编者按：我国学者刘奋荣最近访问了范·本特姆教授。她把访谈的结果整理后又译成中文。我们感到英文稿也非常重要。所以在此我们把中英文稿全部发表。

与约翰·范·本特姆教授面对面

——聆听逻辑、语言和信息领域的巨匠

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约翰·范·本特姆(Johan van Benthem)是荷兰阿姆斯特丹大学的逻辑学教授，美国斯坦福大学的人文科学的博撒 (Bonsall) 教授。在上世纪 90 年代，他创建了阿姆斯特丹大学的逻辑、语言与计算研究所（the Institute for Logic, Language & Computation，缩写为 ILLC）。该研究所横跨数学、计算机科学、哲学和语言学，旨在研究信息的结构和信息流。在此期间，他也是欧洲逻辑、语言和信息基金会（the European Foundation for Logic, Language and Information，缩写为 Folli）的第一任主席。迄今他已经出版了大约 10 本书，发表了大约 300 篇论文，指导了近 50 名硕士和 50 名博士。他也是多个杂志的编辑。他还是荷兰艺术与科学学院（the Dutch Academy of Arts and Sciences）、欧洲科学院（the Academia Europaea）和国际哲学院（the Institut International de Philosophie）的院士。由于他的卓越成就，1996 年荷兰政府授予他斯宾诺莎奖。有关他的更多信息可见他的个人主页：www.illc.uva.nl/~johan/。

我最近访问了范·本特姆教授，问到他如何进入逻辑学研究领域，他的学术历程以及他对逻辑的一般观点。下面是我与他交谈的摘录：

刘奋荣：由于您在逻辑学方面的工作，您在中国非常著名。但我们对您个人的情况知之甚少，您能否简要谈谈这方面的事情？据我所知，您在大学本科期间是学物理的，得到过物理学学士学位。您是何时开始对逻辑感兴趣的？

范·本特姆教授：我 1949 年出生于荷兰，激荡的 60－70 年代是我在荷兰的求学时代。我喜欢高中的每一门课程，但不偏爱其中的任何一门。当我考入阿姆斯特丹大学时，物理系和哲学系正好在一座楼里，所以我曾经不经意地选修过一门逻辑。对我来说，这门神奇的逻辑课让我大开眼界：正是逻辑揭示了我们所做的日常事情（例如，谈话，推理和

论辩）背后的精妙的数学结构。所以我爱上了逻辑学，为此转到了哲学系。我的一篇硕士论文研究的就是哲学中的时态逻辑，另一篇硕士论文是关于数学中的弱选择公理。毕业后，我很快成为阿姆斯特丹大学一名助教。那时正是颠倒旧大学体制的学生革命时期（the Student Revolution）。作为最年青的教师，我被直接选举为哲学系的主任，整天召开由学生、教授和秘书参加的无休止的大型集会，激烈讨论没有学术强权或学术权威的新生活，成为一代新人: 到那时学生给自己的学业打分，开设课程是为了工人阶级的需要而不是为了知识精英。那是一个奇妙的时代，因为我们都是年青人，渴望自由和新世界。当然现在看来，我们的理想带有强烈的政治色彩，因此造成了不少有问题的事件。不管怎么说，上世纪 70 年代对我们今天的学生来说已经很遥远了。荷兰的诸大学早已回到独裁、等级森严和弥漫商业气息的模式了。

那时，只有深夜在家，我才能找到一片私人时间的绿洲来研究逻辑，使得我能够在经历的所有革命事件中仍然保持心智健全。从 1973 年到 1977 年，我在 M. 劳波（Martin Löb）教授的指导下做了关于模态逻辑方面的博士论文。1977 年我成为格罗宁根大学（University of Groningen）的教授，任务是拓展哲学与数学之间逻辑学的研究空间。1986 年, 我又回到阿姆斯特丹大学，接替 M. 劳波教授的贝斯教位。从 1991 起，每年 4 月到 6 月我也在美国加利福尼亚的斯坦福大学任教。

刘奋荣：您能否谈谈您的博士论文《模态对应理论》（*Modal Correspondence Theory*）? 您在《哲学逻辑手册》（the *Handbook of Philosophical Logic*）也写了一章是关于对应理论的， 您为什么选择这个论题? 1985 年您出版了自己的专著《模态逻辑与经典逻辑》（*Modal Logic and Classical Logic*）。这些工作之间有什么联系?

