Hand Book of the First World Congress on the Square of Opposition

www.square-of-opposition.org

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Edited by

Jean-Yves Béziau and Gillman Payette

Contents

1 First World Congress on the Square of Opposition

1.1 The Square : a Central Object for Thought

The square of opposition is a very famous theme related to Aristotelian logic dealing with the notions of opposition, negation, quantification and proposition. It has been continuously studied by people interested in logic, philosophy and Aristotle during two thousand years. Even Frege, one of the main founders of modern mathematical logic, uses it.

During the 20th century the interest for the square of opposition has been extended to many areas, cognitive science ultimately.

Some people have proposed to replace the square by a triangle, on the other hand the square has been generalized into more complex geometrical objects: hexagons, octagons and even polyhedra and multi-dimensional objects.

1.2 Aim of the Congress

This will be the first international congress organized about the square of opposition.

The square will be considered in its various aspects. There will be talks by the best specialists of the square, and this will be an interdisciplinary event gathering people from various fields: logic, philosophy, mathematics, psychology, linguistics, anthropology, semiotics. Visual and artistic representations of the square will also be presented. There will be a musical performance and a movie illustrating the square.

The meeting will end by a final round square table where subalterned people will express their various contrarieties, subcontrarieties and contradictions.

1.3 Primary Organizers

Jean-Yves Béziau, University of Neuchâtel/Swiss National Science Foundation, Switzerland

Michael Frauchiger, Open University and Lauener Foundation, Switzerland

Katarzyna Gan-Krzywoszynska, Poznan University, Poland

Alessio Moretti, University of Neuchâtel/University of Nice, Switzerland/France

Gillman Payette, Dalhousie University/University of Calgary, Canada

Fabien Schang, Archives Poincaré/University of Nancy 2, France, France

1.4 Supporting Organizers

Alexandre Costa-Leite, University of Neuchâtel/ENS, Switzerland/France

Catherine Duquaire, EBC, Lyon, France

Joana Medeiros, TVR, Rio de Janeiro, Brazil

2 Abstracts of Invited Talks

Non-Classical Stems from Classical: N.A. Vasiliev's Approach to Logic and His Reassessment of the Square of Opposition

VALENTIN BAZHANOV
Ulaynovsk State University Russia
bazhan@sv.uven.ru

In XIX century the persistent ("dead") opposition to Aristotelian logic may be noticed. Nicolai A. Vasiliev (1880 – 1940) perceived this opposition and stressed the fact that the way for the novel – non-Aristotelian – logic is already paved. He makes an attempt to construct non-Aristotelian logic (1910) though to large extent remains within old Aristotelian paradigm style of reasoning. What reasons forced him to reassess the status of particular propositions and to replace the square of opposition by the triangle of opposition? What the place in this procedure and the sense of "method of Lobachevsky" which was implemented in construction of imaginary logic? Why psychologism in the case of Vasiliev happened to be important factor of composition of new – imaginary as it was called by the author – logic? What arguments used Vasiliev for the introduction of new classes of propositions and statement of existence of various levels in logic? These questions will be discussed in the presentation.

Human Deontic Reasoning and the Deontic Square of Opposition

SIEGHARD BELLER
University of Freiburg, Germany
beller@psychologie.uni-freiburg.de

Social norms in general and deontic concepts such as ban and permission in particular are core concepts of social life. By indicating what is forbidden and what is allowed, they constrain individual behavior in favor of group interests and thus constitute an essential part of what defines the identity of a culture (one famous instance is the Polynesian concept of *tapu* known in European languages as "taboo"). The deontic domain has been studied in Cognitive Psychology for more than three decades now, and several bodies of data have been collected. Developmental data on the acquisition of the deontic system, for instance, show that it takes children several years to acquire the system of the four deontic modalities (*ban, permission, obligation and release from obligation*). Reasoning data from Wason's selection task demonstrate effects of specific deontic factors on reasoning about the violation of deontic conditional rules. As in many languages the four deontic modalities are distinguished, the deontic square of opposition seems to be a "natural" basis for developing theories on human deontic reasoning capabilities, but – amazingly, this square of opposition has been largely neglected. In this talk, it is argued that drawing inferences from social norms can be conceptualized according to the deontic square and that people are able to reason from the relations of this square accurately and flexibly.

The 0-corner of the Square of Opposition, Paraconsistent Logic and the Polyhedron of Opposition

JEAN-YVES BÉZIAU
University of Neuchâtel/Swiss National Science Foundation, Switzerland
jean-yves.beziau@unine.ch

The O-corner of the square corresponding to "not all", "not necessary", "not obligatory", has been considered suspicious since it is not naturally lexicalized. For this reason, some people have even proposed to replace the square by a triangle of contrariety, "all-none-some", where "some" has a more natural meaning. However Robert Blanché has shown that it makes sense to consider also a dual triangle of subcontrariety and that these two triangles form a star-of-david within a hexagon where the traditional square takes place.

In this lecture I will show how I was led to discover that the O-corner can be considered as a paraconsistent negation in the modal square in the same way that Gödel has shown that the E-corner of the modal square - impossibility - corresponds to intuitionistic negation. Moreover I will explain how then I was led to consider two further hexagons and a polyhedron of opposition which ties together the the two hexagons with Blanché's hexagon and describes the relations between 16 modalities.

Perceptual Contrariety

IVANA BIANCHI AND UGO SAVARDI
University of Macerata and University of Verona, Italy
ivana.bianchi@unimc.it and ugo.savardi@univr.it

Within the framework of the perceptual analysis of relationships, as first developed by Gestalt psychologists, the authors present an experimental research project, carried out over the last 10 years, which investigates contrariety in terms of perceptual experience.

By shifting the approach from a traditional analysis of philosophical logical and strictly linguistic aspect to a perceptual plane, a new theoretical proposal for the domain of cognitive science emerges.

Methods, materials, the types of questions addressed, and the main results of this research project are presented here. Two aspects of this investigation will be focused on: a description of the structure of pairs of contrary properties in terms of phenomenological psychophysics and the generation of a set of "rules" representing the principles of perceptual contrariety.

Can there be an Epistemic Square of Opposition?

PASCAL ENGEL
University of Geneva, Switzerland and Institut Jean Nicod, France
pascal.engel@lettres.unige.ch

It seems (more or less) easy to transpose the alethic square of opposition to deontic modalities, but what about epistemic modalities? It is tempting to put knowledge at the top left, ignorance at the top right, belief at the bottom left and disbelief at the bottom right. Or should we distribute the relationships differently? It's not clear that it works, and we need to work out the logical relationships between belief and knowledge, belief and disbelief. In particular belief and disbelief are not opposed in the way knowledge an ignorance are: they are species of belief, whereas ignorance is not a species of knowledge. What are the relationships between knowing and asserting, believing and assertion? And there is the vexing issue whether knowledge implies belief. Can there be cases of knowledge without belief, as some claim? It is not even clear, it will be argued, that there is an epistemic square, or at least there are several. These philosophical difficulties will be discussed against the background of various epistemic logics, but most of the paper will deal with an informal discussion of the relationship between the main epistemic modalities.

Lexical Pragmatics and the Geometry of Opposition

LAURENCE R. HORN
Yale University, USA
laurence.horn@yale.edu

On the 35th anniversary of my attempt in Horn (1972) to establish the viability of a Gricean approach to the lexicalization asymmetry in the Square of Opposition (in its simplest form, the paradigm reflected in all/some/no(ne) vs. *nall), I propose to return to the scene of the crime. This presentation will include:

- a (not entirely impartial) look back, beginning with a review of proto-Gricean approaches dating back to De Morgan (1858), at the pragmatic line (the line dismissed as inadequate or flawed by Hoeksema 2003, Jaspers 2005, and Seuren 2006, inter al.) on the three-sided square, including aspects of the original arguments whose force has not, I would submit, been fully appreciated
- the utility of the "arithmeticized Square" (Horn 1989) and its relation to scalar predication-the status of the "intermediate" values on the Square (_most/many/few_ for the determiners; likely/unlikely for the epistemic modalities; should/ought to/shouldn't for the modal auxiliaries, usually/often/rarely for the quantificational adverbs, etc.) and their implications for a model of lexicalization
- the cross-linguistically widespread tendency to minimize subcontrary opposition and maximize contrary opposition in natural language and its relation to "R-based" strengthening implicature (as in neg-raising) and O→E drift, for which the locus classicus is the contrary (=[necessary [not]]) reading expressed by "Il ne faut pas que tu meures".

- the case of the binary connectives: (both)...and/(either)...or/(neither) ...nor/(*noth)...*nand
- the epistemic considerations that convert the downward-pointing (A-E-Y) triangle of Blanché (1953, 1969) into an neo-Aristotelian square.

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Seuren, P. (2006) "The natural logic of language and cognition", Pragmatics 16.1:103–138

Doctrine of Distribution in "Traditional" and Modern Quantification Theory

SAUL KRIPKE
CUNY, USA

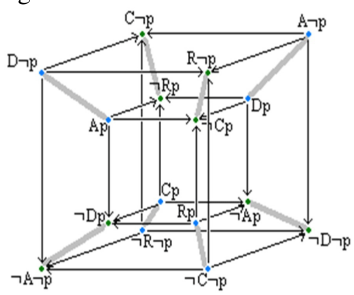
The Crowdy Logical Zoo Inhabited by the Old Square of Oppositions and the Many Strange Visitors of it

ALESSIO MORETTI
University of Neuchâtel, Switzerland and University of Nice, France
alemore@club-internet.fr

As said by its very name, the logical "square of oppositions" codifies graphically Aristotle's logical theory of oppositions (4th century b. C.). This concept, at the same time very abstract (for it dives into the heart of mathematical logic) and very concrete (for it evokes vividly war, conflict and all kinds of confrontations) is very important, for many reasons. Just to evoke three of them, (1) the square (and its avatars) expresses the essential properties of mathematical quantification ($\exists, \forall$) and of logical modality ($\Box, \diamond$); (2) perhaps more deeply, it seems to rule the functioning of "negation" ($\neg$) itself (negation is just a particular geometrical case of opposition), a concept as crucial – for all fields – as mysterious, as many contemporary debates, particularly in mathematical logic, show; (3) furthermore, the square of oppositions has constantly influenced the true conceptual creation in fields very distant from logic and mathematics, in so far its simplicity means a very strong (thus appealing) conceptual expressive power.

But despite this importance of the concept of opposition, it is still rather unknown that, nowadays, "opposition theory" (for short: the square) has definitively given place, in 2004, to "n-opposition theory" (an infinity of logical-geometrical, highly symmetrical, n-dimensional solids), a new rich and growing field (or zoo...) of modal logic at the intersection between abstract logic and solid n-dimensional geometry. To speak more simply (more intuitively), the logical square has given place in 1953 (thanks to Robert Blanché) to a “logical hexagon”, and in 2004, after some works of Béziau (2003) on the relations of instances of this last figure to negation, it has been proven (Moretti, Pellissier) that both the square and the hexagon, followed by a new “logical cube”, belong to a regular series of n-dimensional objects called “logical bi-simplexes of dimension n” (and the zoo goes even beyond this!).

In our present speech, after recalling, by help of many public-friendly projections of the new logical-geometrical shapes, the main trends and conceptual achievements of n-opposition theory (from where it comes, how it works, how to handle it, to where it seems to lead), we will review some of the classical pioneering new uses which were made of the old square oppositional shape outside logic (outside the zoo): for instance (but the complete list is much longer) in psychology (Piaget in cognitive science as well as Lacan in psycho-analysis), in linguistics (Greimas in semiotics as well as Austin in pragmatics) and in philosophy. From this last point of view, as a more detailed, pedagogical, example of such possible uses of the square and/or of its progeniture, we will introduce to one of such new exported models, one in pragmatics (“speech act theory”), inspired by a study of Denis Vernant about “denial” (2003), a “pragmatic hyper-cube” that we propose in order to refine a former “pragmatic hexagon”.



Aristote, De interpretatione

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Moretti, A., “Logical ‘Hyper-Flowers’. The ‘Oppositional Cuboctahedron’ Belongs to an infinite (fractal) series of n-dimensional solids”, (Proceedings of the UNILOG 2005, to appear)

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Moretti A. and Pellissier R., “The Logical Hyper-Tetraicosahedron”, (to be submitted)

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Some Things that are Right with the Traditional Square of Opposition

TERENCE PARSONS
UCLA, USA
tparsons@ucla.edu

The doctrines encoded in the traditional square of opposition were invented by Aristotle. These doctrines differ from modern views principally in that the A form (Every P is Q) and the O form (No P is Q) are contraries. This results in the A form having existential import: if every P is Q then there must be P's. More importantly, the O form (Some P is not Q) turns out to be true when there are no P's. In late medieval times this was taken to be the correct view. The idea that the O form is true when its subject term is empty may be defended on the grounds that these forms are pieces of canonical notation in a theory of logic, and that they do not necessarily reflect ordinary usage. On this view, the doctrine is coherent; it leads to theory in which all main terms of affirmative propositions have existential import, and the main terms of negative propositions are the opposite: a negative proposition is automatically true whenever any of its main terms are empty.

The question remains whether a semantics can be given which agrees with these results, and in which the O form (Some P is not Q) is treated as an existentially quantified proposition with a negation inside. This becomes important when the notation is expanded – as it was in late medieval times – by quantifying the predicate term, and allowing negation signs to occur more widely, so as to yield forms such as "not every P is not no Q". I argue that the doctrine works smoothly, and preserves the generalization about affirmative and negative forms given above.

The Blessings of Undue Existential Import

PIETER SEUREN
Max Planck Institute for Psycholinguistics, The Netherlands
pieter.seuren@mpi.nl

This paper results from recent work on the history and contents of the traditional Square of Opposition, in the context of a growing sense of dissatisfaction with the pragmatic (Gricean) answer to the counterintuitive features of standard modern predicate calculus (SMPC). A basic tenet is the view that a logic is defined by its constants (operators), and that the operators of both SMPC and traditional Aristotelian-Boethian predicate calculus (ABPC) are represented by lexical items (words) in any natural language. The logic of natural language thus becomes an empirical question of lexical analysis and description. I argue that the meanings of the logical operators in natural language are defined on the basis of set-theoretic principles. Following up on Dehaene's and Pica's work on the geometrical and arithmetical powers of illiterate Amazonian Indians, a basic-natural level is identified, at which the mathematical and logical powers of individuals are still underdeveloped. Cultural development and school training will elevate individuals to what I call a strict-natural level. Further development along mathematical principles leads to a nonnatural constructed level. I argue (Seuren 2006) that SMPC represents the constructed level, ABPC represents the strict-natural; level, and the basic-natural predicate logic (BNPC) of Hamilton (1860) and Jespersen (1917), where some implies not-all, represents the basic-natural level.

Aristotle's original logic is discussed extensively. It is found that he left his logic unfinished but sound. The error of undue existential import was introduced by his later commentators, especially Boethius. Abelard (1079–1142) completed Aristotle's logic in the Master's own sense, that is, without undue existential import, thus defining Aristotelian-Abelardian predicate calculus or AAPC.

