronoun; etc.). The post-semantic is some kind of presupposed encyclopedia which is taken for granted and never made explicit (when I say "it is one o' clock" I normally assume to refer to my time zone, unless the contrary is explicitly stated). Both pre-semantic and post-semantic contexts can be interpreted as cognitive contexts, i.e. as assumptions or explicit information for what is going on in the relevant situation. The semantic context is the "objective" context, the features of reality given in the semantic evaluation (however odd this may sound in the face of the limitation of semantic theory as far as the interpretation of lexical items is concerned - see Thomason 1991, Marconi 1997. In this paper we will not deal with this aspect of the matter).

conceptions of semantics and philosophy. Such different conceptions are normally associated, respectively, with the classical paradigm of model theoretic semantics (Kaplan, Lewis, Stalnaker) on the one hand and with the A.I. paradigm (McCarthy, Buvac, Giunchiglia) on the other hand. For the sake of simplicity I will mainly restrict my attention[4] to Kaplan 1989 and to McCarthy 1993 and Giunchiglia 1993. The two different conceptions can be summarised by means of the following schema:

a) context as:	b) context as:
set of features of the world <time, place, speaker,...>	set of assumptions on the world (+ rules) <axioms, rules>
"context is a package of whatever parameters are needed to determine the referent ... of the directly referential expressions" Kaplan 1989	"context is a group of assertions closed (under entailment) about which something can be said" McCarthy 1993
"each parameter has an interpretation as a natural feature of a certain region of the world" Kaplan 1989	"a theory of the world which encodes an individual's perspec- tive about it" Giunchiglia 1993

In "Afterthouhgts", Kaplan explicitly speaks of the “metaphysical” point of view in describing contexts, while in "Notes on formalizing contexts" McCarthy uses a notion of context which leads to the idea of "microtheory" (Guha) or to the idea of a subjective point of view on the world (Giunchiglia). Given these differences, I will distinguish the two conceptions of contexts as:

(a) "objective" or "metaphysical" (ontological), and

(b) "subjective" or "cognitive" (epistemic).

---

[4] Hints at a comparison between these two theories has been given by Thomason and Moore (1995), where the authors stress the fact that "there are difficulties with the view that contextual effects in natural language are confined to Kaplan-like effects". Also referring to these two theories Giunchiglia and Bouquet (1997) speak of a contrast between "pragmatic" and "cognitive" context, and Bouquet (1998) speaks of the contrast between metaphysical and cognitive context.

We have here two very different interpretations of what a context is: features of the world, or representation of features of the world. Apparently, the concern of the cognitive theory is wider than that of the metaphysical theory: the cognitive theory is concerned with *any* feature of the world, not just with the limited set devised by Kaplan (however enlarged by Lewis[5]). An inviting picture is often tacitly assumed: the two theories seem to correspond to two contrasting philosophical stances and two different kinds of formalism:

(a) the metaphysical theory is an expression of realism or objectivism, and goes hand in hand with model theoretic semantics (particularly with direct reference theory and with the double indexing);

(b) the cognitive theory is the expression of an anti-realistic attitude typical of cognitivism and subjectivism; it goes hand in hand with computational, mostly syntactic, solutions (with predicates of belief that take names of propositions as arguments).

I don't think this pairing of theoretical interpretations and kinds of formalism is correct. On the contrary, it seems to give an oversimplifying and misleading picture. To link multi-context theories with a subjectivist view represents a dangerous step which would cast a useless restriction on such theories. On the other hand, it would be possible to use model theoretic semantics to represent a subjective point of view (think also of autoepistemic logics). However, to make the contrast simpler, I will keep this general oversimplification as a starting point.

Eventually, the discussion should be carried out at a logical level. From this point of view, we may think of the contrast between model theoretic semantics and local model semantics.[6] Which formalism can better express our basic intuitions on the working of our language and reasoning? Shall we have a radical opposition or can we find an equivalence relation between the two paradigms? After all, alternative paradigms sometimes do converge.

In this paper, however, I will not carry out the confrontation at the logical level; I will discuss instead some philosophical aspects of the contrast between Kaplan's theory of

---

[5] In the 1981 postscript of Lewis 1970, Lewis says that the package of features of context should be extended. However, Lewis 1980 suggests that, besides the choice of building richer and richer indexes, we might leave most of the aspects implicit and at the same time extend double indexing (restricted by Kaplan to possible world and time) to include location and standard of precision. The criterion concerning which features should be packed into an index is: give only features that can be shifted.