范·本特姆教授：我的博士论文研究的是哲学逻辑的核心问题：模态，但采用的方法是数学的。我感到哲学逻辑不应该由于自己的“迅速发展”而孤立于主流逻辑之外成为另类，因为我们可以用经典的方法来理解它。我把模态语言翻译为经典语言，用一阶逻辑和二阶逻辑的模型论描述模态逻辑在各种框架类上的表达力。特别是，这种研究揭示了模态公式正好是具有双拟不变性（invariance for bisimulation）的一阶公式。就是从那时起，我的方法论开始形成，我常常从两个角度考察问题，一个是模态逻辑，另一个是一阶逻辑，像格式塔转换（Gestalt Switch）一样。

关于《哲学逻辑手册》，我说什么好呢？此手册的编者 D. 格柏（Dov Gabbay）要求我写对应理论一章，我也就这样做了！ 我的专著《模态逻辑与经典逻辑》到 1982 就写好了，但它的出版历程很复杂，从波兰转到意大利。此书是我的博士论文的一个扩充，也加

上我后来在以下方面做的一些工作：模态公理与框架性质之间的对应关系的全面描述，框架类的模态可定义性，以及其他许多有趣的结果。

刘奋荣：您的《时间逻辑》（*The Logic of Time*）发表于1983年。您在此书中想要提出的最重要思想是什么?

范·本特姆教授：此书继续我在硕士论文方面的研究工作，但其切入点与我的论文不同。《时间逻辑》主要关心的不是像模态对应理论那样的逻辑技术，而是对时间这个概念的理解。因此该书的主要工作是用逻辑工具分析我们常识范围内的时态表示和时态推理的哲学问题和语言学问题。我对这个问题感兴趣的原因是：当时对什么是时间存在着不同的本体论观点，有的认为时间由时点构成，有的则认为时间由时段构成。不同的观点也形成有关于时间推理的不同的方法。我力图用逻辑来构造不同的时间观，不仅仅是物理学中经典的时间观。顺便提一下，对时间的研究现在已经成为许多学科共同关心的课题。通过本书的写作，我接触了许多来自人工智能甚至认知心理学的成果。我想，正是因为这种跨学科的视角使得此书得以不断重印。

刘奋荣：那么时间是时点构成的，抑或是事件构成的，还是时段构成的，您个人认为那个更合理?

范·本特姆教授：从哲学上说，我倾向时间由事件构成，但从数学上说，不管我书中那些极端热忱的言论，我还是喜欢时点！

刘奋荣：在1986年，您出版了新书《逻辑语义学论文集》（*Essays in Logical Semantics*），其中的论文主要研究广义量词（generalized quantifiers）。这些工作与您以前做的工作相差甚远。为什么您会做这样的转变?

范·本特姆教授：这种转变大约发生在1980前后，我开始对自然语言感兴趣。为什么做这样的转变?生活中经常如此，这次我也是率性而为。在生活中，你会因为遇到他人而改变自己的研究方向。在阿姆斯特丹大学，我曾有几个对语义学感兴趣的优秀学生，例如，J.胡能迪克（Jeroen Groenendijk），M.斯托克霍夫（Martin Stokhof）和A.德·穆伦（Alice ter Meulen）。他们现在已经很出名了。人们经常说老师影响学生，但也有相反的情况：学生造就了老师！通过他们，我对蒙塔古语法（Montague Grammar）产生了兴趣。我受到的另一方面影响来自我高中时的校友F.日瓦兹（Frans Zwarts）。他现在是一位很有影响的荷兰语言学家，也是格罗宁根大学的校长。他从事广义量词方面的研究，所以在J.巴瓦斯（Jon Barwise），R.库普（Robin Cooper），E.基南（Ed Keenan）和其他专家的著作中不断被提到。

刘奋荣：什么使得广义量词的研究如此重要?

范·本特姆教授：一直以来，我所接受的形式语言哲学的观点说的是，自然语言不清晰，应该由逻辑来“治疗”。但通过对形式语义学的研究，我认识到，自然语言中存在多种形式结构。自然语言当然是一种相当成功的人际交流媒介，没有迹象表明我们应该放弃它而采用形式逻辑语言。我对用量词如何描述情境（situations）的语言的表达力尤其着迷。我们能言说什么，为什么正是这个量词的指令系统（repertoire）超越了世界上的所有语言显得既自然又稳定? 我在《逻辑语义学论文集》中试图对此做出数学解释。这本书说明人们关于量词的指令系统如何与表达完备性的系统要求相结合，这里的表达完备性指的是诸如单调推理和其他语义规定。它也说明量词如何追求算法的简单性，即我用“语义自动机”（semantic automata）来建模的东西。最后一个论题，也是我还在继续研究的论题，是“自然逻辑”（natural logic）：有多少逻辑推理不用更深的逻辑构造就可以在自然语言的表层上直接做到?