Then the new method of valuation-space (VS) modelling is introduced, which reduces predicate calculus to set theory and is a necessary prerequisite for a complete analysis of the logics involved, represented in the form of logical polygons (not just squares). These define all relations of entailment, contrariety, contradiction and subcontrariety in the system. This polygonal representation opens the way towards a definition of the concept of logical power. According to this definition, the most primitive predicate logic of Hamilton and Jespersen, BNPC, is the most powerful of all, given its twelve basic expressions. It is also logically sound, but fails to maintain consistency through discourse. ABPC is maximally powerful within the constraints of eight basic expressions, and is discourse-proof but not logically sound, owing to undue existential import. SMPC is both discourse-proof and sound, but has lost most of the logical power of ABPC, let alone BNPC.

Finally, it is shown that ABPC, unlike SMPC, has great functional advantages for the informativity of quantified sentences. Its undue existential import is only an apparent defect, since natural language uses lexically fixed presuppositions to select a restricted universe of discourse for each context as it comes into being. This makes it necessary to redefine existential import as being encoded not in the existential quantifier but in the semantic conditions of lexical predicates, and to extend ABPC with a presuppositional component, which automatically selects the correct universe of discourse for each discourse-anchored utterance. Undue existential import, long taken to be a logical nuisance, thus turns out to be a great blessing for the functionality of human communication.

The paper will not be read out in full: only a rapid sketch will be given. An extensive text will be made available for those who are interested in the full story.

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On the 3D Visualization of Logical Relations

HANS SMESSAERT
Catholic University of Leuven, Belgium
Hans.Smessaert@arts.kuleuven.be

In the first part of this talk I want to present a 3D representation for the relations of contradiction and (sub)contrariety between modal statements as featuring in the standard Modal Square of Oppositions. The polyhedron in question, i.e. the rhombic dodecahedron, has twelve rhombic faces and fourteen vertices, and is defined as the dual of the cuboctahedron, one of the central Archimedean polyhedra (consisting of six square and eight triangular faces). This polyhedral representation allows an integration of two lines of insights. First of all, it incorporates the hexagonal generalisations of the Square, not only the original Blanché star but also the paracomplete and paraconsistent stars of Béziau (2003). Secondly, it is fully compatible with the Boolean algebraic approach in Lloyd Humberstone (2005): the rhombic dodecahedron can be defined as a 3D projection of the 4D hypercube representation of the Boolean lattice structure.

In the second part I want to exploit the duality relationship between the cube and the octahedron (i.e. the Platonic polyhedron with six vertices and eight triangular faces) in order to offer a 3D alternative to the Blanché star for the quantifiers of Standard Predicate Logic. This octahedral model will first be shown to apply to comparative quantifiers ('more, less, at least, at most') as well, and secondly be used for the representation of duality relations (of internal and external negation) and monotonicity properties.

Jean-Yves Béziau (2003), "New light on the square of oppositions and its nameless corner", Logical Investigations, 10, pp.218-232.
Lloyd Humberstone (2005), "Modality". In Frank Jackson and Michael Smith (eds.), The Oxford Handbook of Contemporary Philosophy, Oxford: OUP, pp. 534–614

Applications of Squares of Oppositions and their Generalizations in Philosophical Analysis

JAN WOLEŃSKI
Jagiellonian University, Poland
NS_j.wolenski@iphils.uj.edu.pl

Squares of oppositions can be generalized to logical hexagons and octagons. Such figures visualize logical relations (entailment, contrariety, etc.) between categorical sentences (the original interpretation), quantified sentences and modal sentences. The last case provides a particularly interesting application of logic in philosophical analysis. All modalities, alethic, epistemic, axiological, erotetic, etc. satisfy most rules displayed by logical figures, although there are certain exceptions, for example, the entailment from "it is necessary that A" to A. Modal principles stemming from the logical square for modalities, analogical to laws of categorical and quantifies sentences, form something, which can be considered as the minimal modal logic at least for philosophical analysis. The paper will show how some basic problems of theory of truth (are T-sentences tautological?), epistemology (the definition of knowledge), ontology (the problem of logical determinism) or axiology (the principle that being and goodness are co-extensive) can be illuminated by conclusions stemming from logical figures.

3 Abstracts of Contributors

All Men are Animals, but what Does it Really Mean?

JOHAN ARNT MYRSTAD AND LILL ANJUM
University of Nottingham / University of Tromsø, UK/ Norway
arntm@sv.uit.no

Aristotelian logic treats general categorical statements of the form 'All men are animals' as basic and primitive and not as something that can be further analysed or logically deduced. This should be clear from the prominent role they play in the syllogisms where they often appear as the first premise of a valid inference, defining essential properties for a class of objects.

With the introduction of Fregean logic, general categoricals were found to be clearer understood as universally quantified conditionals, where among all things in the world, *if* something is a man, *then* this something is also an animal. This move was so simple, yet so revolutionary, that logic has never been the same since.

But it didn't end with the move from categoricals to conditionals. Instead the conditional interpretation of categoricals was justified by their alleged common logical structure as *material* conditionals. We then have logical equivalence between the following:

(A) All Fs are Gs.

(B) If x is F, then x is G.

(C) $(\forall x)(\mathrm{F}x \supset \mathrm{G}x)$

There are some logically relevant differences between (A), (B) and (C) that seem to be overlooked in debates on causation, laws and dispositions. We will here try to point to some of these differences and show why extensional logic cannot deal with causal matters. Some might not feel threatened by this claim. But anyone who ever employs concepts like 'counterfactuals', 'necessity', 'possibility' or 'possible worlds' without being clear on whether or to what extent one accepts their technical definition within various extensional logical systems, are potential victims of our criticism of the material conditional interpretation.

In this paper we want to show why modern extensional logic cannot deal with causal relations. Via a logical analysis of law-like statements 'All Fs are Gs', where we compare the square of opposition of Port Royal Logic with Frege's logic, we point to a distinction between causal relations and classification. By investigating this distinction further, we hope to throw some new light on interrelated notions like causation, laws, induction, hypothetically and modality. If successful, our analysis should be of relevance for a deeper understanding of any type of causal relations, whether we understand them to be laws, dispositions, singulars or categoricals.

'Not Possible' and 'Impossible' at a Modal Square of Opposition in Aristotle's De Interpretatione 13

ANDRÉS BADENES

andresbadenes@hotmail.com

There are several modal squares of opposition that can be reconstructed from Aristotelian work. The most know of them was pointed out by Cajetan and other medieval commentators (Horn 1989, p. 12). I will deal with a modal square of opposition for possibility in Aristotle's *De Interpretatione* 13; in this square Aristotle presents two notions: possible (and its negation: not possible) and impossible (and its negation: not impossible) as a separated concept from 'not possible'.

'Impossible' (a)du/naton) and 'not impossible' (ou) du/naton) follow from 'admissible' and 'possible' and 'not possible' and 'not admissible' contradictorily but conversely: for the negation of 'impossible' follows from 'possible to be', and the affirmation form the negation, 'impossible to be' from 'not possible to be' (for 'impossible to be' is an affirmation, 'not impossible' a negation). (De Int. 13 22^a32-7; Ackrill 1963)

In the text quoted above there are two kinds of relationships between statements with modal operators (with or without negation): contradictoriety and implication. 'Possible' and 'not possible', and 'impossible' and 'not impossible' are contradictories (cfr. *ib.* 12 21b37-22^a1; *ib.* 22^a1-2; ib 22^a5-7; ib. 13 22^a32-4). Moreover, two implications hold: (1) 'impossible' follows from 'not possible' (cfr. ib. 22^a36), and (2) 'not impossible' follows from 'possible' (cfr. *ib.* 22^a36-7). Aristotle leaves aside the relationship between 'possible' and 'impossible', and that one between 'not impossible' and 'not possible'. By analogy with the categorical square in *De Int.* 7 one can think that the two pairs are contraries and subcontraries respectively. If they were contraries, two problems arise. First, assuming 'possible' and 'impossible' as contraries if 'possible' were true, then 'not possible' ought to be false, but this situation allows that 'impossible' be false, and the implication (1) does not hold. Second, assuming 'not impossible' and 'not possible' as contraries, if 'not possible' were false, then 'possible' ought to be true, but 'not impossible' can be false, and the implication (2) does not hold. These problems do not arise if we suppose that the two pairs are subcontraries. However, other problems result if the two pairs were subcontraries. It is possible that the four corners of the square were true, and then the contradictoriety relationship vanishes. The last possibility is that 'possible' and 'impossible', on the one hand, and 'not possible' and 'not impossible', on the other, be contradictories, but it implies that there are more than one contradictory.

From my point of view it is necessary to compare these statements with the statement without modal operator and its negation. McCall (1967) claimed that term negation could be represented in the shape of modal logic as an intuitionistic negation (Béziau 2003, p. 6), namely, as an impossibility operator. Thus, the contrary negation of φ is $\Box\neg\varphi$ (or $\neg\diamond\varphi$). But which type of operator does represent the modern modal notion of impossibility? If 'not possible' is the contradictory of 'possible' and 'not possible' implies 'impossible', 'not possible' seems stronger than 'impossible'. Hence if 'not possible' were the contrary of φ, as McCall points out, 'impossible' should be weaker than 'not possible'.

To view how 'impossible' bears I appeal to another square at *De Int*. 10 where Aristotle analyzes term negation (*De Int*. 10 19b33-6). There Aristotle displays the contradictoriety relationship at the superior and inferior sides of the square and leaves without name the diagonal relationship (Soreth 1972, p. 405). This last relationship indicates that statements universally quantified with term negation and predicate negation (Englebretsen 1976) can and can not be true (cfr. *ib*. 10 19b35-6), but if term negation represents contrariety operator there is a problem. However I claim that Aristotle is thinking in another kind of contrariety: weak contrariety. The intuitionistic operator would hold for strong contrariety and this relationship can be characterized for 'not possible'. Further the principle that governs weak contrariety is weaker than that of subcontrariety because the former allows that two statements be true and false. Finally if strong contrariety operator can be reconstructed as a paracomplete negation and subcontrary operator as a paraconsistent negation (Béziau 2003, p.6), I think that weak contrariety operator can be reconstructed like a non-alethic negation.

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McCall, St. (1967) "Contrariety", Notre Dame Journal of Formal Logic, VIII, 1/2, pp. 121-32.

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Le Carré Sémiotique dans tous ses États

SÉMIR BADIR
FNRS / Université de Liège, Belgium

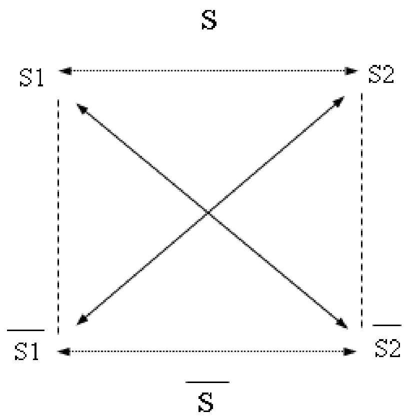


Schéma de la "structure élémentaire de la signification" (Greimas 1970 : 137), désigné aussi par la suite comme "carré sémiotique" (Greimas & Courtés 1979 : 31).

Le schéma graphique que Greimas & Rastier proposent en 1968 dans l'article "Les jeux des contraintes sémiotiques" (in Greimas 1970) présente une grande proximité avec le carré logique : il lui emprunte la présentation graphique en carré, la présence de termes à ses angles, la présence par paire de rapports schématiques entre ces termes et l'indexation apparemment identique de deux de ces rapports (contrariété et contradiction). L'étude que nous proposons consistera à montrer deux choses. 1°) La présentation du carré sémiotique est l'aboutissement d'une chaîne de transformations de l'expression, d'abord simplement verbale, puis usant d'un système de notation symbolique, enfin schématique et graphique. Cette chaîne de transformations est concomitante d'une influence de la logique, mais relayée par l'anthropologie (celle de Lévi-Strauss) et la linguistique (celle de Hjelmslev et de Jakobson). 2°) Le carré sera devenu la "bonne forme" de la théorie sémiotique non sans lui imposer un fléchissement décisif. De fait, la "pensée graphique" à l'œuvre dans le carré a poussé la théorie sémiotique vers l'abstraction et la systématisation.

GREIMAS, Algirdas Julien [1970] : Du Sens, Paris, Seuil.
GREIMAS, Algirdas Julien & COURTÉS, Joseph [1979] : Sémiotique. Dictionnaire raisonné de la théorie du langage, Paris, Hachette, = Université, 1993.

The Validity of the Square

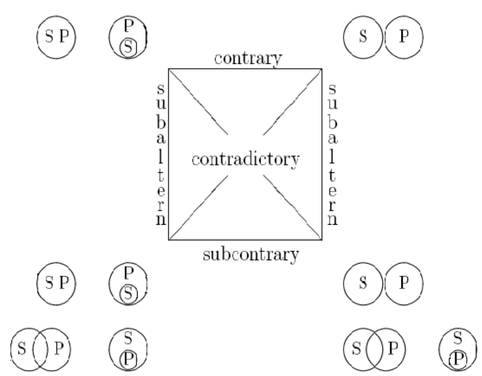
HANOCH BEN-YAMI
Central European University, Hungry
benyamih@ceu.hu

The prevalent attitude to the Square is that it is not strictly valid: any translation of its sentences into the Predicate Calculus (PC) preserves only some of its inferential relations. Modern logic also offers a diagnosis of the error it involves: Aristotle has tacitly assumed that there are subjects in the domain, yet this is not asserted or presupposed by any of the Square's sentences; when eliminated, some of the alleged inferential relations are also eliminated. These criticism and diagnosis assume that the translation of the Square into the PC preserves semantic structure, and thus assume that the semantic principles according to which the PC is constructed are those of natural language (NL) too. In recent work I challenged this assumption. The PC allows only singular referring expressions, while in NL we find plural ones as well. Consequently, in the translation into the PC, the grammatical subject of the Square's sentences is translated by a predicate; yet in NL it functions as a plural referring expression. On the basis of this analysis I constructed a deductive system, comparable in its power to the first order PC, but more adequate for representing the semantics and logic of NL. In my talk I show that all logical relations of the Square are valid, and explain how the translation of its sentences into the PC distorted their semantics and as a result generated the illusion that some of these relations are invalid.

Visualizations of the Square of Opposition

PETER BERNHARD
University Erlangen-Nuremberg, Germany
Peter.Bernhard@sophie.phil.uni-erlangen.de

The representation of the four categorical propositions by different diagram systems allows a deeper insight into the relations of the logical square-e. g. with Euler diagrams one can "see" the *subcontrary* relationship by the fact that on the one hand SiP and SoP can partly be represented by the same diagrams and that on the other hand SiP and SoP together include every possible case, so that at least one diagram of them must be constructible; while the *subaltern* relationship can be seen by the fact that the two diagrams representing SaP form a subset of the diagrams representing SiP and that the diagram for SeP is also one of the diagrams for SoP, etc). Further diagram systems which will be examined are: the Existential Graphs of C. S. Peirce, Venn diagrams, the modified Euler diagrams of J. N. Keynes, and Frege's Begriffsschrift.



Strong Paraconsistency and the Intuition of Opposition

FRANCESCO BERTO
University of Venezia, Italy
francescoberto@tin.it

Strong paraconsistency, also called *dialetheism*, demands a thorough revision of the classical ideas of negation, opposition and contradiction, by claiming that some contradictions hold, are true, and it is rational to accept and assert them. Although such a position is naturally portrayed as a challenge to the Law of Non-Contradiction (LNC), all the main formulations of the Law are not disputed by a dialetheist, in the sense that she is committed to *accept* them by her own theory. Her dialetheic attitude is expressed by typically accepting, and asserting, both the usual versions of the Law, and sentences inconsistent with them.