[6] We have to distinguish a *semantic level*, where model theoretic semantics may face the challenges of inferential semantics of local model semantics, and a syntactic level, where a modal logic with belief operators is just an alternative to other syntactic solutions, such as a non-modal logic which uses predicates of belief on names of sentences. For a general discussion of these different solutions see Frixione 1994. Generally speaking, we may see two alternative directions:
(i) extending modal logic to include further cognitive aspects; see for instance Fagin and Halpern 1983, Thomason 1998 and Thomason (forthcoming);
(ii) leaving the predicate calculus as it is (even first order, if we like) and enrich the structure, giving more relations among different logical systems, as in multi-context systems; see for instance Giunchiglia, Serafini and Frixione 1993 and Giunchiglia and Serafini 1994. See also McCarthy (b)

demonstratives and McCarthy's theory of commonsense reasoning. Contrasting the two kinds of theories, we are offered different possible strategies:

(1) The two theories deal with different problems, and should be developed separately;

(2) The two theories have a large intersection, and should co-operate to solve problems which are not solvable by each theory separately.

(3) The two theories are reducible to each other, and it is to be decided which direction is the most promising.

As it often happens, probably no one of these possibilities is the right one; a more realistic and promising alternative could be a work of convergence which composes the best of each approach. The three alternatives, however, deserve a careful study because the problems posed by each of them can help to enrich our understanding of the possibility of the future research.

1. Separation

A separatist vision stresses the difference of aims and problems to be solved by the two kinds of theories.

The *theory of the metaphysical context* has been devised in order to treat the peculiar logical behavior of indexicals (expression like "I", "here", and so on). In classical semantics it was impossible to give a correct semantic value to sentences with indexicals because of their dependence on context. The classical example given by David Kaplan:

"I am here now"

is a sentence which is always true; however, it is not a necessary truth, because we cannot say that it is true in all possible worlds. I might have been somewhere else. Kaplan 1977 (parr. VI-VII) proposed a solution for the formal treatment of this kind of sentences (which, following Kripke's terminology, we might call "contingent a priori "). We have to distinguish between two indexes at which sentences are to be evaluated: on the one hand, we evaluate them at all circumstances (pairs of a moment of time and a possible world); on the other hand, we evaluate them at contexts of utterance (speaker, time and location). From this work onwards logicians began to speak of "double indexing"[7] to indicate this novel treatment of semantical evaluation. Double indexing is a tool to evaluate two different aspects of indexicals: one aspect deals with the objective context of utterance, and it evaluates the linguistic meaning of the indexicals, the "character", intended as a function that - given the

[7] Actually, double indexing was "invented" by Kamp in 1971 for a treatment of "now", and rediscovered by Kaplan for treating indexicals and demonstratives in general (see Kaplan 1977, par.VII).

context - gives the "intension" or "content" of the indexical. E.g. the character of "I" will be a function which gives, depending on each context, the way to refer to the speaker of the utterance in any possible world. It will give the "intension" of "I" as used in that context, that is the constant function which gives the same individual at each possible world.

In short, Kaplan develops the main idea of model theoretic semantics (the meaning of a sentence (its intension or content) is its truth condition), enriching it with a new level of semantic analysis, the level of character. While content or intension is a function from possible worlds to extensions, character is a function from contexts to contents. The peculiar behavior of indexicals is summed up by saying that indexicals (and demonstratives in general) have stable content (they are rigid designators) and unstable character (they map on different contents, depending on the context).

The *theory of cognitive context* has been devised in artificial intelligence to solve a problem of common sense reasoning. After the attempts based on non-monotonic logic, especially circumscription, McCarthy thought that a problem was still unsolved: the problem of generality. Any system of axioms can be transcended: we may al

wherhtahe a[illegible]pY“p§)1)H)’h Y□dis ch agninTsomve teneenc, truet iTsomve contex, b

pienCriClem oflaziness". Laziness guidts mostm ofourt intelleCxuialosptratn

e to

make it possible for us to navigate through them (e.g. I can assume that *p* is true in context A; then enter context A and derive *q*; eventually exit context A and assert that *q* is true in A). The study of among-context rules is one of the most promising novelties in this field of research. The framework inside which this work is done is the formal treatment of common sense reasoning, default reasoning and problem solving in actions