刘奋荣：在您1991年出版的书《行动中的语言》（*Language in Action*）中，研究的焦点是范畴语法（Categorical Grammar）的逻辑基础和类型论基础。在此项工作中，读者主要看到的是λ-演算和逻辑推演，此时您似乎又成为证明论专家了，这是为什么？

范·本特姆教授：在我出版了《逻辑语义学论文集》之后，我想要理解自然语言更一般的机制或者称之为“操作系统”（operating system），更想要理解其中的量化和推理如何进行。这里的核心思想是：思维的对象构成一个范畴的谱系（a hierarchy of categories）。当然，我们知道这在哲学和数学中是一个老观点，B.罗素的类型论（Theory of Types）以及莱斯尼斯基（Lesniewski）和埃杜凯威兹（Ajdukiewicz）的范畴语法（Categorial Grammar）就是基于这个思想的。这两种传统直到上世纪50年代才由于J.兰贝克（Joachim Lambek）的工作结合在一起，我的书把这项工作推向深入。自然语言可以看作是一种类型论或λ-演算，但重要的是，它只用到非常有限的资源，不像数学基础研究那样需要极丰富的结构。我在书中提出如下思想：λ-演算的一个小片段就能为自然语言中意义的结合提供一种“粘合剂”（glue），同时我也说明了依赖资源的λ-演算和子结构证明系统（substructural proof systems）是如何形成这种思想的。尤其，我对拉姆贝克型语法推演给出一种柯里－霍华德语义（Curry-Howard semantics），以此说明形式证明和语义如何是一个硬币的两面。在这种联系中，我也更一般地证明像切割－消去法（Cut Elimination）那样的证明论方法如何能用于数学语言学和语义学。所以这已经超出了“形式语言”（formal language）和“自然语言”（natural language）的问题。更精微的问题应当是：添

加多少逻辑的粘合剂才能解释自然语言是如何起作用的。这似乎也是逻辑与语言学之间结合的关键。

刘奋荣：这样看来， 1997年出版的《逻辑与语言手册》（*Handbook of Logic and Language*）还属于语言逻辑研究的领域。此书在国际逻辑界取得巨大的成功，对中国的逻辑学家影响也很大，并且不断被引用。作为此书编者之一，您认为它的主要特点是什么?

范·本特姆教授：逻辑与语言之间的共同之处可以追溯到中世纪以前，但直到有了R. 蒙塔古的工作才变得系统起来。《逻辑与语言手册》包括现代主要的研究成果以及它们与计算机科学和认知科学的联系。我们的作者们囊括了当今主要的逻辑－语言学派，例如，支配－粘合理论（government-binding theory），情境理论（situation theory），或博弈论语义学（game-theoretic semantics）。我们希望本手册以一种客观公正的方式来表述这些理论。而且，本书包括了该领域中的主要论题和技术成果。例如，广义量词、范畴与类型、时态表达式、情境与部分逻辑、动态解释与推理，特性结构与统一化逻辑。同时，做这件事情的另一个目的是：通过提供一个有利于逻辑学和语言学之间思想交流的平台，协助创建一个学术研究的共同体。

刘奋荣：您个人对逻辑与语言之间的关系有何看法?

范·本特姆教授：我在此方面的看法随着时间的推移变化很大。一般来说，有两种观点，较强的观点认为：语言自身有数学结构；较弱的观点认为：逻辑只是为自然语言中的现象建模提供方便的工具使之清晰化。这两种观点都可见于《逻辑与语言手册》。我个人认为，自然语言比逻辑形式理论更丰富。例如，自然语言是一种包含生物进化的过程。无论我的逻辑分析如何接近我的想法，它只给出一种片面的观点，即把语言看作是承载信息的工具，它没有涉及语言的其他功能。