The aim of this paper is to develop a formulation of the Law which appears to be unquestionable, in the sense that strong paraconsistentists are committed to accept it without also accepting something inconsistent with it, on pain of *trivialism* – that is to say, on pain of lapsing into the position according to which everything is the case. This will be achieved by characterizing a negation operator via the primitive intuition of *material opposition*, or *content exclusion*, which I claim to be shared by paraconsistent logicians and dialetheists, too. Strong paraconsistentists ask us to stop using 'not' (as well as 'true') as an exclusion-expressing device, because 'not-α' is insufficient by itself to rule out α (and 'α is true' is insufficient by itself to rule out that α is also false). However, the dialetheic account of the pragmatic notions of *acceptance* and *rejection* shows that strong paraconsistentists do believe in the impossibility of some couples of 'facts', or 'states of affairs', simultaneously obtaining; or, equivalently, that they assume that some properties or states of affairs, such as x's accepting and x's rejecting the same sentence, are materially opposed to each other. By means of an exclusion-expressing negation characterized via the intuitive notion of material opposition, we may establish a minimal formulation of the LNC, in the sense of a version on which both the orthodox friend and the paraconsistent foe of consistency can agree. All of this shall not constitute a cheap victory on dialetheists: we may just learn that different things have been historically conflated under the label of 'Law of Non-Contradiction'; that dialetheists rightly attack some formulations of the Law, and orthodox logicians and philosophers have been mistaken in assimilating them to the indisputable one.

Imagination and the Square of Opposition

JEAN-YVES BÉZIAU, ALEXANDRE COSTA-LEITE AND GILLMAN PAYETTE
University of Neuchâtel, ENS and Dalhousie University, Switzerland, France and Canada
jean-yves.beziau@unine.ch,
alexandre.costa-leite@unine.ch and gpayette@dal.ca

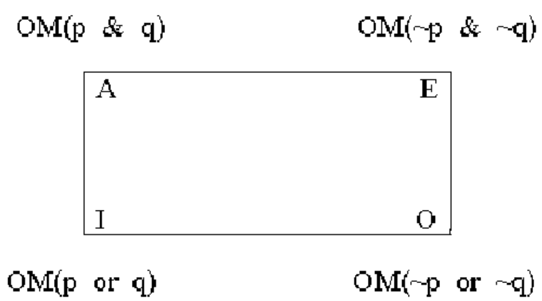
In this talk we intend to examine the possibility of using a modal operator for 'imagines' in the phrase 'a imagines φ'. This was attempted by Ilkka Niiniluoto following Hintikka's construction of logics of belief and knowledge. We approach this problem by constructing squares of opposition for imagination. The intention is to understand how the imagination operator might fit into a square where the only operators are imagination and negation. But also to consider how the imagination operator might interact with the 'possibility' operator in a square setting. This discussion finds many squares lacking, but it does offer some viable squares for both imagination and its interaction with possibility.

On Emplacing

ARTHUR BIERMAN
San Francico State University, USA
`abierman@sfsu.edu`

This is part of a longer essay, "On Emplacing", which I conceive as a sequel to Russell's "On Denoting" and Strawson's "On Referring".

I address their differing ways of relating the Square'categoricals, and provide an alternative. I abandon the traditional alethic logic they used to frame their arguments and replace it with a conceptual logic. This enables me to incorporate the virtues of both their views and the failures of neither. By introducing conceptual negation, [∼], in addition to alethic negation, [–],we can re-conceive the truth relations between categorical statements. Think of [Not,∼] as the traditional suffixes [non-] and [un-], as in "non-red" and "unreal". A and E are conjunctive statements and I and O are disjunctive statements + OM. OM is the Omnitude Determiner for categorical statements. OM's scope covers the complete lists of the subjects/arguments in the A and E conjuncts and in the I and O disjuncts. The conjuncts and disjuncts must have the same list. ∗ ∗ ∗∗ Suppose Patsy and Quentin are Jill's children, and that she has no others. p = Patsy is asleep ∼p = Patsy is ∼asleep/awake q = Quentin is asleep ∼q = Quentin is ∼asleep/awake With these and OM, we can construct the Square of Categorical Statements, as follows:



Contradiction, “Contraryness and Inconsistency: Elucidation and Terminological Proposal

ANDRÉS BOBENRIETH
Universidad de Valparaiso, Chile
abobenri@yahoo.es

To think about inconsistencies involves reflecting on several basic notions widely used to talk about human knowledge and actions, such as negation, opposition, denial, assertion, truth, falsity, contradiction and incompatibility, just to name the more perspicuous ones. All of them are regularly used in natural language and for each one of them several definitions or conceptions have been proposed throughout the history of western thought. That being so we tend to think that we have a good enough intuitive understanding of them but also that a more precise definition would help to clarify their meaning and assist us to use them in a more appropriate manner. I this essay I will try to clarify these notions and thus make a terminological proposal.

Aristotle’s Non-Logical Works and the Square of Oppositions in Semiotics

STEFANIA BONFIGLIOLI
University of Bologna, Italy
stefaniabonfiglioli@libero.it

As well known, Aristotle’s theory of opposition can not be confined to his logical works. In the *Nicomachean Ethics* and the *Eudemian Ethics*, for instance, there are several passages concerning the notion of contrariety (*enantiotēs*). More precisely, Aristotle’s ethical works deal with the contraries (*enantia*) having an intermediate (*meson*). My first aim is to reconstruct this theory of *meson* regarding it as a meaningful link between the *Ethics* and other Aristotelian works, such as the *Categories* and the *Metaphysics*. Secondly, from a historical point of view the very notion of *meson* lets one back to the origins of the opposition theory in ancient philosophy. I am referring to Plato’s notion of *meson*, which implies a previous idea of dual opposition. Moreover, the same notion of *meson* might lead to a comparison with the complex and the neuter term belonging to the square that semioticians are most familiar with: Greimas’ square.

Applying the Square of Opposition to Reality

JOSEPH E. BRENNER
International Center for Transdisciplinary Research and Study (CIRET), France
joe.brenner@bluewin.ch

The paper re-examines the definition of contradiction and its implications for the square of opposition from the standpoint of a logic of and in reality (LIR) that is emerging from the original work of the Franco-Romanian philosopher Stéphane Lupasco. I propose the extension of the square of opposition by changing the underlying truth-functional logic to one of real elements - processes and entities - and their interactions (or counter-actions), involving alternating and reciprocal actualization and potentialization. The purport of the square of opposition and its sub-structures (lines, intersections, corners) will be reinterpreted according to this physical/metaphysical

view of opposition. My approach retains the intuitive value of the square but applies it to change and complex non-linguistic phenomena. This dynamic view of the square supports its morphological interpretation by Petitot. However, any static diagram begs the question. The use of new visual techniques for dynamic knowledge representation of these concepts may be preferred.

Words, Predications, Forms of Things and Forms of Signified Items: Which Ontological-Semantic Foundations for the Square of Opposition?

VÉRONIQUE BRIÈRE
University Paris X, France
vbriere@free.fr

We will question the principles articulating semantics and ontology, principles which give an effective foundation to the modus of the logical square. This last displays, effectively, a special kind (or regime) of signification : seen from the apophantical point of view, "signifying" means signifying predications, that is, it means saying that something belongs (to something), signifying a judgement, and establishing, as being alternative, affirmation and negation. But such a regime (of signification) presupposes, on the ontological plan, a rather astonishing status to be given to the signified items of the *word* and of the *verb*, as well as to the verb "to be". These are measured not as names of beings, but as entities determining definite units, that is, they do not presuppose the substantial unity generally associated to the "logic" of signification as well as to the signified unit. Which kind of exact consistency must be taken to be necessary inherent to the "something " (*ti*) founding the signification, and, thereafter, the apophantical regime? Facing this question is a necessary move in order to explain the fact that something *undefined* (*aoriston*) may nevertheless "signify something in some sense," as is the case for "non-human". We will draw a link between the consequences of such a limit given between *determined and undetermined* by Aristotle - at the beginning of *De interpretatione* - and his other relevant texts, especially *Categories*, which discuss this allegedly prior ontological status of a "being", as measure of the signified item. We will try to clarify, relying also on the issues of sophistic criticism, the critique by Aristotle of the ontological and hermeneutic "suppositions ", a critique which leads to the constitution of a - philosophically new - form "by itself" of the signified item, conceived in order to distinguish the measure of the "something" from the platonic substance. The aim at issue here is therefore that of letting appear, at the very place of the canonical "square ", assumed to instantiate the heaviest and most tempered ontology, some principles which deconstruct the request of laying Being *under* the signification.

The Fourth Corner of the Square

EDWARD BUCKNER
Canada
d3uckner@btinternet.com

The paper is a critique of Terence Parsons' claim that 'For most of the history of Aristotelian logic, logicians assumed that negative particular propositions (i.e. Latin propositions of the form quoddam A est B, standardly represented as 'some A is not B') are vacuously true if their subjects are empty'.

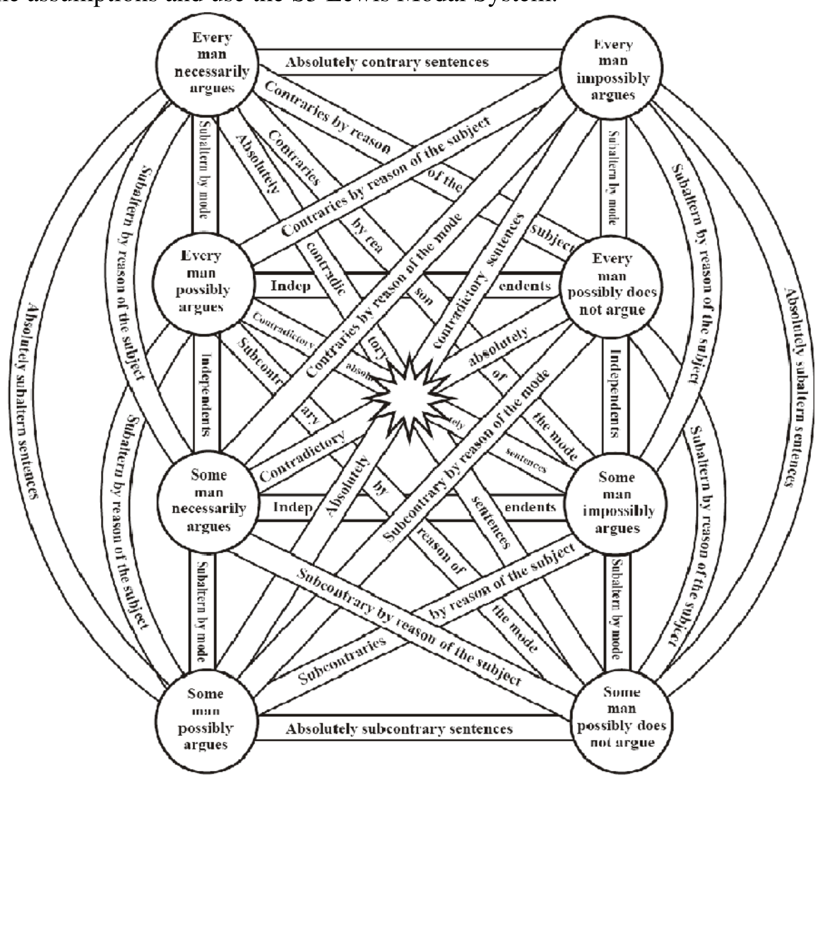
It is argued that (with the exception of the twelfth century writer Peter Abelard) Aristotelian logicians did not see any flaw in their system because they did not think terms could be 'empty' in the sense required for there to be a flaw. Supporting evidence is drawn from the Latin texts of Boethius, Anselm, Abelard, Avicenna, Abelard, Paul of Venice, Gregory of Rimini, Aquinas, Leibniz and others.

The paper is illustrated with manuscript pictures of the square of opposition, one from an early (9C) manuscript of Boethius commentary on the Perihermaneius. It includes fresh translations of Latin logical writing.

The Medieval Modal Octagon and The S5 Lewis Modal System

JUAN M. CAMPOS-BENÍTEZ
Benemérita Universidad Autónoma de Puebla, México
juancamposb@hotmail.com

The modal medieval octagon for both quantification and modality shows several interesting relations. We take modal conversion for AE and II sentences below (where the first vowel stands for quantifiers and the second for modes. For example II: some French may be philosophers, some philosophers may be French). The informal reading poses no problems, but when formalized they cannot be proved unless we make some assumptions and use the S5 Lewis Modal System.



The Inversion Principle and The Interpretation of The Square of Oppositions

WAGNER DE CAMPOS SANZ
Universidade Federal de Goiás, Brazil
sanz@fchf.ufg.br

Natural deduction rules for logical constants are mainly of two kinds: introduction rules and elimination rules. These rules have been regarded as a way of showing explicitly the meaning of logical constants.

However, in order to admit that the rules can give a definition for the logical constants, some constraints must be imposed on the structure of these natural deduction rules, as it is clearly perceived by anyone acquainted with Prior's criticism.

Actually, introductions rules are frequently regarded as primary *vis-à-vis* elimination rules. Eliminations are, in the final analysis, no more than consequence of introductions, as has been said by Gentzen. Elimination rules should be in some kind of harmony with the stated introduction rules. There is an enormous amount of literature on this subject, and, we would like to notice, many of them espouse a point of view that is in a straight connection with intuitionist principles.

Usually, a set of eliminations rules for some logical constant is accepted as correct, in regard of a set of introduction rules for this same constant, if the *inversion principle* holds. Although Lorenzen was the first to have used such expression, it is in Prawitz dissertation, published in 1965, that it came to be used to designate a relation of adequacy holding together introduction and elimination rules for a specific logical constant. The *inversion principle* was stated in many different ways. In our communication, we intend to adopt one such statement and examine it closely, the statement made in Negri & Von Plato's book, Structural Proof Theory, p. 8:

> **Inversion Principle**: *Whatever follows from the direct grounds for deriving a proposition must follow from that proposition.*

For the usual logical constants these direct grounds are the introduction rules.

It is very interesting that there is one special logical constant which is usually conceived as having no introduction rule, having only one elimination rule. The absurd constant is seen as a proposition that has no subject and no predicate, as something that can be asserted but which lacks introduction rule. That seems problematic.