These operations or rules across contexts provide a general framework for defining contexts as a rich formal object, a new tool for the analysis of reasoning. Actually, McCarthy remarks that we cannot expect a definition of the concept of context in AI. We cannot expect to know what a context is: "instead, as is usual in AI, various notions will be found useful" (1993, p.1). Still, in most works on contextual reasoning contexts are regarded as assumptions associated with some circumstance; we shall therefore keep the distinction between contexts (sets of assertions representing the cognitive state of an individual or a group) and situations (states of the world at a certain time).[9]

Which conclusion can we derive from this first glance upon the two theories of context? The first conclusion cannot be anything but a modest answer: we have two theories with different purposes, different logical environments, different formalisms. Let us keep an eye on both of them and on their developments, but let us not try to mix oil and water.

This answer is too modest, because of the easy interconnections between the two theories. On the one hand, when indexes were first introduced into model theoretic semantics, Lewis considered the possibility of including a speaker's beliefs or background knowledge in the index, so that indexes could become somehow "cognitive". On the other hand, theories of cognitive context have to face the problem of the context of utterance and/or the context of the "external observer". After all, cognitive theories of context have been devised in order to deal with common sense reasoning, and in reasoning we use indexicals and demonstratives; how to cope with them? Can we find some sort of integration among the two theories? In the following I will try to evaluate some possible developments of this option.

---

[9] Thomason and Moore (1995) speak of situations in Situation Calculus as states of the discourse context, intended as "common ground that is appropriate for generating and interpreting referring expressions. This common ground not only draws on general background that any participant will normally share, but can exploit more particular materials they share as colleagues or close acquaintances." This could also be taken as a definition of cognitive context, where attention is paid not only to the sharing of assertions, but also to the sharing of rules. In our approach, however, a context is always understood as a limited and well defined set of rules, not as a general background, as in Stalnaker's view. What people share are mostly rules to navigate among contexts, which sometimes have to be defined depending on the problems coming up to be solved. We need in this case a partition of prototypical contexts which are supposed to be accessible to speakers, even if they are not actually possessed by them (along the lines of Putnam's deference).

2. Integration

In many papers, John Perry has emphasized the cognitive difference between character and content[10] and the relevance of the difference for belief and behavior. Just two examples, in a rough reconstruction:

- I am at a supermarket and I see sugar on the floor; I think something like "He, who is pouring sugar on the floor is really stupid; (therefore) I will go to the cashier to protest". Later I realize that the sugar is falling out of my own pack of sugar and I think something like: " I am pouring sugar on the floor; (therefore) I will reverse the pack of sugar". Here the indexicals "he" and "I" have different character and the same content (me, who is the same in all possible worlds). Only the differences of character prompt the differences of practical inferences.

- I am near a mirror and I see a bear attacking somebody; I believe he (the prey) is very unlucky and runs the risk of being killed and I am very sad for him. A moment later I realize that the reflex in the mirror is a reflex of me, and the bear is attacking me. I believe that the best thing to do is to run as fast as I can. In these two cases, the different character of "he" and "I" prompts two different lines of reasoning and action, linked to two different cognitive states. The content of my thoughts is the same, but the characters are different.

However, Kaplan's Logic of Demonstratives only allows for the general strategy that permits us to determine a content from a character + a context; to deal with the differences envisaged by Perry, we need something more. We need a theory that can help us to represent the cognitive relevance of the distinction between character and content. As Perry has abundantly shown, the difference in character has consequences on my cognitive state, on the set of my beliefs and the inferences I can derive from what I say. It is a tempting suggestion to consider the two theories as co-operating on different levels towards an integrated theory: the Logic of Demonstratives (LD) will represent the mechanism that makes it possible to derive the content from the character; a Multi-Context Theory (MC) can represent the mechanism that makes it possible to show the different cognitive contexts in which such a derivation is admissible. MC will represent the relations among contexts that license different inferences depending on the indexical used by the speaker in the objective context.

Think of a description of the two different contexts exemplified above:

(c1) a person is attacked by a bear without acknowledging that he is attacked;

(c2) a person is attacked by a bear and he acknowledges that he is.

---

[10] Actually Perry uses different terms, approximately corresponding to Kaplan's. I use Kaplan's terminology for the sake of uniformity.