实际上，对我而言，关于逻辑与语言的关系更有趣的是下面的问题。我们知道，逻辑从根本上说是研究人造物的，逻辑的语言是人们出于某种目的设计出来的。但自然语言不是设计出来的，它们是进行中的认知现象。现在我不再对比较逻辑与语言那样的大问题感兴趣，而是对它们的结合感兴趣。现在我们有许多中介语言，它们都是设计出来的，但同时又在实际中使用。例如，为人机交流设计的编程语言，或在法庭上使用的专用语言。我想理解的问题是：我们如何能促成自然语言和形式语言的融合。某些特设的行为(譬如某些博弈)似乎“符合”我们的认知功能，从而能被整合，而其他的则不能。例如，成功的博弈已经成为我们生活的一部分。对我来说，理解这样的融合在认知科学中是一件比研究像“机器是否像人？”那样的大问题更富有成果的事情。顺便提一下，我的一位姑妈常

说“男人（men）当然是机器，真正未解决的问题是妇女是否也是机器……”。

刘奋荣：这样看来，您花了 10 年时间研究时态逻辑和模态逻辑，又花了 10 年时间研究自然语言。到了上世纪 90 年代，您的兴趣似乎又转移了。1996 年您的专著《探究逻辑动态学》出版了，您能否谈谈此书的研究成果?

范·本特姆教授：首先，我应该说，90 年代我又回到模态逻辑，部分是因为我有像 M. 德·莱克（Maarten de Rijke），Y.维尼玛（Yde Venema）和其他非常优秀学生的压力。他们期望我指导他们研究模态逻辑，我能拒绝谁呢?但是，我的新兴趣导致了一个新的转向。模态逻辑，特别是以动态逻辑形式出现的模态逻辑，越来越多地用于研究计算和程序结构。所以我做了此方面的研究。何况模态逻辑的转向也非常符合在哲学和语言学范围内更广泛的“动态转向”（Dynamic Turn），因为模态逻辑的转向使得认知行为、解释过程、推理成为逻辑理论研究的主要对象。例如，由此产生了信念修正理论（belief revision theory）、论说表示理论（discourse representation theory）或阿姆斯特丹大学风格的动态语义学。这让我非常激动，因为它使我看清过去总隐藏在我思维深处的多种逻辑层面。这些层面从来没有在任何一个逻辑演算中显现出来。所以这本书试图传达这种新视野的魅力，构建它的逻辑结构，并且揭示一些惊人的结果，即使对逻辑的经典部分也不例外。

刘奋荣：您在这本书中取得什么样的技术成果?

范·本特姆教授：我以双拟关系为核心来处理模态语言，也用对双拟关系成立的逻辑术语来刻画动态逻辑的表达力。不同的表达力形成一个谱系，最上层是完全的一阶逻辑。尤其，这种模态精致结构的观点使我和H.安德烈卡（Hajnal Andréka）和I.内梅蒂（Istvan Németi）一起发现了一阶逻辑的安保片段（the Guarded Fragment），即一阶逻辑的可判定部分，这在当时无人知晓。从那时起人们对此做了很多研究。这种宽泛的技术架构现在用于研究程序模型、动态推理的多样性，也用于研究具有静态成分和动态成分的逻辑的建构。此书的另一个主要兴趣是寻求低复杂性因而更适宜判定的系统。此书中一个令人惊奇的结果是我从动态的视角把一阶逻辑作为模态逻辑来分析，只要你接受塔斯基语义学（Tarski semantics）的扩展。这个结果揭示了标准逻辑的一个可判定的内核，而通常的不可判定性变成了标准模型的数学特性的一种边际效应，一种副作用。

刘奋荣：1996**年**10**月，您是荷兰国家研究组织（**the Dutch National Research Organization**，缩写为**NWO**）颁发的首届斯宾诺莎奖（**Spinoza grants**）的获奖人之一。此奖的奖金高达**2**百万荷兰盾。据我所知，此奖是颁发给荷兰科学界最有声望的科学家的，而且获奖的科学家数目非常有限，奖金金额巨大并且不带任何附加条件。您却用此奖金建立

了科研项目：“行为中的逻辑”（*Logic in Action*）。这是怎么一回事?