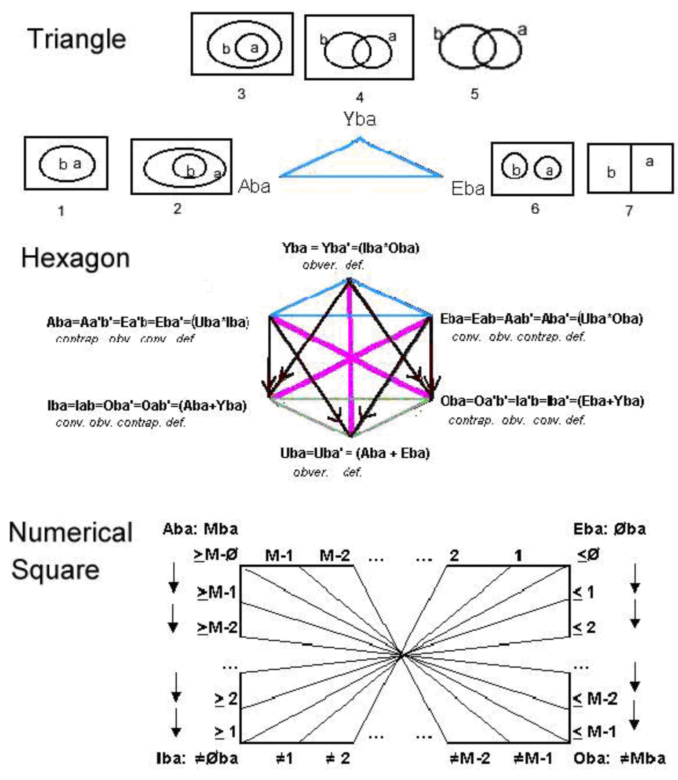
The above-mentioned authors (and many others) claim that the absurd elimination rule (*ex falso quodlibet*) is entirely justified by the use of the stated *inversion principle* plus the fact that there is no introduction rule for the absurd.

What we intend to do in our communication is to examine the putative argument that would give support to that claim. We will argue that it was built on the contemporary interpretation made on the square of oppositions. A challenge for such justification seems to follow as soon as we challenge the contemporary interpretation of the square.

Fuzzy Syllogisms, Numerical Square, Triangle of Contraries, Inter-Bivalence - Historical Appendix on the Quantification of the Predicates

FERDINANDO CAVALIERE AND ANTONIO DONNARUMMA
University of Bologna and University of Salerno, Italy
cavaliere.ferdinando@gmail.com and
antonio.donnarumma@mail.ing.unibo.it

This work presents new unpublished syllogisms, called "**Distinctivi**" **D**, which takes place by means of **Hexagon** of oppositions **H**, in which the Particular **Yba (only some b are a)** is the contradictoria of the Universal **Uba (all or no b are a)**. Y is preferred, as primitive, to I or O, being more "natural" than the others. Typical inferences of the systems are the **obversions: Uba = Uba', Yba = Yba'**. D-systems encloses traditional Syllogisms. We consider Polygonal and Numerical developments, including intermediate quantifiers ("the majority of", …) and some applications in Modality, Semiotic (synonymous-antonymous), *Enunciative Logic* (**semi-implication**). Polygons are finally absorbed in the **D-Numerical Square** DNQ. We discover isomorphisms between bivalent D-system and **Non-Standard Logics** this way: ***depriving** the subject-class of the **quantifier** and **transferring** its (pre)numerical attribute **to the value of truth** of the judgement.* These "(Poli-)Inter-bivalent" Logics admit **intermediate values** *between true and false*, and a **weakened Principle of Contradiction**. In that way we get Fuzzy Logic, and present the **Fuzzy Cube of Opposition**.



Aristotle's Square in a Logic of Scientific Discovery

CHRISTOPHER DARTNELL, DOMINIQUE LUZEAUX AND JEAN SALLANTIN
Euriware, Polytechnique and Lirmm, France
christopher.dartnell@euriware.fr,
dominique.luzeaux@polytechnique.org and js@lirmm.fr

We present our use of Aristotle's square and its extensions (see [1], [2]) to formalize a pragmatic logic of scientific discovery. We provide an interpretation of the resulting hypercubic structure to frame the paraconsistent and paracomplete representation of the computation of a theoretical predictive model corroborated by experimentation. This activity of producing a predictive and explicative model is at the core of the scientific interactive process of publication, refutation, and model confrontation that occurs during the construction of a consensual theory by a community. Finally, we describe in a constructive way how this logic can be achieved by a hierarchical and modular community of auto-epistemic and adaptive agents, as in [3].

[1] Béziau, J.Y.: New light on the square of oppositions and its nameless corner. Logical Investigations 10 (2003) 218–233
[2] Moretti, A.: Geometry for modalities? Yes: through n-opposition theory. In Béziau, J.Y., Costa-Leite, A., Facchini, A., eds.: Aspects of Universal Logic. Travaux de logique 17, Neuchâtel (2004) 102–145
[3] Sallantin, J., Dartnell, C., Afshar, M.: A pragmatic logic of scientific discovery. In Todorovski, L., Lavrac, N., Jantke, K.P., eds.: Discovery Science. Volume 4265 of Lecture Notes in Computer Science., Springer (2006) 231–242

The Geometrical Logical Figures and the Objective and Normative Structure of Thought

AIMABLE-ANDRE DUFATANYE
École Normal Superieur, France
aimabledufatanye@yahoo.fr

The square of oppositions and many other geometrical logical figures have proved to have increasingly more applicability in different domains of knowledge in different fields of knowledge. After generalizing the classical theory of opposition of propositions, and extending it to the structure of opposition of concepts, and after restructuring Apuleius' square by transforming it into a hexagon, and after noticing that his oppositional hexagonal structure has fruitful applications in different fields (which we shall illustrate with the application of the hexagon to the logic of norms by G. Kalinowski), Robert Blanché has claimed that his logical hexagon can be considered as the objective basis of the structure of the organization of concepts and as the formal structure of thought in general. This raises some questions. On the one hand, one can wonder if Robert's assumption is free from psychologism. On the other hand, the question, "What justifies the fact that the conclusions stemmed from fictional logical figures are successfully used to clarify some problems in logic, in linguistics, in law, and even in some daily concrete situations?" remains. In this paper these questions will be discussed and it will be argued that the assumption that Blanché's hexagon or any other logical figure constitutes the formal structure of thought is more a metalogical or metaphysical commitment (choice) than a universal result of logical or scientific investigations.

Aristote, De interpretatione
J.-Y.Béziau, "New light on the square of opposition and its nameless corner", Logical Investigation, 10, (2003), pp.218-232.
R.Blanché, (1966) Structures Intellectuelles, Essaie sur l'organisation systématique des concepts Paris, Vrin.
G. Kalinowski, (1996) La logique déductive , Esai de présentation aux juristes Paris, PUF
G. Kalinowski, "Axiomatisation et formalisation de la théorie hexagonale de l'opposition de M.Blanché (système B) " Les études philosophiques, 22, 1967, pp.203-208

From the Square to the Star: Etoile de Blanché, Carré Apuléen & Carré Latin

JEAN-CLAUDE DUMONCEL AND PIERRE SIMONNET
Centre d'Études Théologiques de Caen and Université de Corse
jcl.dumoncel@club-internet.fr and simonnet@univ-corse.fr

The Apulean Square is by now a marshalling yard of Thought. Its four corners AEIO became four free places waiting for such and such "interpretation", with symbolic flags in the Amsterdam perspective where A became a Box $\Box$ and I a Diamond $\diamond$. Since A is the corner of Necessity, of Demonstrability and of Duty, the Apulean square is on one axis an epitome of Philosophy (with Metaphysics, Epistemology and Ethics, respectively). And the expansion of the Square in the Star AEIOUY of Blanché was obtained in this philosophical perspective. From the Whiteheadian Square (1, 0, j, w), the philosophical axis receives its full foundation in the Boolean constant 1 of "Boolean Algebra", with its two readings : Being and Truth (the ontological reading and the alethic reading). And it was crowned by the Axiological Star of G. Kalinowki. But the stellar expansion opens also the Mathematical axis of the marshalling yard: if you stipulate that the Pythagorean Table of your mathematical operation must be a Latin Square (as a paradigm of group), you obtain at Y the Symetric Difference of two sets, that is the cornerstone of Stone Spaces. In the whole scheme, J.C. Dumoncel explores mainly the philosophical Abscissa, and P. Simonnet (with his automatas) the mathematical Ordinate.

The Square Squared

GEORGE ENGLEBRETSEN
Bishop's University, Canada
genglebr@UBishops.ca

Today's standard predicate logic has little use for–and offers no insights into–the logical relations represented by the square of opposition. By contrast, a term logic gives the square an essential role in logical theorizing and, more importantly, yields intriguing new insights into the very nature of the square. Given that our logic is a term logic, suitably provided with a workable symbolic algorithm, and taking seriously the idea that logically contradictory pairs are mutual negations of one another, we can take universals as negations of particulars. New insights into the square come once it is recognized that there are some (non-normal) contexts in which we would want to say that no universal corresponding to a negated particular can be defined. This face places added demands on the square. However, the square is not only a thing of beauty, it is a thing of power as well, quite capable of meeting these demands.

On Existence and some Ontologies

KATARZYNA GAN-KRZYWOSZYÁSKA
Poznan University, Poland
kgank@wp.pl

Some version of an ontological square of opposition is presented. It is constructed by means of standard first-order methods. The appropriate language is introduced. The simplicity of ontologies (of ontological theories) is considered from so called an erotetic point of view. The very background of my paper is some informal convictions of Roman Suszko mixed with the idea of the structure of philosophical systems which was elaborately considered in Jules Vuillemin's works.

Pseudo-Weak Logics and the Traditional Square of Opposition

LUIS ESTRADA–GONZÁLEZ
National Autonomous University of Mexico, Mexico
lestrada@minerva.filosoficas.unam.mx

To P. F. Strawson, *in memoriam* Perhaps the main problem with the traditional square of opposition is that there are good reasons to think that some Aristotelian inferences are valid in ordinary language (Strawsonian claim) but their symbolization shows their invalidity (Quinean claim). So, what can be done for they can coincide? (Both Strawson and Quine deny this could be done.) In this paper, using an interesting class of logics, "pseudo-weak logics", it will be presented a proposal that (i) could validate more relations in the square than classical logic (ii) without a modification of canonical notation neither of current symbolization of categorical statements though (iii) with a different but reliable semantics. At the end of the paper some open problems on the properties of these logics, especially some relations between them and other logics and a translation of classical logic into them will be discussed.

Contradicting the Improbable

PAUL M. HEALEY
UK
paulmsrf@btinternet.com

A deviant Square of Opposition is proposed; where The Possible is substituted for the Universal Affirmative, The Impossible for the Universal Negative, The Probable for the Particular Affirmative and The Improbable for the Particular Negative; the reason for this substitution is to support the case for a rational understanding of bias as a relevant predicate. This I hope will show bias as a subject is relevant to every object; because it can be shown the effective calculation of rational values determines the bias of an object. To support the substitutions in the Deviant Square of Opposition I will demonstrate the universality of The Possible is not merely a subjective mater.

Peirce's Dagger and Natural Logic

DANY JASPERS
Hogeschool voor Wetenschap en Kunst, VLEKHO-Brussel, Belgium
dany.jaspers@vlekho.wenk.be

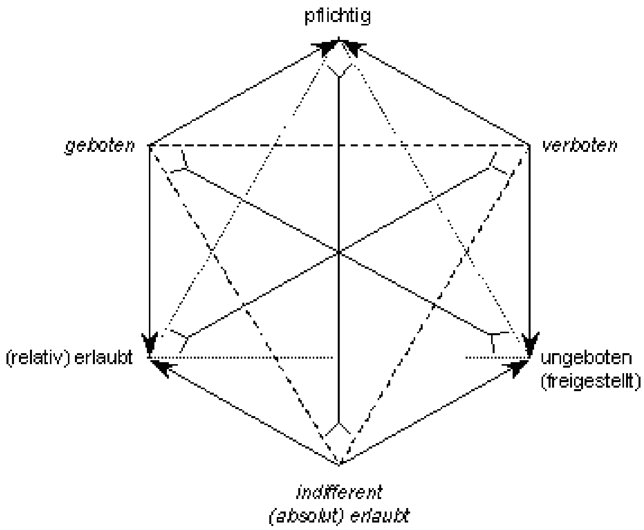
Peirce (1989 [1880]) proved that the logical vocabulary of the propositional calculus can be made extremely economical: all operators can be generated from a single basic truth function, the joint falsehood operator, which is both binary and negative. The hypothesis worked out in the present paper is that this operator, Peirce's Dagger, suffices to characterize the lexical semantic substrate of a range of standard operators in natural language as well. The analysis will lead to an asymmetrical two-dimensional calculus of a type first proposed by Löbner (1990. The latter sheds new light on the O-corner problem and the role of pragmatics (Horn 1989; Levinson) in accounting for asymmetries in the Boethian Square.

Horn, L. R. (1989), A Natural History of Negation, University of Chicago Press, Chicago.
Levinson, S. C (2000), Presumptive meanings, MIT Press , Cambridge, MA.
Löbner, S. (1990), Wahr neben Falsch. Duale Operatoren als die Quantoren natürlicher Sprache, Max Niemeyer, Tübingen.
Peirce, C. S. (1989 [1880]), "A Boolean Algebra with One Constant" (1880), in: C.S. Peirce, Christian J.W. Kloessel, eds., Writings of Charles S. Peirce, A Chronological Edition, vol. 4, 1879-1884, Indiana University Press, 23, 218-221

Supererogation and the Deontological Decagon

JAN C. JOERDEN
Europa-Universität Viadrina Frankfurt (Oder), Germany
joerden@euv-frankfurt-o.de

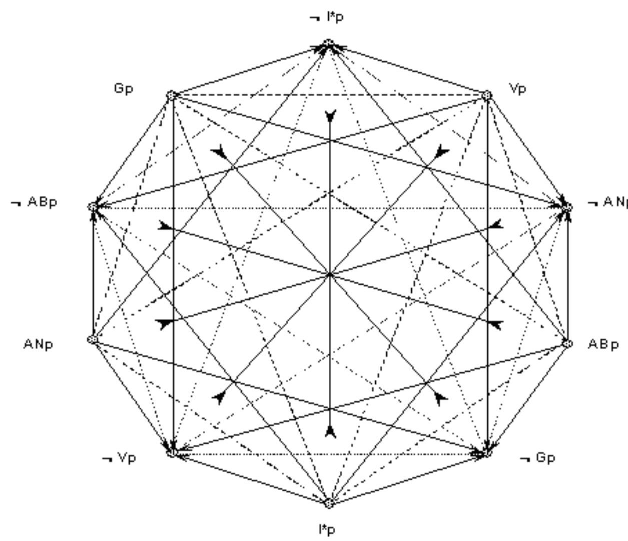
Well known in literature is the deontological hexagon, which is an extension of the square of opposition (cf. e.g. Kalinowski, La logique des normes, Paris 1972, p. 106 et seq.; Lenk, in: Lenk (ed.), Normenlogik, Pullach bei München 1974, 198



ff.): (geboten = obligatory; verboten = forbidden; indifferent = (absolute) erlaubt = indifferent; ungeboten = not obligatory; (relativ) erlaubt = not forbidden; pflichtig = nicht indifferent = not indifferent; = contravalence; → = implication; = exclusion; ... = disjunction)

In this system, however, supererogatory behaviour (e.g. giving 100 Dollar to a beggar) cannot be reflected correctly: Supererogatory behaviour is certainly neither obligatory nor forbidden. And since we usually react to such behaviour by bestowing a morally motivated (positive) sanction, such as praise or honour, it cannot be regarded as morally indifferent. In order to be able to represent supererogatory acts the deontological hexagon requires an extension. To make this extension possible I suggest employing the expressions "exhorted" and "dehorted". Exhorted and dehorted acts are, on the one hand, neither obligatory nor forbidden and, on the other hand, are not morally indifferent (I). The concepts of exhortation and dehortation make it possible to differentiate between coercive prescription (following the traditional meaning of *praecepta*), on the one hand, and non-coercive advice (*consilia* again in the traditional meaning). Both of these expressions concern non-coercive advice, whereby exhortation is understood as positive advice to commit an act and dehortation negative advice to omit an act. If the exhorted act is committed the act is supererogatory. If a dehorted act is omitted the omission is supererogatory. The logical relationship of the deontic concepts "exhorted" (E) and "dehorted" (D) is such that they obviously cannot both apply to the same act p. The concepts "exhorted" (E) and "dehorted" (D) are furthermore not compatible with the concepts "obligatory" (O) nor "forbidden" (F). For, the commission of one and the same act cannot be both coercively and not coercively required.