Using McCarthy's operator "is true", we could have axioms such as

in c1: *is true* that the person referred to as "he" is attacked by a bear
in c2: *is true* that he(c1) = I
therefore
is true that I am attacked by a bear

Given that a general rule for reacting to an attack by a bear is to run away, if in c1 I believe that *he* has to run away, then in c2 I believe that *I* have to run away. However, in c1 I do not have the identity between the token "he" and the token "I". In c1 the person attacked by a bear does not run away and he is killed. That is, in c1 I am killed.

McCarthy insists on the philosophical neutrality of his idea of context: according to him, contexts are a mathematical tool, like groups. Like group theory, a theory of contexts should be considered as a theory that can be applied to whatever it can be applied to. However, it is difficult even to think of a theory of context in McCarthy's sense as formalizing Kaplan's idea of context. For Kaplan, a context is just a set of parameters (features of reality), whereas for McCarthy contexts are sets of assertions. It might be possible to embed a Kaplan-style theory of context within a multi-context theory, using different names for Kaplanian contexts (for instance "situations"). Actually, some attempts have been made to apply standard model theoretic semantics (based on Kripke models) to multi-context theories. However, there are doubts concerning the utility of such a compromise, while there are well grounded attempts to build a different kind of semantics for multi-context systems.[11] There are reasons, both philosophical and technical, that suggest an alternative view, where the *theory* of objective context is reducible to the *theory* of cognitive content (warning: without reducing the objective context or situation to the cognitive context).

3. Reduction.

The examples given above (Perry's supermarket and bear) show which inferences the logic of demonstrative cannot account for. However, we cannot ask a theory to do a job it has not been devised for. LD's work consists in making the step from contexts to contents. We cannot ask more of this theory, which in itself represents the best treatment of indexicals.

However, we may think of a general problem for LD. In order to work properly, LD presupposes that we assign certain values to the parameters (speaker, location, time). What happens when we are not able to give a fixed value to the parameters? Let us make a list of situations in which such a problem arises:

[11] See Giunchiglia and Ghidini 1998.

- situations of dialogue
  (continuous shift among different "I"'s)
- situations of vagueness
  (when "here" depends on an intended "there")
- situations of lying
  (when "here" is uttered to mean somewhere else)
- situations in which cognitive context is relevant
  (in general)

Let us reflect on some examples. Kaplan attaches great importance to the fact that utterances of "I am here now" are true in every context. However, I could truly say "I am not here now" in an answering machine, or I could truly write "I am not here now" on a post-it, attaching it on the door. If such tokens of “I am not here now” are true in the relevant contexts, then "I am here now" is false. On the other hand, when I utter or write the relevant tokens of “I am not here now” I am indeed there, so the tokens should be considered as true. Or

out of town. I tell the truth and I am sure that what my wife understands is false. LD just tells you that the speaker is in town, making the utterance true. It gives no hint at all to understand what is really going on.[13]

We might treat the previous examples under the “integration view”, where cognitive context has just the role to fix the value of indexicals, and LD begins after that. However, if we find too many uses of indexicals that require *ad hoc* adjustments, and many interesting uses of indexicals that cannot be accounted for in LD, we might think of an alternative paradigm. In the literature we find different suggestions to treat the multiform use of indexicals.[14] Quentin Smith suggests a rule for treating indexicals like "I" as referring to entities which have a relation with the speaker (with the speaker itself as a limiting case). This takes into account sentences like "I am short of petrol", and so on. Récanati suggests that indexicals and demostratives are not really self-reflexive tokens, but tokens whose linguistic meaning (or character) is basically intended to pick up some "relevance" relation: "here" picks up the relevant place, "now" picks up the relevant time, and so on. Being the place and time of utterance is just one of the many possible relevance relations. Certainly, since Lewis, there have been many attempts to enrich the metaphysical "context" with background knowledge and standards of precision. However, as background knowledge becomes more and more important in principle, we find it very hard to give it a formal treatment, even in the setting of the already complex arrangements of model theoretic semantics. Looking for alternative treatments could help to imagine new research strategies.