范·本特姆教授：实际上，因为此奖没有任何附加条件，所以我原来想用它来做一些真正令人吃惊的事。我想在美国佛罗里达珊瑚礁区买下一个热带小岛作为给同行的礼物。那时的想法是这个小岛可以为同行服务几百年。但是，唉，还是常识获胜。结果我用此奖金做了我总想在阿姆斯特丹大学逻辑、语言与计算研究所希望看到但从未发生过的三件事，即建立三个新型科研项目。第一个研究项目是“逻辑与博弈”，由P.德克尔（Paul Dekker）和Y.维尼玛牵头，把模态逻辑学家和语义学家集中在一起研究信息交流和互动作用。除了其他的方面的贡献，这个项目已经成为逻辑学和博弈论之间的一座桥梁。第二个研究项目是“计算逻辑”（Computational Logic），由德·瑞杰克牵头，其目的是给我们在模态逻辑和其他逻辑方面的理论研究一个“强有力的臂膀”，即一个计算实验的实验室。现在这个实验室成为我们的“语言与推理技术实验室”（Lab for Language and Inference Technology）。在斯宾诺莎项目完成后，这些项目带头人都在我们的大学里得到永久的职位，所以这个故事还在继续下去。第三个也是最后一个项目是“教学与传播”（Didactics and Dissemination），由范·艾克（Jan van Eijck）牵头。范·艾克现在也成为阿姆斯特丹大学CWI中心和乌得勒支（Utrecht）大学的一名教授。这个项目编制了具有创新精神的逻辑教学软件，也出版了一本书来主动适应高中关于逻辑的教材。此书开始的一卷的标题为“思想机器”。利用这个项目我们在那几年邀请了许多国外的访问学者，颁发论文奖金等等。成为富人真好，哪怕就5年！

刘奋荣：在1999年，您开设关于“博弈中的逻辑”（*Logic in Games*）的电子讲座。您能解释一下博弈为什么对逻辑学家有如此重要的意义?

范·本特姆教授：你可以从我早期的著作中预见我下一步的工作。你知道，《探究逻辑动态学》只描述了过程的概念，但它没有探究社会中多主体的交互作用，像交流。所以交流自然成为下一步要研究的对象。譬如，我发现提问和给出答案就是一种相当基本的交流过程，正如孤独的思想者在逻辑中推导一个有效的结论那样普遍。这是一种自然的动态转向（the Dynamic Turn），对我来说现在似乎也如此。描述这种过程最好的模型就是博弈。博弈在许多学科中都运用广泛，而且有人认为，博弈的全部数学都已知了，颁发诺贝尔奖给约翰.纳什（John Nash）就是最好的说明。

但我认为研究博弈才刚刚开始。博弈作为一种自然活动到处存在，而且它们似乎是稳定的，超越一切文化。我在每一个大洲都教授过逻辑博弈（包括亚洲）而没有遇到任何障碍。对这一现象必定存在一般的认知理由。而且，博弈对交互作用的认知过程是一种丰富

的模型，关于这种认知过程我们有生动的直觉。这些直觉吸引了对通常计算模型背后的信息流感兴趣的逻辑学家。博弈也提供了一种实验的可能性，它们是一种免费的认知实验室。我们也可以为逻辑的目的设计博弈，考察人们对此如何反应。当然，论辩和其他许多逻辑活动也有博弈论意味。我们许多人都有过在一群人中“输掉”一场论辩的痛苦经历，这几乎和输掉一场足球比赛一样糟糕。

刘奋荣：您的专著《博弈中的逻辑》（*Logic in Games*）已经被多次提到，但应该到2004年才出版。我们应该如何理解此书名?

范·本特姆教授：首先，注意这个“应该”。在这个新的领域我一直在发表新的文章，有时甚至在经济学的期刊上——此类具有实用倾向的学术刊物似乎或多或少提高了我的声望。但这本书还在制作中。无论如何，它的目的是证明和构建逻辑与博弈在两个方向上的结合。首先，“博弈中的逻辑”指的是下列事实：许多逻辑活动可以看成是一种博弈，已经存在许多“逻辑游戏”，例如，语义赋值、一致性保持、证明、或模型比较。一般而言，我们总可以建立基本的逻辑概念与博弈选手的获胜策略之间的联系。我的书名的第二层意思指的是一般博弈中的逻辑结构，这里的一般博弈指经济竞争、社会合作、下棋、英式足球、战争和对话。所有这些活动都涉及由智能推理选手的准则支配的行为。在这个更广泛的领域中，逻辑可以帮助澄清可能的博弈结构和选手在博弈进程中的思考机制。这本书有许多关于逻辑系统的成果可以服务上述目的。此书的总方案是建立一个整合框架使逻辑提供精致结构来描述博弈论中策略均衡（strategic equilibrium）的更全面的理论。