Fitting together the deontic concepts O, F, E and D seems to suggest a *four-dimensional* deontic conceptual system. A hexagon, as introduced regarding a *three-dimensional* conceptual system, is obviously no longer sufficient to represent these four concepts and their four negations ($\neg O, \neg F, \neg E$ and $\neg D$). These four concepts and their negations would require a deontological octagon. However, even an octagon would not be sufficient for an adequate representation of our usual moral conceptual system. For the concepts of obligatory and forbidden acts require for a proper understanding of their deontic content the further concept of an indifferent act (Ip). The additional new concepts of exhorted and dehorted acts (Ep and Dp) do not cover the field of indifferent acts (Ip), for, it is quite possible that an act is neither "obligatory" (O), nor "forbidden" (F), nor "exhorted" (E), nor "dehorted" (D). Indeed most acts committed or omitted usually fall into the category of indifferent acts. For instance, going for a walk, playing chess, or eating are acts which are usually neither obligatory, forbidden, exhorted nor dehorted. Rather, they are morally indifferent. In order to have a deontic conceptual system which completely covers all relevant acts there must be a system with five basic concepts (along with their negations). Such a *five-dimensional* deontic conceptual system can be presented in the following deonto-



logical decagon: (G = geboten = O = obligatory; V = verboten = F = forbidden; AN = angeraten = D = exhorted; AB = abgeraten = E = dehorted: I* = indifferent; ¬= nicht = not; p = die jeweilige Handlung = the act in question; →= Implication; ······· = Disjunction; —— = Exclusion; = Kontravalenz;)

William of Sherwood, Singular Propositions and the Hexagon of Opposition

YURII KHOMSKII
ILLC, The Netherlands
yurii@deds.nl

In classical Aristotelian logic, the traditional view has always been that there are only two kinds of quantities: *universal* and *particular*. For this reason, philosophers have struggled with *singular* propositions (e.g., "Socrates is running"). One modern approach to this problem, as first proposed in 1955 by T. Czeÿzowski, is to extend the traditional square of opposition to a *hexagon of opposition*, illustrating three distinct kinds of quantities, as shown in the figure below (where "*u*" stands for "singular affirmative" and "*y*" for "singular negative").

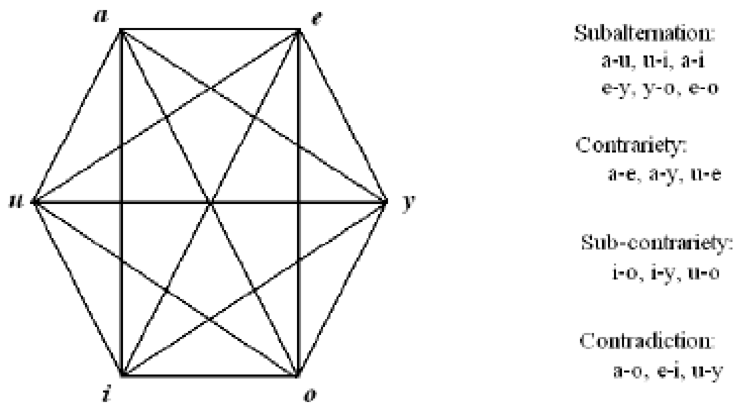


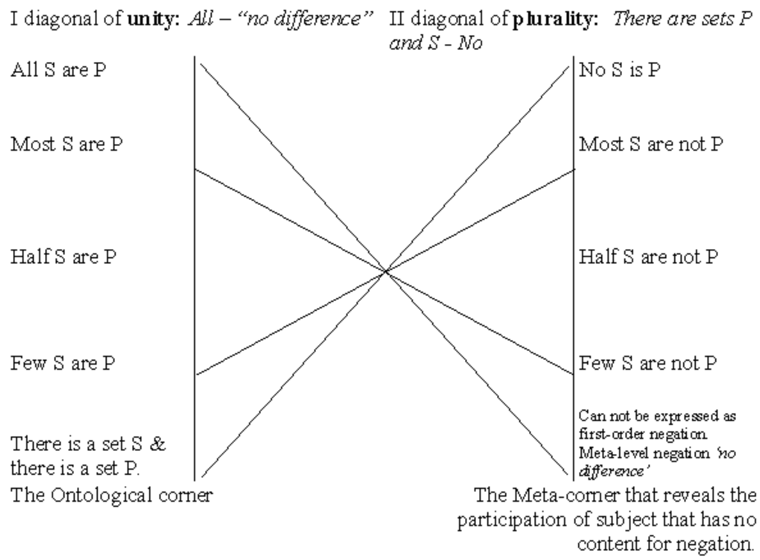
Figure 1: The hexagon of opposition.

We argue that, much earlier than Czeÿzowski, the logician William of Sherwood developed the same theory of singular propositions, as early as the 13th century AD, and that there are indications that the hexagon itself was present in his writings. This leads us to the thesis that, perhaps, William of Sherwood, and not Czeÿzowski or any other logician from the modern era, deserves the real credit for the invention of the hexagon of opposition.

Extended square of opposition deduced from the principle of opposition and logical and ontological equivalence

RAINER KIVI
Tartu University, Estonia
rainer.kivi@emu.ee

The Aristotelian-medieval square of opposition represents in diagrammatic fashion the highest principle of Aristotle's metaphysics. The traditional square works in a whole-part framework. The project was motivated by an interest in whether the square was extendable by natural language quantifiers like *most, half* and *few*, and whether the extended square could solve the problem of existential import. The research reveals that the traditional square has three crucial flaws, all dependent upon the concept of logical contradiction. These defects point out that the traditional concept of contradiction is discrepant and vague. The notion should be either revaluated or set aside as unreliable. The square of opposition is symmetrically extendable if it is based on ontological and logical equivalence. (The ontological square of opposition could be drawn as a separate diagram.) The equivalence analogized by lines forms in the middle of the extended square a so-called point of symmetry. On the one hand, the approach is in harmony with the principle of opposition; on the other hand, the concept of equivalence is simple, clear and, as such, compared to contradiction, consistent. The extended square of opposition opens a new perspective on the logic-first philosophy relationship and provides an opportunity to modify the theory of syllogistics.



The Square of Opposition in Modal Logic and Modal Reasoning

HOLGER LEUZ
University of Regensburg, Germany
holger.leuz@psk.uni-regensburg.de

The Square of Opposition of standard logic has a counterpart in alethic modal logic. This 'Modal Square' is closely related to the duality of possibility and necessity operators. When we look beyond modal logic and con-sider the epistemology of alethic modality and practices of modal reasoning, some problems with the Modal Square and duality arise. As Brody's Paradox illustrates, counterfactual possibility claims have to be supported by explicit constructions of hypothetical scenarios. These constructions are subject to various admissibility con-ditions. But the absence of any necessary truths precluding a certain possibility does not amount to having the required construction of a hypothetical scenario at hand. So, on a verificationist construal of modal semantics, the Modal Square and duality may even be invalidated. But on a more conservative attitude towards modal logic, we have to recognize that actual modal reasoning involves multiple modalities and is much more complicated than the standard picture of modal logic (and some possible worlds metaphysics derived from it) suggests.

Aristotle's Square of Oppositions and W.Ockham's Razor

ELENA LISANYUK

St. Petersburg State University, Russia
elenalisanyuk@gmail.com

From the time of W.Ockham up to nowadays 'razor' motives have an influence on logicians' domain. Whether ontological commitments anyhow affect the validity of logical inference, or not? Is it necessary to eliminate any such commitment in logic? How should the semantic framework be outlined in order to avoid them? In the ancient and medieval logical tradition, no logical theory was possible without being based on a semantic framework with strong ontological roots.

The logical square of oppositions is formed up with the help of a number of logical parameters such as predication, quality, quantity, and truth conditions. All these are bound together in the Aristotelian pioneering system of categories.

According to Aristotle, the square of oppositions is formed by the four types of simple categoricals that differ in quality and quantity. Aristotelian ideas on predication are normally described as inherence theory which endows predicates with more general status than subjects. In a categorical, the subject together with the copula are responsible for ontological relations, whereas predicates carry out the contents of categoricals. Consequently, affirmative categoricals with subjects pointing to non-existent entities are taken to be false as well as negatives ones speaking of actually existing objects. Aristotle attributed existence to single things only, and thought that human intellect is capable of grasping them directly and immediately. In many places in his logical writings, Ockham claimed to be an ancestor of Aristotelian ideas, and saw his logical theories as interpreting and correctly developing Aristotle's theories. His famous razor method was designed to eliminate all non-necessary ontological commitments in between real things and intellective soul. In order to accomplish this ambitious project Ockham introduces a renovated supposition machinery; the theory of mental language and a new light in the manner of predication. In my paper, I intend to show that Ockham's approaches end up with a new understanding of the Aristotelian square of opposition with the basic difference in the domain of ontology.

Gottfried Ploucquet's Attempts to Refute the Traditional "Square of Opposition"

WOLFGANG LENZEN
University of Osnabrueck, Germany
wolfgang.m.lenzen@t-online.de

In various books published between 1759 and 1782, Gottfried Ploucquet developed a logical calculus which is distinguished from traditional logic in the following respects.

1. The so-called Identity-theory of judgments according to which each affirmative proposition amounts to an identity between subject and predicate;
2. Certain deviations from the traditional theory of opposition including the thesis that the negation of the particular negative proposition 'Some S is not P' is itself a particular rather than a universal proposition;
3. A deviant conception of conversion allowing, in particular, 'Some S is not P' to be converted into the unorthodox proposition 'No P is some S';
4. A formal method for determining the validity of a syllogism independently of the traditional classification into "forms".

In my contribution it is shown that:

- The "Identity theory" is invalid in the strong form put forward by Ploucquet but valid in a weaker sense maintaining only that, e.g., 'Every S is P' can be transformed into an identity O.(S)=Q.(P) where 'O' and 'Q' denote sort of quantifiers ranging over sets.
- Ploucquet's critique of the traditional theory of opposition is mistaken since it rests on an untenable conception of the 'subject" of a particular proposition;
- Ploucquet's theory of conversion - leading to the "Quantification of the predicate" - basically anticipates all the details that are usually attributed to William Hamilton (1861).

Logical and Categorical Extensions of Aristotle's Square

DOMINIQUE LUZEAUX, JEAN SALLANTIN AND CHRISTOPHER DARTNELL
Polytechnique, Lirmm and Euriware, France
dominique.luzeaux@polytechnique.org, js@lirmm.fr and christopher.dartnell@euriware.fr

We start from the generalization of Aristotle's square in [1], [2], [3] and [4], and study them from both syntactic and semantic points of view. First, we provide an interpretation of the vertices and sub-alternation edges of the resulting geometrical figure, and show that the underlying logic is none other than classical logic. Then we turn to semantics and use categorical logic. We discuss the necessary properties of the category in order to provide a working semantic for the previous various extensions and show how they arise from an adjunction between two categories. This paves the way for a more general theory of reasoning where Aristotle's square and its generalizations do not model only the reasoning abilities of a unique agent, but arise as the interaction of several agents leading to a straightforward model of learner-teacher interactions.

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[4] Pellissier, R.: "Setting" n-opposition. In: UNILOG05, (Forthcoming) (2006)

How to Fit Singular Propositions into the Square: The Solution of John Wallis (1616-1703)

JAAP MAAT
University of Amsterdam, The Netherlands
j.maat@uva.nl

In this paper, I discuss a tract by John Wallis (1616-1703) on singular propositions. Wallis was a central figure in 17th-century intellectual life. He was an outstanding mathematician, acquired fame as the most skilful cryptanalyst in the world, made major contributions to linguistics, published various theological works, and was active as a scientist, being a founder member of the Royal Society. He also wrote a textbook on logic, to which he appended a treatise on singular propositions.

Wallis defends the view that singular propositions should be reduced to universal ones, offering a series of arguments. His treatment of the subject was extremely influential. It was taken over by the Port Royal logic and became the standard view in logic books well into the nineteenth century. In the paper I investigate Wallis' arguments, and try to find an explanation of why he disregarded the problematic aspects of his position.

The Square of Opposition and the Paradoxes

TERESA MARQUES
University of Lisbon and Logos/University of Barcelona, Spain
teresamiguel@mail.telepac.pt

Can an appeal to the difference between contrary and contradictory statements deal adequately with paradoxical cases like the sorites or the liar? Some linguistic evidence supports the idea that sentences like 'John is lucky'/ 'John is unlucky' can be both false, but can't be both true. The sentences are contrary statements, not contradictory. If this distinction exists in cases that generate paradoxes, perhaps it can be appealed to to disentangle paradoxes, like the sorites or the liar. A positive answer to the question above would proceed by stressing out that paradoxes arise because we take contrary statements to be contradictory statements. Whereas it is puzzling that two contradictory statements can be untrue, it is not at all puzzling that two contrary statements are untrue. The answer to the above question given in this paper will be negative, though. It is justified by discussing the alternatives of how a distinction between contrary and contradictory statements can be motivated and developed with respect to paradoxical cases. In each case, it is shown that the available alternatives of motivating or grounding the distinction, in a way useful to deal with the paradoxes, are either inapplicable, or produce new versions of the paradoxes, or both.

Existential Commitment in the Cartesian Square of Opposition

JOHN N. MARTIN
University of Cincinnati
john.martin@uc.edu

Contrary to Jean-Claude Pariente, I argue that Arnauld and Nicole in *The Port Royal Logic* hold the traditional view that affirmative categorical propositions, both universal and particular, carry existential import, while at the same time being "about" ideas. The paper explains how Arnauld and Nicole retain a medieval account of signification in terms of objective being, use it to define extension and truth as relations among ideas, but nevertheless maintain the existential import of terms by positing causal occasionalism. The result is striking adaptation of medieval semantics to an ontology that denies Aristotelian sensation and its causal theory of reference, but retains its descriptive account of signification and correspondence theory of truth.

Square vs Triad

ROBERT MARTY
University of Perpignan, France
marty@univ-perp.fr

The main theories of meaning are dyadic (Saussure, Hjemslev, Barthes), triadic (Peirce) or quadratic (Greimas). According to a theorem of relational algebra, we have the possibility of describing every polyad as a relative product of triads. On this basis, we propose to approach the "semiotic square" (Greimas) by a Peircean triad, that is, as a relative product of triads. We show, by a phenomenological reading, that the constitution of a semantic category, as well as that of the Greimassian square, finds its echo in the creation–by a "quasi-mind", in other words, by some sort of automaton capable of semiotic behaviour–of an internal dyad of subcontraries determined by an external dyad of opposites instituted by the culture. That allows us to establish a bridge whose usefulness we will test by making, at first, transit Peirce's universal categories.