As I said before, the traditional answer of multi-context theories is that background knowledge is partitioned. Sentences and utterances are interpreted relatively to local models that depend on cognitive contexts, which could be interpreted as partitions of the background knowledge. We need a representation of these different partitions of our knowledge and rules to define accessibility among such partitions, which is exactly the aim of multi-context theories. But we cannot always take a well defined partition as a starting point; we may have

---

[13] This last case may fall under a general category of vagueness. Expressions such as "here" are really vague, and their interpretation strictly depends on cognitive assumptions and information, briefly on cognitive context. Sentences like "I am here now, at line *x* of page *y*" are common in a classroom. In Kaplan they should fall under the category of "demonstrative use of indexicals" (1977, par.2). However, we need some cognitive context to interpret them. You could say that what I am really saying is "I am *reading* here now". That is perfectly true. This means that Kaplan, saying "I am here now", is really saying "I am *staying* here now". Unless there is a particular metaphysics of the verb "to be" which has to be explained, we need to re-assess all our intuitions concerning sentences like "I am here now". In logic we abandoned the centrality of the verb "to be" and gave different interpretations of it (identity, predication, inclusion). If Kaplan translates "I am here now" into "position of physical body of Kaplan at location x and time y", we must also take into account alternative translations as "position of the awareness of the individual at location x and time y". Recanati (forthcoming) seems to be more radical, reducing indexicals to relevance-dependent expressions.

[14] See the examples in Smith 1989, Corazza 1995, Predelli 1998, Bianchi 1999 and Recanati (forthcoming).

to build it up *via* rules among other already defined partitions. Therefore, we need some mechanism to build up our cognitive contexts as the reasoning advances. In the literature, we already have some tools for this purpose: formal elaborations of bridge rules or other operations among contexts, the idea of working contexts and the idea of bridge rules, whose significance is in part still to be worked out.[15] If these ideas are put to work, the general framework of multi-context theory could be thought of as a way of treating in a unifying way all the cases LD is able to treat AND all the cases LD is not able to treat.

What do these programmatic remarks mean concerning our intuitive opposition between objective and cognitive context? The main point is that we can only speak of objectivity from some point of view.[16] The idea of an objective reality, independent of us, arises when there is conflict among different opinions and beliefs.[17] This does not mean that objective reality *depends* on a point of view; it means that we cannot *express* objectivity without placing ourselves in some contextual point of view.[18] Therefore, we have to provide constraints that go beyond the general definition of a logic of demonstratives, which represents a metaphysical view from nowhere. Let us try to explain this point better. Given a simple case, with an individual and an observer, some general constraints dealing with indexicals and demonstratives could be expressed in the following way:[19]

(1) the meaning of a sentence depends on speaker, place and time;
(2) the values of these parameters (speaker, place and time) must be represented
    (a) as part of the speaker's cognitive state,
    (b) as part of an observer's cognitive state.
(3) speakers and observers may evaluate these parameters differently; therefore, we need a representation that always explicates the cognitive context from which the evaluation of the parameters is made. We may explicitly represent this point of view as the point of view of the interpreter.

---

[15] These rules could, for instance, give a formal expression to those kinds of cognitive operations that go beyond (or come before) conceptualization in terms of stereotypes and frames; we may refer to the idea of "conceptual blending" developed by Gilles Fauconnier, which has not yet received a formal treatment. See Fauconnier and Turner 1998.
[16] Penco 1999a discusses more widely the concept of objectivity as a context-related notion.
[17] This point is widely discussed in Brandom 1994.
[18] We may *postulate* objective reality, e.g. the unique individual corresponding to "he" in all possible worlds, even if we know we might never be sure who "he" really is. The uncertainty of *who* he is, is the uncertainty of different kinds of recognition procedures and different causal or anaphoric trees or chains, which are no more accessible to us. Think of cases like Homer or Odysseus; we may refer to them saying "If Odysseus existed, *he* certainly was a great navigator".[18] Nobody doubts that we would be using "he" to refer to an objective entity, assuming that he existed. On anaphoric chains see also Penco 1999c.
[19] Here I am followking Bouquet and Giunchiglia (1997). The idea of the necessary interplay of three points of view (speaker, observer-reporter and intepreter) is developed in Brandom 1994.