刘奋荣：到此为止，我们似乎已经谈到您的大部分著作。回顾我们所谈的话题，我看到的是一位逻辑学家、一位语言学家、一位计算机科学家，甚至一位博弈论学家。但是这些与哲学有什么关系？

范·本特姆教授：我很高兴你能提到这一点，这个问题十分关键。对我而言，在所谓的“哲学逻辑”和其它邻近学科的问题之间已经没有清楚的界限了。如果回顾20世纪有关意义、知识和行为等哲学问题的历史， 你会发现关于这些问题的思想总穿梭于各个学术领域。在斯坦福大学2003年春季课程“哲学中的逻辑”(参见http://staff.science.uva.nl/~johan/298-2003.html)中，我以一些基本的论题为例已经说明这一点。譬如，组合原则（compositionality）、有效后承关系（valid consequence）、条件句(conditional)、知识(knowledge)和相信(belief)等等。可以说，我把哲学看成是一种“催化剂”或“调味品”，它使得跨学科之间的研究成为可能。相反，我现在开始怀疑哲学逻辑

中所谓更“哲学内在”（philosophy-internal）的问题，这些问题就像是智力的黑洞：它们吸取大量的精力，却似乎任何结果也不会得出。

刘奋荣：在上世纪90年代，您是阿姆斯特丹大学逻辑、语言与计算学院的创始人和欧洲逻辑、语言和信息基金会的第一任主席。1998年您在耶亨(Liège)被授予荣誉博士，2001年你被选为国际哲学院的院士。您还是荷兰国家认知科学委员会（National Cognitive Science Committee）的主席。您的简历甚至长得多。2003年，阿姆斯特丹大学推举您为大学资深教授(University Professor)，这是一个声望极高的职位。您如何看待这些奖励和声望？您在从事创造性地研究工作时如何处理方方面面的利益和繁忙的工作？

范·本特姆教授：对于这个问题，我没有考虑太多。如果我这样做，我可能真的要被吓坏的。我总是被像这样传记性的描述搞得目瞪口呆。有时我认为存在两个我。一个我就是一个个体，他从学生时代以来没有取得多大进展，他喜欢偏安一角读书，偶尔与学生和同事谈谈天，谈天的内容有时有意义有时无意义，他今天对这个感兴趣明天对那个感兴趣，他喜欢环球旅游，对人们解释他已经理解的东西。但还有另一个我，一个公众的我。他想影响学术界，他想创建公共机构，他试图影响他人的生活，让他的学生做这个，让他的同事做那个。有时我问自己，这非常不同的两个我是如何捏到一块的。

确实，繁忙的公众生活总会耗费科研时间，但另一方面，它也有助于科学研究，因为你能得到更多的机会获得新思想，特别是与学生工作，他们可能是你最预想不到的思想的源泉。公众的我给了我许多机会与人交往，从而丰富了私人的我，促进了我的科研工作。

刘奋荣：总之，您先开始研究逻辑，然后研究语言，然后研究信息。看起来您好像通常是花5年的时间写一本书，然后用它结束你生活的一章。您生活的下一章是什么，您下一个五年计划是什么？

范·本特姆教授：你必须认识到五年计划只是一种假象。我回顾自己的过去，然后写下过去5年工作的成果。但我从未坐下来用计划经济的风格计划我的下一个五年计划，如果有这样一个五年计划的话，因为我并不擅长预测我自己的未来。但如果你坚持要我这样做，那么我会说我想更深入地了解逻辑与认知科学之间的联系，即当人们使用语言或推理时他们究竟做了什么，他们的大脑里一直在做什么。我是荷兰国家认知科学委员会的主席这个事实就反映我对此真有兴趣。即使如此，不像我那更富有创造性的同事M. 范·兰巴哈（Michiel van Lambalgen）那样，我在这个方向上还没有发表任何东西。一个很好例子是上面我谈到博弈时说的，现在我们正在设计新的博弈使得它们可以顺利地融入到人类的行为当中。我喜欢与经验科学家联合搞科研，设计新的博弈做实验，然后看看哪些起作用哪些

不起作用，为什么如此。事实上，我们正在与人工智能和实验博弈论界的科学家团体进行这样的合作。

更一般地说，我现在感兴趣的是用真正改变人们生活的逻辑做事。所以你可以说我在变老，又回到我们早先谈到过的革命学生时代。那时知识精英好像真的有助于这个世界变得更美好。