Dimensions of Opposition: Representing the Square by Two-dimensional Operators, and Some Linguistic Applications

INGOLF MAX
University of Leipzig, Germany
max@uni-leipzig.de

It has been widely discussed that there is apparently no perfect formal representation of the traditional square of opposition by using modern formal translations. Strawson (1952, 170 f.) offers a "formalistic solution" which is somehow crazy and gives rise to search for a better "realistic solution" which "illuminates some general features of our ordinary speech." Any possible "formalistic" solution seems to force us to the following alternative: either to take existential preconditions for granted (tacit presuppositions), i.e. there is no need for a syntactic or even semantic representation of such preconditions (Frege's position), or to find a syntactic place for the formalization of existence which seems to be possible only by adding a **conjunct/disjunct** like $\ldots \wedge / \vee \exists x F x$ (in free logics: existence predicate, or – in free logics with identity – e.g. $\exists x(x = a)$. But using **logical conjunction/disjunction** forces us to give up the intuitive difference between **explicit (asserted)** and **implicit (presupposed)** meaning. My thesis is that a **two–dimensional framework** allows to leave this pseudoforcing alternative. I offer a unifying syntactic approach without using conjunction/ disjunction at the beginning. This paper consists of three parts:

1. We introduce some new syntactic tools: variable quantifiers, a new entailment operator and a presupposition-preserving negation acting on two-dimensional arguments. The first dimension gives the familiar classical reading of the **assertion** of a sentence. The second one represents the relevant **existence presupposition**. The new operators are characterized by special reduction rules which allow the interaction of both dimensions. It can be shown that this solution offers a unified and homogeneous representation of the traditional square of opposition.

2. It will be demonstrated how German/English *phase particles (schon/already, noch/still* etc.) form a specific square of opposition. Criticizing Löbner (1989) I use several two-dimensional negations for explicating the relations within this square of opposition.

3. It is widely accepted that by using a special rise-fall contour-**bridge/hat contour**) – we get the phenomenon of scope inversion of the $\forall$-quantifier and negation. But this scope inversion seems to be no simple switch of their positions. Using a variable quantifier and a presupposition-preserving negation a bridge contour can be formalized by simply inverting their direct order.

Multi-dimensional logical systems are suitable for representing different types of squares of opposition and their linguistic applications.

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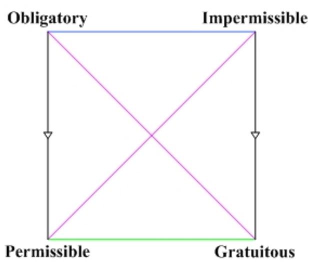
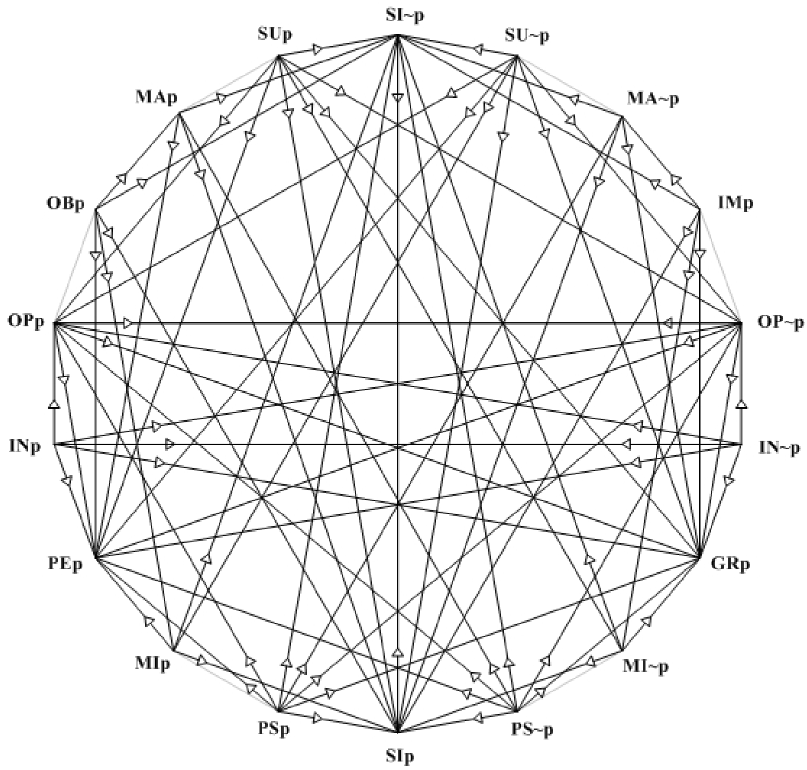
From the Deontic Square to the Deontic Octoecagon and Beyond

Paul McNamara
University of New Hampshire, USA
mcnamara.p@comcast.net

I will discuss the traditional deontic square in the context of the emergence of deontic logic as an academic discipline in the mid-Twentieth Century, beginning with standard deontic logic (or its near cousins) and the Andersonian-Kangerian reduction of deontic logic to a normal modal logic with a constant that has a deontic or evaluative flavor.



We will see that from the outset, and persistently, the informal language used to describe the square and basic operators contains the kernels of more expansive figures, since the language conflates distinct operators, not all of which can be represented in the square. These conflations are not confined to deontic logic, but also appear in the literature on ethical theory and contribute to confusion there as well. Such reflections will motivate various expanded figures like those found in the author's Stanford Encyclopedia of Philosophy entry on "Deontic Logic" (and in the entry of the same title in Volume 7 of the Handbook of the History of Logic), figures intended to represent various operators associated with such notions as what is obligatory, permissible, optional, indifferent, must be done, ought to be done, is the least that can be done, is supererogatory, etc. Throughout, parallel figures providing partitions of the objects of normative appraisal into finest discrete classes will be developed in tandem; for example, parallel to the deontic square, on one reading, is a threefold partition of objects of deontic appraisal into those that are either obligatory, impermissible, or optional, without overlap. Some attention will also be given to the impact that some of the central challenges to standard deontic logic have on the status of the deontic square and similar figures. The most salient example pertains to the fact that the traditional deontic square, on the traditional deontic definitional scheme, is tautologically equivalent to a principle of "no conflicts", that it can't be the case that a proposition and its negation are each obligatory. This has of course been challenged.



Paraconsistency, Negation and the Double Square

FRED SEYMOUR MICHAEL
Brooklyn College CUNY, USA
fmichael@brooklyn.cuny.edu

B. H. Slater has argued that the negation operator in paraconsistent logic is just a subcontrary forming operator and not negation at all. But then Slater denies that there is such a thing as paraconsistent logic. It is more surprising to find the same position taken by Graham Priest and Richard Routley, who argue:

> Traditionally A and B are sub-contraries if A v B is a logical truth. A and B are contradictories if $A \vee B$ is a logical truth and $A \& B$ is logically false. Now in da Costa's approach we have that $A \vee \neg A$ is a logical truth. But $A \& \neg A$ is not logically false. Thus, A and $\neg A$ are subcontraries, not contradictories. Consequently da Costa negation is not negation since negation is a contradiction forming functor, not a subcontrary forming functor.

The same argument leads to the conclusion that $\diamond\neg A$ is not negative. In classical modal logic, $\diamond A \vee \diamond\neg A$ is a logical truth, whereas $\diamond A \& \diamond \neg A$ is not logically false. $\diamond A$ and $\diamond\neg A$ are subcontraries, so $\diamond\neg p$ is not a modal negation. The problem is that $\diamond\neg p$ is contradictory to $\Box p$, which certainly is positive, making $\diamond\neg p$ negative. What

I argue is that da Costa's logic can be seen as a subsystem of a larger system that also includes intutionistic logic and in this larger system, da Costa negation is the contradictory of a proposition that is indisputably positive, showing that negation in paraconsistent logics such as the da Costa systems and Priest's LP really is negation.

Why are There no Negative Particulars? Horn's Conjecture Revisited

JACQUES MOESCHLER
L'Université de Genève, Switzerland
Jacques.Moeschler@lettres.unige.ch

Natural languages have a singular property, which distinguishes them radically from formal languages as predicate calculus. They do not have words to express what is called, following the classical analysis of quantifiers and negation, negative particulars. In the logical square, the relations between quantifiers and negation are well-known: positive universals (A) imply positive particulars (I) (*all the F are G* implies *some F are G*), negative universals (E) imply the negative particulars (O) (*no F is G* implies *some F are not G*), A and O on the one hand, E and I in the other being contradictories, whereas A and E are contraries and I and O sub-contraries. The crucial point is that no language lexicalizes a quantifier in O, as shown in the following table.

A	I	E	O
all	*some*	*no*	**nall*
always	*sometimes*	*never*	**nalways*
both	*one (of them)*	*neither*	**noth*
and	*or*	*nor*	**nand*

Horn (1989, 2004) proposed an interesting conjecture to explain this phenomenon: natural lan-guages tend not to lexicalize complex values. This conjecture explains why *some… not, not always, not both, not… and* are not lexicalized. Horn's conjecture is given through a neo-Gricean analysis of scalar implicatures (Gazdar 1979, Levinson 2000, Horn 1989). If from an observational point of view Horn's conjecture is adequate, it raises questions from a descriptive and an explanatory point of view. From a descriptive point of view, it is based on the distinction between truth-conditional contents (what is said) and non-truth-conditional contents (what is implicated). Moreover, Horn makes the assumption that the implicatures drawn from I and O are identical, which means that I and O both implicate the conjunction of I and O:
(I $>>$ I & O), and (O $>>$ I & O). This analysis is contradictory from an informational point of view, and incompatible with the principle according to which scalar implicatures yield more specific contents than the asserted ones. Last, Horn's analysis

is not explanatorily adequate, because it assumes that the positive and negative quantifiers form symmetrical quantitative scales (<*some, all*>, <*some… not, no*>), which is doubtful for the negative quantifiers, since O is not lexicalized.

Our analysis will not insist on the non-necessity of the lexicalization of O, but on its non-possibility, for reasons related to its content. The revisited version of Horn's conjecture takes the following form: *Lexicalize only concepts whose specifications are calculable*. The calculability of quantifiers inferred contents will not be defined in terms of information, but of relevance. Finally I will show how a relevance-theoretical approach makes it possible to solve, at the level of explicatures, the classical problem of scalar implicatures.

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A Newly Discovered Medieval Diagram of the 'Square' on Gotland, Sweden

UAININN O'MEADHRA
The Swedish Medieval Church Graffiti Project, Sweden
uomeadhra@delta.telenordia.se

A diagram of the 'square' in Latin minuscule scratched in medieval times into the wall plaster in a church has just been identified on the Baltic island of Gotland, Sweden. This is a unique find for Scandinavia. Paleography and location suggest a possible late 13th century date. This short presentation will indicate questions raised in terms of the strange location, as well as text and diagram form which find parallel in both Greek and Latin medieval manuscripts. The congress audience is encouraged to contribute from their various specialist viewpoints to an assessment of the scientific potential of this discovery.

Saving the Square and Having it All

ALEX ORENSTEIN
Queens College and The Graduate Center CUNY, USA
aorensteinny@earthlink.net

On the one hand there is the "old" problem of saving the traditional square of opposition. On the other hand there is the current problem of providing an account of quantifiers for natural language dealing with plural quantifiers, e.g., Many men, Lots of lions, etc. as well as the standard 'Every' and 'At least one' of standard current predicate logic.

I immodestly attempt to offer a single unified solution to both of these problems making use of: a. special restricted quantifiers , b. an account of demonstrative noun phrases, and c. a revival of the "dreaded identity theory of predication" by treating the copula in terms of identity. My work is guided in good part by themes found in the Terminist tradition of Ockham and Buridan.

John Buridan on the Bearer of Logical Relations

ERNESTO PERINI-SANTOS
Universidade Federal de Minas Gerais, Brazil
epsantos@fafich.ufmg.br

John Buridan presents an argument to establish that two contradictory sentences can be false at the same time. Let us take the sentence 'Socrates is running', uttered by you at time t . I want to contradict your utterance and say 'Socrates is not running'. But while you were talking, Socrates was sitting, and as soon as I begin to talk, he starts to run. Just as the extension of the time intended by a statement is underdetermined by the tense of the verb, the intention of the speaker determines the slice of time used as present. The speaker can use the present tense to refer to a segment of time that does not include the moment of its utterance as part of it. So my proposition is true, about of the time of the utterance of your proposition. The bearer of truth values are sentences uttered by a speaker, or statements, otherwise there is no determined truth-conditions. In this Austinian-like semantics, the square of opposition has statements, not sentence types, at its corners.

Classical Modal Logics of the Square of Oppositions

JERZY PERZANOWSKI
Jagiellonian University, Poland
jerzy.perzanowski@wp.pl

Two questions are basic for investigation of modal logics of a given subject: first, **indication** - just to find these logics, and next, **interpretation** or **reading** - to interpret or read them in proper way.

Indication of modal logics of the square of oppositions is clear and easy. I indicate them in the most general case. Interpretation, however, is a rather subtle question, changing from case to case. I will do this in four cases: the case of quantifiers, the canonic case of usual alethic modalities, the case of logics of truth and falsity and the case of deontic modalities.

Aristotle's Cubes and Consequential Implication

CLAUDIO PIZZI
University of Siena, Italy
pizzic@unisi.it

In so-called logics of consequential implication the couples of formulas $\{A \rightarrow B, A \rightarrow\sim B\}$ and $\{A \rightarrow B, \sim A \rightarrow B\}$ enjoy a relation of contrariety, so that they grant the construction of at least two different kinds of allomorph squares of oppositions. It is then possible to build 3-dimensional figures (*Aristotle's cubes*) whose lateral faces are allomorph squares of the first and of the second kind. It is also possible to devise analogous constructions based on variants of consequential implication such as consequential equivalence and a weaker notion of consequential implication. The standard square of modalities is obtained by degeneration of Aristotle's cubes.

Applications Of The Square of Opposition in Language, Phonology and Semantics

MARIA POPOVA AND IVAN KASABOV
NBU, Bulgaria
ivankasabov@yahoo.com

Our paper presents applications of the so-called square of opposition in systematic examinations of natural languages. It demonstrates the paradigmatic relations between all phonemes in a given language.

The general characteristics of word-signs in natural language is best analyzed within the categorial framework according to the principle of the semiotic square of oppositions, by substituting the abstract and formal I by any concrete word whatsoever of a given language, so that word-members of the same category can be found which are directly related to it. The basic semantic relations in natural language and systematic relations between all words in lexical ontology can be presented in the same way.

As strange as it may seem, it is possible to present all principal relations in the case systems of different languages, following the same principle of oppositions in the square. Surprisingly, in these same relations we can discover the basic motive of a word's terminological, metaphoric and metonymic transformations, as well as transformations in the meanings of polysemantic words.