A main point of these remarks is to treat indexicals within a framework of defeasible reasoning. Expressions such as "I", "here", "now" have such different uses that we need rules to distinguish not only the time and place of utterance, but also the time and place of the actual or intended audience, giving different restrictions when these are the same or different. What is more important, we need to plug into our formalism some rule that would permit an intended interpretation to be defeated in the face of new information on these aspects. We may give a formal treatment of the workings of our language *as if* there were an absolute point of view, from which to assign values to any parameters we need. However, in our linguistic interchange we just *aim at* objectivity and truth, and we have to explicitly embed in our formal representation of objectivity and truth the possibility of failure.

This result does not entail the elimination of an objectivity independent of human accessibility. It is a result about our forms of expressing objectivity as what we provisionally reach; we may also build theories with as-if condition (if the evaluations of the parameters are given, the theory would work as in Kaplan). But evaluations cannot always be given, and most often, when given, they are wrong. Our ontology is what we *say* the world is made of; therefore we need to take into account each time the point of view, the cognitive context where the objective state of affairs is presented as such. What we think objective may always result in a mistake.

4. Conclusions

At most, this paper could help to stimulate a comparison between theories, from both a technical and a philosophical point of view. The success of model theoretic semantics could yield suggestions even in a different framework, where researchers deal with problems - such as limited knowledge - which were not the basic concern of people working with traditional logical methods.

At least, this paper is supposed to provide some materials for reasoning about the different ways we use the term "context". A context is what we know about a situation: we might speak of "situations" as the set of physical features of reality (and fiction), and of "context" as the way of representing them. Alternatively, we might speak of "contexts" as the physical features of reality (and fiction), and of "views" as the way of representing them. We might also go on using the same term for different entities, using "context" both for certain physical features (speaker, time and location) and for a representation of our knowledge of a situation. But we can do so only insofar as the two contexts in which we do that do not come into contact. When they do, we must choose.

REFERENCES

Bianchi, C. (1999) "Three Forms of Contextual Dependence", in P.Bouquet, L.Serafini, P.Brézillon, M.Benerecetti, F.Castellani (eds.), *Modeling and Using Context - Lecture Notes in Artificial Intelligence 1688*, New York: Springer, 67-76.

Bonomi, A. (1983) *Eventi Mentali*, Milano: Il Saggiatore.

Bonomi, A. (1992) "Persistent Truths", *Intellectica*, 1/2:79-103.

Bouquet, P. (1998) *Contesti e ragionamento contestuale*, Genova: Pantograf.

Brandom, R. (1994) *Making it Explicit*, London: Duckworth.

Corazza, E. (1995) "Je suis un autre", *Archives de Philosophie*, 58:199-212.

Fagin, R., Halpern, Y.J., Moses, Y., Vardi, M.Y. (1993) *Reasoning about Knowledge*, Cambridge (Mass.): MIT Press.

Dinsmore, J. (1991) *Partitioned representations*, Dordrecht: Kluwer.

Fauconnier, G., Turner, M. (1998) "Conceptual Integration Networks", *Cognitive Science*, 22 (2): 133-187.

Frixione, M. (1994) *Logica, significato e intelligenza artificiale*, Milano: Angeli.

Giunchiglia, F., Serafini, L. (1991) "Multilanguage First Order Theories of Propositional Attitudes", in *Proceedings of the 3rd Scandinavian Conference on A.I.*, IOS Press: 228-240.

Giunchiglia, F. (1993) "Contextual Reasoning", in C. Penco, C.Dalla Pozza (eds), *Linguaggi e Macchine,* special issue of *Epistemologia*, 16: 345-364.

Giunchiglia, F., Bouquet, P. (1997) "Introduction to contextual reasoning, an Artificial Intelligence Perspective", in B. Kokinov (ed.), *Perspectives on Cognitive Science*, vol 3, Sofia: NBU Press, 138-159.

Giunchiglia, F., Serafini, L. (1994) "Multilanguage Hierarchic Logics (or how we can do without modal logics)", *Artificial Intelligence*, 65: 29-70.

Giunchiglia, F., Serafini, L., Giunchiglia, G., Frixione, M. (1993) "Non-omniscient Belief as Context-based Reasoning" in *Proceedings 11 IJCAI*: 548-554.

Giunchiglia, F., Ghidini, C. (1998) "Local Model Semantics, or Contextual Reasoning = Locality + Compatibility", in *Proceedings of the Sixth International Conference on Principles of Knowledge Representation and Reasoning* (KR'98), Los Altos (CA): Morgan Kaufmann, 282-289.