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Interview with Johan van Benthem

"A Life of Logic, Language, and Information"

Johan van Benthem is University Professor of logic at the University of Amsterdam, and Bonsall Professor of humanities at Stanford University. In the 1990s, he was the founding director of the Institute for Logic, Language & Computation (ILLC), a joint venture of mathematics, computer science, philosophy, and linguistics, for studying the structure and flow of information. Also in that period, he was the first president of the European Foundation for Logic, Language and Information (Folli). He published some 10 books and 300 articles, is an editor of many journals, and supervised some 50 master's theses, and 50 Ph.D. dissertations. He is a member of the Dutch Academy of Arts and Sciences, the Academia Europaea, and the Institut

International de Philosophie. In 1996, he received the prestigious Spinoza Award for his total research from the Dutch Government. Homepage: www.illc.uva.nl/~johan/.

In a recent interview, Johan van Benthem spoke about his entry into the field of logic, the course of his career, and his general views on logic. Excerpts follow here.

Fenrong: You are very famous in China because of your logic, but we know little about you personally. Could you tell us something about yourself? As far as I know, you got a bachelor in physics. When did you begin to think about logic?

Prof. van Benthem: I was born in 1949, and became a student in the exciting 1960s and 1970s in The Netherlands. I liked every subject in high school, but had not fallen in love with any one of them in particular. When I entered the university, the Department of Physics shared a building with the Department of Philosophy, and I once accidentally walked into a logic course. For me, this was an amazing eye-opener: the fact that logic reveals an elegant mathematical structure behind the ordinary things that we do, like talking, reasoning, and argumentation. So I fell in love with the subject, switched departments, and did a Master's Thesis on temporal logic in Philosophy, and another on weak axioms of choice in Mathematics. Upon graduation, I quickly became an assistant professor in Amsterdam. These were the days of the Student Revolution which turned the old university system upside down. Being the youngest faculty member, I was immediately elected head of the Philosophy Department, and found myself chairing endless general assemblies of students, professors and secretaries, full of radical talk about a new life without power or authority, and a new type of human being, where students would grade themselves, and courses would serve the needs of the working class rather than an intellectual elite. Wonderful times, because we were all young, with a strong sense of liberation and a new world – but also heavily politicized, with many problematic events on the darker side. Anyway, those 1970s are already archeological prehistory to our students today, as Dutch universities have long since returned to autocracy, hierarchy, and business models.

In late evenings, at home, I found an oasis of private time for doing logic research, as a counterbalance to preserve my sanity amidst all the revolutionary events. I did my Ph.D. on modal logic from 1973 to 1977 with Professor Martin Löb. In 1977, I became a professor at University of Groningen, with the task of setting up a logic environment between philosophy and mathematics. In 1986, I returned to the University of Amsterdam as Löb's successor on the Beth Chair. Since 1991, I also teach at Stanford University in California, from April to June every year.

Fenrong: Can you say something about your dissertation, *Modal Correspondence Theory*? You also wrote a chapter on correspondence theory in the *Handbook of Philosophical Logic*, why did you choose this topic? Your book *Modal Logic and Classical Logic* was published in 1985. How is that connected?

Prof. van Benthem: The dissertation is about the core subject of philosophical logic: modality, but the methods are mathematical. My feeling was that philosophical logic should not be an isolated alternative to mainstream logic with its own 'industry', because one can understand it by classical methods. Based on translations of modal languages into classical ones, I used model theory of first-order and second-order logic to describe the expressive power of modal logics over all sorts of frame classes. In particular, this research led to the discovery that the modal formulas are precisely the first-order formulas that have the special property of invariance for bisimulation. Ever since that time, my methodology is to work 'in tandem'. I look at many things from two perspectives, modal and first-order, as a sort of Gestalt Switch.

About the *Handbook*, what can I say? The editor Dov Gabbay told me to write on this topic, and so I did! The monograph *Modal Logic and Classical Logic* was ready by 1982, though its publication history is complicated, running from Poland to Italy. It is the extensive version of my dissertation plus later work on a comprehensive account of correspondence between modal axioms and frame properties, modal definability of frame classes, and many other pleasant things besides.

Fenrong: *The Logic of Time* was published in 1983. What were the most important ideas that you wanted to present in this book?