A Logical Framework to Annotate Documents in a Virtual Agora

JEAN SALLANTIN, CHRISTOPHE DOUY, ABDELKADER GOUAICH, JUAN CARLOS MARTINEZ, DENIS PIERRE, ANTOINE SEILLES , JEAN-BAPTISTE SOUFRON JEAN-PHILIPPE COINTET
Lirmm, France
jean.sallantin@lirmm.fr, cdouy@pikko-software.com, Abdelkader.Gouaich@lirmm.fr, martinez@interquanta.com, pierre@normind.com, antoineseilles@gmail.com, soufron@gmail.com

"O brave new world / That has such people in't!" (Miranda 5.1)

William Shakespeare, The Tempest

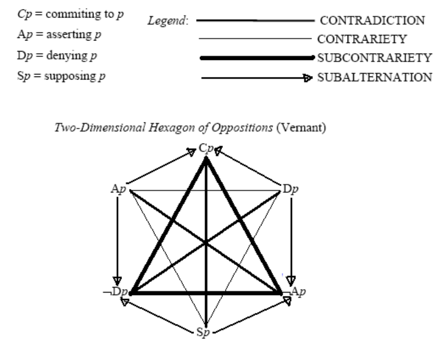
We propose a logical framework allowing citizens to formulate contrasted opinions about some parts of submitted documents in a public debate area. These opinions are expressed in order to facilitate confrontations and reinforcements. The added value comes from the argumentative aspect. We escape from a Manichean vision of a debate. We prefer to foster the possibility to formulate contrasted visions. We provide a way to interactively display the highs and the lows of a debate.

In our first experimentation, citizens express their opinions as being judgments about a statement in the context of a specific thematic. There are debates about judgments that are opposed respecting a square of opposition. A treemap is used to give the cartographies of the debate. (http://www.betapolitique.fr/arak/glosser.html?documentId=0)

Illocutionary Oppositions

FABIEN SCHANG
Nancy Université, France
schang.fabien@voila.fr

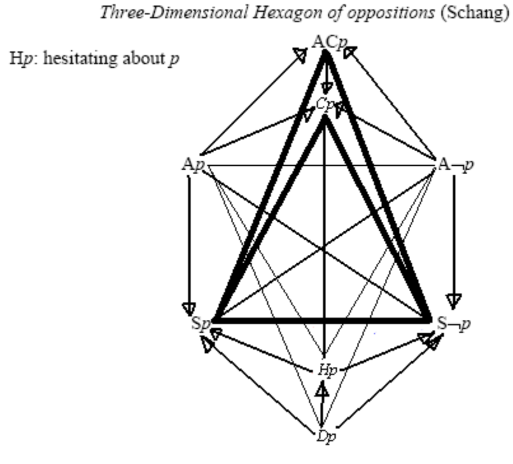
A modal treatment of illocutionary acts is suggested within a general theory of speech acts (following [Searle & Vanderveken's 1985]).



Two-Dimensional Hexagon of Oppositions (Vernant)

An assertoric modal logic is thus suggested in order to account for the pragmatic features of several ordinary concepts such as knowledge, belief, certainty, assumption, doubt, and so on. The resulting formal logic is an assertional logic conflating both declarative and epistemic sentences: a S5-system of assertion and supposition LAS, in which every assertive act is to be parsed as an illocutionary one with distinctive features (direction of fit, degree of force, and the like). In order to catch the formal features of these concepts, the theory of oppositions will be used and displayed within rival oppositional structures.

Three-Dimensional Hexagon of oppositions (Schang)



[Searle & Vanderveken 1985]: Foundations of Illocutionary Logic, N.-Y., Cambridge Univ. Press.

The Logic of the Ontological Square

LUC SCHNEIDER
Université de Geneva, Switzerland
luc.schneider@lettres.unige.ch

In *Categories 1a20–1b10* Aristotle introduces two orthogonal distinctions, namely that between types (kinds) and tokens (instances) on the one hand and that between tropes as particularised attributes and substances as their bearers on the other hand. Combining these two dichotomies results in a four-fold categorial scheme called the *Ontological Square* (Angelelli 1967, 12), which consists of substances, instance attributes, types of substances and types of attributes. Variants of this four-category ontology have been promoted by Jonathan Lowe (1998, chap. 9; 2006, chap. 2) and, to some extent, Brian Ellis (2001; 2005a, 375–376; 2005b, 462).

The intuitions underlying four-category ontology can be captured in *Kind-Instance Logic* (KIL), a calculus of many-sorted second-order logic inspired by work of Donald Mertz (1996; 1999). Thus, the formal concepts of four-category ontology turn out to be logical concepts. Furthermore, KIL, and hence four-category ontology, can be given a first-order semantics (Shapiro 1991, 74–75), in which n-adic instance attributes are modelled as tuples of the membership relation $\epsilon(n)$. Finally, Kind-Instance Logic may be extended in order to allow for reasoning about attribute instances that are located in time and possibility space. This variant of KIL, called *Situated Kind-Instance Logic* (SKIL) offers a formal framework which unifies event-based (Parsons 1990) as well as situation-based (Barwise & Parry 1983) approaches in natural language semantics.

The talk is divided into three parts. In the first part we shall outline the basic insights underlying four-category ontology. In the second part, we will describe the syntax and semantics of KIL and, time allowing, sketch the proofs of its soundness and (weak) completeness. In the third part, we will outline the syntax and semantics of SKIL and show how to embed in SKIL the formal predicate of *being located at* which holds between relation instances, times and situations, enabling us to give an extensional account of alethic and temporal modalities, at least as far as statements about physical objects are concerned.

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Direct Negation in Proof-Theoretic Semantics and the Square of Opposition

PETER SCHROEDER-HEISTER
Universität Tübingen, Germany
www-ls.informatik.uni-tuebingen.de/psh

The standard approach to negation in proof-theoretic semantics is via its intuitionistic interpretation using *falsum* as a logical constant. The inference rule *ex falso quodlibet* is then obtained from the fact that no canonical way of proving *falsum* is available, so that it is vacuously true that every canonical proof of *falsum* can be transformed into a proof of any proposition whatsoever. While this point is itself related to the interpretation of the *square of opposition* (see Wagner de Campos Sanz' contribution to this conference), I would like to relate the *square* to the treatment of direct or explicit negation in proof-theoretic semantics. By *direct negation* I mean negation given through explicit denial rules governing the refutation of propositions, in contradistinction to the indirect treatment via a *falsum* constant.

Suppose a rule-based definition is given, consisting of clauses with positive heads ('assertion clauses') and clauses with negative heads ('denial clauses'). They are called clauses for *primary assertion and denial*. Then by a procedure very close to *inversion* or *definitional reflection*, corresponding inferences for *secondary assertion and denial* can be generated, the secondary denial of A saying that all canonical conditions for the primary assertion of A can be refuted, whereas the secondary assertion of A says that all of the canonical conditions for the primary denial of A are refutable. The system as a whole is called *balanced*, when secondary assertion and denial can be inferred from primary assertion and denial, respectively.

In my very tentative talk, I would like reach a result of the following kind: Primary assertion and denial are contraries, secondary assertion and denial are subcontraries, secondary assertion and denial are subalterns to the corresponding primary judgements, and (primary assertion)/(secondary denial) and (primary denial)/(secondary assertion) are contradictories.

Interpreting Squares of Opposition with the Help of Diagrams

SUMANTA SARATHI SHARMA
Indian Institute of Technology, India
sumantas@iitk.ac.in

The traditional square of opposition is defended with the help of Ackrill's translation of 'O' type propositions and Strawson's revision of truth conditions. Both these approaches are lingual analysis of propositions. The present paper explores the possibility of developing an alternative diagrammatic technique, to test the validity of syllogisms, which would satisfy both traditional, as well as the modern viewpoints. Logicians argue either for or against any system of interpretation. Hence, we fail to find any standard diagrammatic technique, which incorporates both the points of view together. The principle behind it is to represent the minimum content asserted by categorical propositions. Since the diagrams remain the same, we have two different interpretation of the proposed representation system. The proposed technique attempts to interpret the squares of opposition diagrammatically with the help of propositions.

Square of Opposition in Terminist Logic A Study of Consistency of Discourse

FABRICE SILPA
French West Indies University, French West Indies
Fabrice.Silpa@martinique.univ-ag.fr

We propose in this paper a study of the relation between the Square of Opposition and the consistency (by no contradiction principle) of a universe of discourse developed with terminist proposals. The Square of Aristotle establishes the relations between the terminist proposals (contrary and contradictory for example) which make possible to determine consistency.

Our basis is the symbolism of Terminist Logic in order to make proposals composed of terms (subject and predicate) which are connected by an operator (copula) so that any proposal form is [S cop P]. All the proposals are analyzed by using the Square of Opposition. This analysis leads to the data-processing implementation of a Software of Study and Research called Ariste, in token of the founder of Logic, which integrates the principles of Aristotelian logic.

Oppositions Within a Frame

JÜRGIS SKILTERS
University of Latvia, Latvia
jurgis.skilters@lu.lv

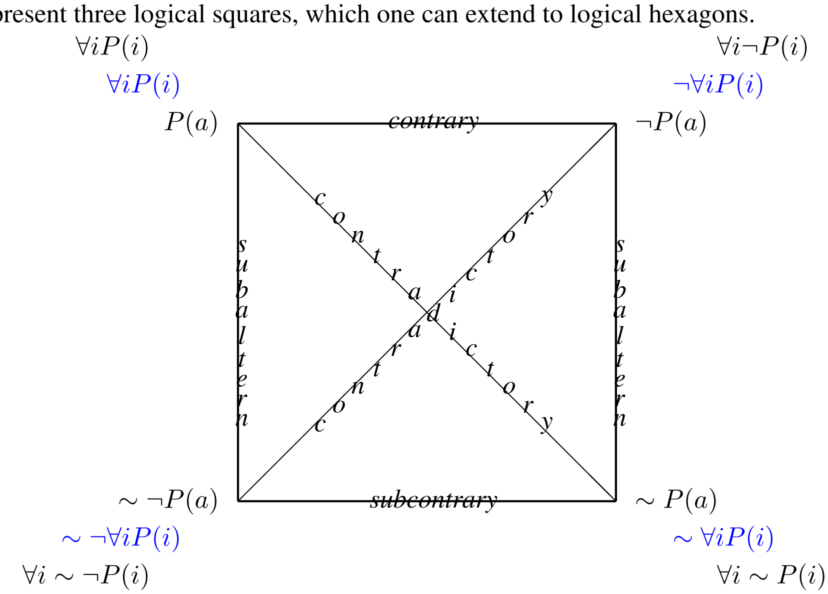
The current approach extends the square of oppositions (SOO) regarding the lexical semantics in general and knowledge representation theories in particular. This extended SOO is characterized as a framework for representing natural language (NL) oppositions. (1) Mutually exclusive and (2) complementary meaning relations are considered to be crucial. Vagueness and polysemy are discussed in respect to these relations of oppositions and are characterized as inherently frame-dependant.

The key idea of the present approach: Only a particular frame (i.e. a partially perceptually determined recursive knowledge structure) makes it possible to articulate NL oppositions. The NL-semantics of oppositions hardly depends on the frames of articulation and is construal-based and threefold constrained (cognitively, conventionally and contextually).

Non-Traditional Squares of Predication and Quantification

MIREILLE STASCHOK
Humboldt-Universität zu Berlin, Germany
staschokm@philosophie.hu-berlin.de

I will present three logical squares, which one can extend to logical hexagons.



The first square is based on the non-traditional theory of predication, which was developed by Sinowjew and Wessel ($\neg$ is a second kind of negation). Some advantages of this theory of predication will be discussed (connected with vague predicates, categorial mistakes, empty terms). The middle square is a non-traditional quantified version according to a logical system by Sinowjew. It will be shown that this non-traditional theory of quantification is superfluous, since it is based on an obscure difference between two kinds of quantification. Therefore only the outer square should be regarded as a non-traditional quantified version of the square.

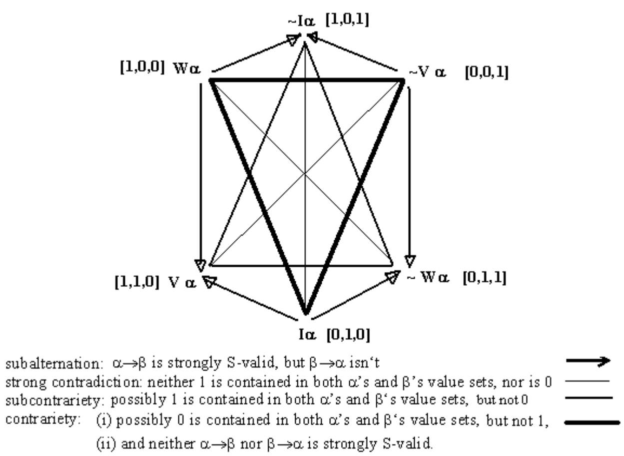
A Blanché Star for Truth-Functional Paraconsistent One-Place Operators

CORINA STRÖßNER AND NIKO STROBACH
Universität Rostock, Germany
niko.strobach@uni-rostock.de

The following results converge nicely with, but were developed independently of Béziau (2003), (2005) in Strößner (2006) and Strößner / Strobach (2006). We didn't study paraconsistent S5-modalities, but took as a starting point the idea that Łukasiewicz (1931) mistook his three-valued truth-functional one-place operators for modal operators while, in fact, they are different kinds of "negators" and "veridicators". This becomes clear if one considers paraconsistent versions of them, semantically defined for a variant of RM3 (cf. e.g. Priest (2001)) enriched by "V", which we call S.

α	$W\alpha$	$V\alpha$	$I\alpha$	$\sim\alpha$
$\{1\}$	$\{1\}$	$\{1\}$	$\{0\}$	$\{0\}$
$\{1,0\}$	$\{1\}$	$\{0\}$	$\{1\}$	$\{1,0\}$
$\{0\}$	$\{0\}$	$\{0\}$	$\{0\}$	$\{1\}$

"V" is read as "it is at least true that" (or "it is at least the case that"), "W" as "it is nothing but true that" (or "it is only the case that"), "I" as "it is true and false that" (or "it is as well the case as not that"). "W" is definable as "$\sim V \sim$", $I\alpha$ as $V\alpha\wedge\sim W\alpha$. "$\sim$" behaves classically upon consistent input (so does "$\rightarrow$"). The new operators enforce consistent input. In contrast to RM_3, S contains strongly valid formulae, i.e. formulae that yield the output $\{1\}$ upon *any* input. Of all 27 one-place operators just these operators form a Blanché star (hexagon) made up of three complete squares of opposition:



S is decidable, and a manageable decision procedure, extending Quine's simplification rules for classical propositional calculus, can be defined, and tableaux for several distinct consequence relations are available. The language S+ results if one adds a mirror image "Λ" of "V" that turns consistent input inconsistent ([10,10,0]). It can be shown that $\{V, \Lambda, |\}$, where "|" is a paraconsistent Sheffer stroke, is a complete base of connectives for S+, so every truth-functional paraconsistent logic is a sublanguage of S+. Some results carry over to three-valued and simple fuzzy logics.

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R. Boscovich's Onto/Logical Square of Oppositions

JANUSZ SYTNIK-CZETWERTYŃSKI
Świętokrzyska Academy, Poland

Ruder Josip Boscovich (1711 - 1787) - a great philosopher, mathematician, physicist and astronomer. The greatest of the forgotten - as Barrow wrote. The author of a Theory of Everything which claims that the world can be reduced to simple, homogeneous, discontinuous and invariable physical points, being centers of the forces of repulsion and attraction. Boscovich's system of kinematic atomism constitutes a crucial step in the development of physics and philosophy. The physical points combine both material and psychological features, but the view prevailing in philosophical literature is that they have more of a material nature.