Kaplan, D. (1978) "On the Logic of Demonstratives", *Journal of Philosophical Logic*, 8: 81-98.

Kaplan, D. (1989) "Afterthoughts", in J.Almog, J. Perry, H.Wettstein (eds.), *Themes from Kaplan*, Oxford: Oxford U.P.

Konolige, K. (1986) *A Deduction Model of Belief*, Los Altos (CA): Morgan Kaufmann.

Kripke, S. (1977) "Speaker's Reference and Semantic Reference", in P.A. French, T.E. Uehling, H. K. Wettstein (eds.), *Studies in the Philosophy of Language* (*Midwest Studies in Philosophy,* Vol.II), Minnesota: Univ. of Minnesota Press.

Lewis, D. (1970) "General Semantics", *Synthese*, 22: 18-67.

Lewis, D. (1980) "Index, Context, and Content", in S.Krange, S.Ohman (eds.), *Philosophy and Grammar*, Dordrecht: Reidel, 79-100.

Marconi, D. (1997) *Lexical Competence*, Cambridge Mass.: MIT Press.

McCarthy, J. (1993) "Notes on Formalizing Contexts", in *Proceedings 13 IJCAI*: 555-560.

McCarthy, J. (a) "A logical Approach to Context" see: www.formal.stanford.edu/jmc/logical.html.

McCarthy, J. (b) "Modality, si!, modal logic, no" see: www.formal.stanford.edu/jmc/modality.html.

McCarthy, J., Buvac, S. (1997) "Notes on Formalizing Contexts (Expanded Notes)", in A. Aliseda, R. van Glabbeek, D.Westertahl (eds.), *Computing Natural Languages*, Stanford 1997 (also: Tech.Rep. CS-TN-94-13, Stanford, 1994).

Palladino, D., Penco, C. (1992) "Frames and Logic in Knowledge Representation", *Epistemologia*, 15: 119-140.

Penco, C. (1998) "Contesti e ragionamento: da Frege all'intelligenza artificiale", in L. Montecucco, F. Castellani (a cura di), *Normatività logica e ragionamento di senso comune*, Bologna: Il Mulino, 343-360.

Penco, C. (1999a) "Holism in A.I.?" in M. Dalla Chiara, F. Laudisa, R. Giuntini (eds.), *Language, Quantum, Music*, Dordrecht: Kluwer, 37-48.

Penco, C. (1999b) "Objective and Cognitive Context", in P.Bouquet, L.Serafini, P.Brézillon, M.Benerecetti, F.Castellani (eds.), *Modeling and using context - Lecture Notes in Artificial Intelligence 1688*, New York: Springer, 270-283.

Penco, C. (1999c) "Sensi, catene anaforiche e olismo ", *Iride,* 12: 190-195

Perry, J. (1979) "The Problem of Essential Indexical", *Noûs*, 13: 3-21.

Perry, J. (1997) "Indexicals and Demonstratives", in R.Hale, C.Wright (eds.), *Companion to the Philosophy of Language*, Oxford: Blackwell.

Predelli, S. (1998) "Utterance, Interpretation, and the Logic of Indexicals", *Mind and Language*, 13: 400-414.

Recanati, François (forthcoming), "Are "here" and "now" indexicals?", paper given at *Context '99*.

Stalnaker, R. (1973) "Presuppositions", *Journal of Philosophical Logic*, 2: 447-457.

Smith, Q. (1989) "The Multiple Uses of Indexicals", *Synthese*, 78: 167-91.

Thomason, R.H. (1980) "A Note on the Syntactical Treatment of Modality", *Synthese,* 44: 391-395.

Thomason, R.H. (1991) "Logicism, AI and Common Sense", in V.Lifshitz (ed.), *A.I. and Mathematical Theory of Computation*, Boston: Academic Press, 449-466.

Thomason, R.H. (1998) "Intra-Agent Modality and Nonmonotonic Epistemic Logic", in I.Gilboa (ed.) *Theoretical Aspects of Rationality and Knowledge*, Losa Altos: Morgan Kaufmann.

Thomason, R.H.(forthcoming). "Foundation of Contextual Logic, part. I" (paper given at *Context '99*).

Thomason, R.H., Moore, J. (1995) "Discourse Context", in S.Buvac (ed.) *Working Notes of the AAAI Fall Symposium on Formalizing Context*, Menlo Park: AAAI, 102-109.