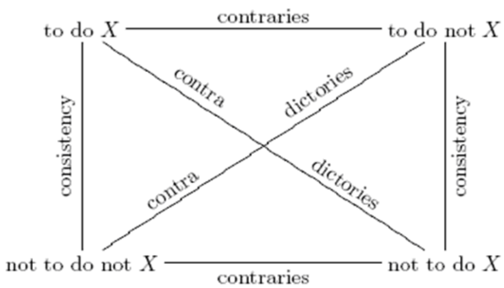
At the turn of the XVII century the dispute on the existence of the world brings two fundamental answers: Leibniz's conception of monads and of man as a computing machine, and Newton's radically different mechanistic theory of man as a living mechanism. How can the differences be overcome? An attempt is undertaken by Ruder Josip Boscovich, whose kinematic conception brings the final reduction of the possible kinds of substances. Material points are the substance of the world, the link between the world of matter and spiritual reality. Using combinatorics and the notion of substantial qualities Boscovich gives not only an extremely interesting answer but demonstrates far-reaching consequences for the theory of nature. He contrasts the world as it appears to be with the world as it really is. Boscovich bases his theory on the assumption that the rules governing both the mental and the physical can be reduced to a single Rule of All Forces governing everything in the Universe.

My presentation of Boscovich's views stresses the psychological aspect of the problem, especially in light of his fairly original attempt to give a common definition of mental states and physical states. Special emphasis is put on a square of onto/logical oppositions which is, I believe, behind Boscovich's construction.

Anselm's Logic of Agency

SARA L. UCKELMAN
ILLC, Universiteit van Amsterdam, The Netherlands
suckelma@illc.uva.nl

The earliest implicit use of a square of opposition in discussions of agency can be found in early 12th-century fragmentary notes of Anselm of Canterbury. Anselm discusses the logic of the Latin verb *facere* 'to do', identifying four types of doing, each type of which can be divided further into six modes. The relationships which Anselm notes hold between the four types of doing can represented in a standard square of opposition as follows:



This square illustrates that Anselm viewed agency as a modal concept, and the foundation of his theory of agency is a modal logic. This in turn shows that the history of treating agency as a modal notion is far longer than one might think, and that modern theories of modal logic may be used to provide rigorous foundations for Anselm's agentive theory.

Square of Opposition and Existential Assumptions of Syllogistic

RAFAL URBANIAK
University of Calgary, Canada
rafal.urbaniak@ucalgary.ca

The classical square of opposition together with the admission of empty terms suggests a certain interpretation of assertoric statements of syllogistic. Quite a few modern authors suggested this reading. However, even though Aristotle's syllogistic does not claim any form of reasoning valid which is not valid in this interpretation, some medieval formulations of syllogistic do violate some of its constrains.

On Computing Modality-Like Diagrams

PAULO A. S. VELOSO AND SHEILA R. M. VELOSO
COPPE-UFRJ and UERJ, Brazil
veloso@inf.puc-rio.br and sheila@cos.ufrj.br

Opposition and modality diagrams share some structural features in that each such diagram consists of two basic entities: the nodes are (representatives of) equivalence classes of formulas and the edges display logical connections (being contrary, contradictory, etc.). The formulas are generated by some formula-building operations, like negation and modalities (or quantifiers). Since the connections are logical, a first step in constructing such a diagram amounts to determining its nodes. In the case of few formula-building operations with simple behavior, the task is relatively simple, but not so otherwise. For instance, it may not be immediately obvious what will be the nodes of the intuitionistic analogue of the classical square of oppositions. We suggest a stepwise approach for the construction of modality-like diagrams. This incremental approach is modular: the basic idea is starting from diagrams with few operations and combining them or adding one operation at a time. The method joins diagrams for sublanguages and then adapts the result. The adaptations are of two kinds: coalescing existing nodes and adding new nodes. We explain the method and justify it. The justification rests on regarding a (perhaps partial) diagram as a kind of algebra describing some equations. We also comment on the application of these ideas and illustrate them with some examples.

Deictical Roots of the Square

KARIN VERELST
Vrije Universiteit Brussel, Belgium
kverelst@vub.ac.be

A tenacious common place wants that Aristotle's logic is a 'logic of terms', and that the terms used in it do have "existential import", leading to all kinds of inconsistencies. The ensuing confusion on the supposed existential import of certain types of propositions in Aristotle's 'logic of terms' as discussed in De Interpretatione 6-7 [7] can be made transparent by showing that what is deictical (as introduced by Benv́eniste [1, 2]) with Aristotle by necessity is existential, and nothing else. This becomes clear from his discussion of contingentia futura further on in de De Interpretatione [4]. A correct reading of the Stagirite's truth definition in [Met. Γ, vii, 1011b(26-28)] lends additional support to such a deictical reading of the Square [8]. This complies with the Medieval viewpoint that only affirmatives do have existential import, and negatives do not [3]. It has been shown by Terence Parsons [6] that on this traditional reading the inferential structure of the square is consistent and complete. This should not surprise us in view of the foregoing: deixis grants the truth and falsity of utterances in an absolute sense, without the need to invoke any additional logical principles [5].

[1] E. Benv́eniste, "Le langage et l'expérience humaine", in: Problèmes de linguistique générale II, Gallimard, Paris, 1966, p. 69.

[2] E. Benv́eniste, PLG I, "'Être' et 'avoir' dans leurs fonctions linguistiques", p. 188.
[3] J.M. Bochénski, Formale Logik, Karl Alber, Freiburg & München, 1978 [1956].
[4] D. Frede, "Aristoteles und die 'Seeschlacht'. Das Problem der Contingentia Futura in De Interpretatione 9", Hypomnemata, 27, 1970.
[5] W. Kneale & M. Kneale, *The Development of Logic*, Clarendon Press, Oxford, 1984 [1962], pp. 45-51.
[6] T. Parsons, "The Traditional Square of Opposition", The Stanford Encyclopedia of Philosophy (Winter 2006 Edition), E. N. Zalta (ed.)
<http://plato.stanford.edu/archives/win2006/entries/square/>
[7] Aristotle, Categories, On Interpretation, Prior Analytics, transl. H.P. Cooke, H. Tredennick, Loeb Classical Library, Harvard University Press, Harvard, 1933 [1996].
[8] Aristotle, Metaphysics, Books I-IX, transl. H. Tredennick, Harvard University Press, Harvard, 1933 [1996].

The Modal Square of Opposition Applied to the Ontological and Cosmological Arguments

PATRICK WALSH
University of Winnipeg, Canada
p.walsh@uwinnipeg.ca

It has often been my experience when teaching introductory philosophy classes that arguments for the existence of God receive a harsh reception. This, in turn, leads to an all-too-quick rejection. This reception, and arguably hasty rejection, rest on an oversimplified understanding of modal concepts like necessity and contingency. In order to develop positive accounts of these arguments and provide more insightful criticism, some important clarification and definition of modal concepts is required.

A Modal Square of Opposition is an invaluable tool in facilitating such clarification and definition. By Modal Square of Opposition, I mean taking the theme of the square of opposition inherited from Aristotelian logic and interpreting it with modal statements in place of the categorical propositions traditionally positioned at the four corners of the square.

The work in my paper will be to show the analysis provided by a Modal Square of Opposition in studying the following two arguments for the existence of God. The Ontological Argument, traditionally ascribed to St. Anselm of Cantebury (1033-1109), and the Cosmological Argument, traditionally ascribed to St. Thomas Aquinas (1255-1274) and with a important refinement by Samuel Clarke (1675-1729).

Anselm's argument posits God as a being of which none greater could exist. As such it was necessary that God exist. Clarke's version of the Cosmological Argument maintains that the existence of contingent beings rests on there being a being whose existence was not dependent on any other being. This is a necessary being, as it were. Clearly the idea of necessity, and how necessity relates to contingency, plays a central role in each of these arguments.

My paper will show how the Modal Square of Opposition provides a durable framework from which to assess these arguments in terms of the claims they make regarding necessity and contingency. In turn, after understanding the nature of such claims in the arguments an assessment of the arguments themselves can take place.

Counter-Examples in Theory-Driven Inquiry

MARK WEINSTEIN
Montclair State University, USA
weinsteinm@mail.montclair.edu

My concern is how counter-examples function within empirical inquiry. The Model of Emerging Truth (UNILOG '05 Proceedings) is applicable to any theory-driven process of inquiry sufficiently rigorous to permit definable model relations in its rational reconstruction, for example, physical chemistry (over time). The task is to define strength of counter-example in terms of the power of particular sentences to deform the information environment within which the correlative universal sentences sit. Deformation is a function of embeddeness (breadth and depth measures available within the model of truth) which supports the correlative notion of degree of entailment.

Basic Square Knowledge

DAG WESTERSTÅHL
Göteborg University, Sweden
dag.westerstahl@phil.gu.se

Things about the square that deserve to be more widely known among philosophers and linguists include:

- The differences between the classical and the modern square extend far beyond the issue of existential import. They concern (a) basic forms of negation; (b) logical relations; (c) whether the square is spanned by any of its members.
- Every (generalized) quantifier (of type $< 1, 1 >$) spans a square, also spanned by its other members but by no other quantifier. The linguistic manifestations of the squares of natural language quantifiers are often worth studying.
- An example: possessive quantifiers ("John's", "no doctors'", "all but five of Mary's", "each of most students'", etc.) have a rather interesting 'square behavior'.

The Application of Vector Theory to Syllogistic Logic

JONATHAN WESTPHAL
Idaho State University, USA
westjona@isu.edu

The logic of syllogistic argument can be represented with vectors. The subject term is represented as a point a unit distance along the horizontal axis from the origin O, the predicate term as a point a unit distance up the vertical axis, and the two term complements as points unit distances in the opposite directions. This gives us four quadrants, which are, traveling anticlockwise from S at 3 o'clock, the SP, -SP, -S-P and S-P quadrants. Propositions can now be represented as vectors to and from the points within these quadrants, including O. Using Leibniz's scheme

A: A non-B non-Ens

O: A non-B Ens

E: AB non-Ens

I: AB Ens

we can represent the four standard-form categorical propositions as vectors, with the vector from S to P representing the proposition that All S is P, and the vector from SP to O representing the proposition that No S is P. Valid syllogisms are then pairs of vectors in which the conclusion is the vector sum. Invalid syllogisms are pairs of vectors in which the conclusion is not the vector sum.

4 Artistic Program

4.1 Music: The Square of Jazz

♣ Phil Stockli, saxophones www.philstockli.com

♡ Michael Beck, piano www.michaelbeck.ch

♠ Dominique Girod, double bass

♢ Dominic Egli, drums www.dominicegli.ch

Opposition as Displayed in the Square as a Means of Composition

Music can function, be perceived and analyzed on a great number of levels, namely a) its basic musical elements like rhythm, harmony, dynamics, tempo, density; b) larger musical structures like motive, melody, harmonic progression, level of dissonance, form, instrumentation as well as c) more artistic (or subjective?) criteria like style, emotional expression, energy, narrative or metaphorical content. Consequently the search for contrasting or opposing musical elements, and their respective placement within the square of opposition, can take place on a great number of levels as well. Music in virtually all styles and periods relies strongly on such contrasting elements, and musical development can be seen as a continuous "play" between them.

For this project we have tried to find specific musical ideas and to examine them as to their behavior within the square of opposition, eventually constructing variations or additions to them which complete the square. This has proved to be quite an interesting source of compositional materials, leading to unexpected, yet musically meaningful results.

Of course, musical material found in this purely rational way has to pass the test of the more intuitive selection of the musician in order to qualify as actual music worthy of performance in front of an audience.

The program of the concert for Jazz quartet consists of a suite of original compositions and guided improvisations which are all based in certain of their parameters on the structure of the square of opposition. Some of them may serve as an acoustic illustration of the square where the structure is more transparent, while others may be heard as music "only", nonetheless owing part of their existence to the square.

4.2 Movie: The Square of Salomé

Jean-Yves Béziau, Catherine Duquaire, Joana Medeiros, Alessio Moretti

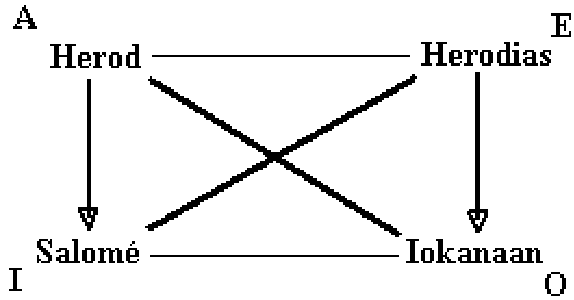
The idea of this project was to use the square as the basis for a movie. We decided to use the story of Salomé. In this famous story there are four main characters: Salomé, Herod, Herodias and Iokanaan. The square was used to display the strong and ambiguous relations between these four characters.

The story itself is from the Biblical period. Herod is Herod Antipas, tetrarch of Galilee and Peraea, and son of Herod the Great who is the King of Judea and author of the massacre of the innocents. Herod Antipas jailed Iokanaan, later on known as St John the Baptist, who was announcing the coming of Jesus Christ. Iokanaan was, also, slandering the wife of Herod: Herodias. Herodias was formerly married to Herod's brother with whom she had a daughter, Salomé, to whom Herod was attracted. According to the story, on one of his birthdays Herod promised to give Salomé whatever she wanted. Salomé, supposedly influenced by her mother who hated Iokanaan, asked for the head of Iokanaan.

The first writings about the story can be found in the Bible, but there Salomé is just named as "the daughter of Herodias". The name Salomé came from the Jewish tradition through which the story was transmitted; Salomé is a Hebraic name with the same origin as Shalom, meaning peace. This story became a legend, a myth, and has been transformed and adapted by many authors, in particular by Gustave Flaubert and Oscar Wilde. Oscar Wilde wrote a play where Salomé seduced Hérod by dancing and kissed the mouth of Iokaanan once his head had been severed.

In our creation we decided not to necessarily follow such and such version of the story - nobody knows exactly where the limit between reality and mythology lies - but rather to see how it was possible to describe the characters through their relations between each other using the square.

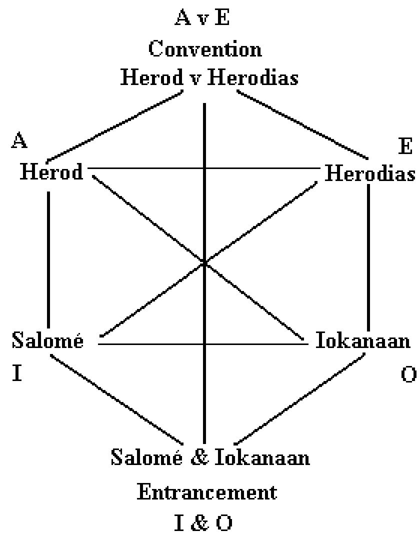
The square we chose is the following:



The relation between Herod and Herodias is an opposition of contrariety; there is no open conflict between the two. For Herod everything is possible; he is also the incarnation of obligation. On the other hand, Herodias is purely negative: she says no to everything and does what is forbidden.

Salomé is what is possible in contradiction with her mother, and Iokanaan corresponds to the unnamed O-corner in contradiction with what is obligatory and necessary.

Salomé and Iokanaan go together by a kind of entrancement expressing the opposition of subcontrariety. Their entrancement is, in contradiction with the union of Herod and Herodias, purely conventional. This can be represented by the following hexagon:



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Notes