Prof. van Benthem: This book continues an interest from my Master's thesis. But it is different in spirit from my dissertation. *The Logic of Time* is not primarily about logic techniques like modal correspondence, but its central interest is understanding *Time*, analyzing philosophical and linguistical issues about our common sense temporal representation and temporal reasoning with logical tools. What interested me was the fact that there are different ontological views of what time is, points or intervals, and different ways of reasoning about it. I tried to use logic to create different views of time, not just the canonical view from physics. By the way, the study of time has always been a common concern of many disciplines, and through the book I also acquired many contacts in artificial intelligence and even cognitive psychology. Because of this interdisciplinary audience, I guess, the book keeps being reprinted.

Fenrong: Which view do you prefer, points, events or intervals?

Prof. van Benthem: Philosophically, I prefer events – but mathematically, despite all my radical enthusiasm of that book: still points!

Fenrong: In 1986, you published a new book, *Essays in Logical Semantics*, which is mainly about generalized quantifiers. It is very different from what you did before. Why this change?

Prof. van Benthem: What happened was that around 1980, I became interested in natural language. Why this shift? As more often in life, it is not a matter of planning: you are steered by encounters with other people. In Amsterdam, I had some excellent students with an interest in semantics, such as Jeroen Groenendijk, Martin Stokhof, and Alice ter Meulen, well-known names today. People often say that a teacher influences the students, but it also works the other way round: students form their teachers! Through them, I became interested in Montague Grammar. The other

influence was an old high-school friend, Frans Zwarts, now an influential Dutch linguist and the Rector Magnificus of Groningen University, who took up the study of generalized quantifiers, as then emerging in the work of Jon Barwise, Robin Cooper, Ed Keenan and others.

Fenrong: But what is so important about generalized quantifiers?

Prof. van Benthem: I had been raised in the paradigms of formal language philosophy, which says that natural language is not clear, but should be 'cured' by logic. But then through formal semantics, I realized that there is a lot of structure to natural language, which is a remarkably successful medium for human communication that shows no signs of abdicating in favour of logical formalisms. In particular, I became fascinated by the expressive power of language for describing situations by means of quantifiers. What can we say, and why is this repertoire natural and stable across the languages of the world? I tried to give mathematical sense to this in *Essays in Logical Semantics*. The book shows how our human quantifier repertoire meets systematic requirements of expressive completeness in terms of properties like monotonic inference and other semantic constraints. It also shows how quantifiers strive for algorithmic simplicity, something which I modeled in terms of 'semantic automata'. A final theme, and still a continuing interest of mine, is 'natural logic': how much logical inference can be done directly on natural language surface forms, without deeper logical constructions?

Fenrong: In your 1991 book *Language in Action*, the focus is on logical and type-theoretic foundations of Categorical Grammar. In that work, the reader sees mainly lambda symbols and derivations, and you seem to have become a proof theorist.

Prof. van Benthem: After *Essays in Logical Semantics*, I wanted to understand the more general mechanisms of natural language, the 'operating system', so to speak, in which quantification and inference function. The key idea here, that objects of thought form a hierarchy of categories, is an old one in philosophy and mathematics, which underlies both Bertrand Russell's Theory of Types and Lesniewski and Ajdukiewicz'

Categorial Grammar. The two traditions came together in the 1950s in the work of Joachim Lambek, and my book takes this much further. Natural language may be viewed as a sort of type theory or lambda calculus – but importantly, it is one with only very limited resources, not the mega-rich structure needed for the foundations of mathematics. In my book I develop the idea that a small fragment of lambda calculus provides the 'glue' for composing meanings in natural language, and I show how this can be developed by using resource-sensitive versions of lambda calculus and substructural proof systems. In particular, I give a Curry-Howard semantics for Lambek-style grammatical derivations, which shows how proof and semantic meaning are really two sides of the same coin. In this connection, I also showed more generally how proof theoretic-methods like Cut Elimination can be used in mathematical linguistics and semantics. So it is no longer a matter of 'formal language' versus 'natural language'. The more sophisticated question is rather how much logical glue must be mixed with natural language to explain how it works. This still seems crucial in the contact between logic and linguistics.

Fenrong: Well, the 1997 *Handbook of Logic and Language* is still in this general line that you mention. It has had great success in logical circles worldwide, and it has been very influential and widely referred to by Chinese logicians. As one of the editors, what do you think were its main features?

Prof. van Benthem: Interfaces between logic and linguistics go back to Antiquity, but they were never very systematic until the work of Richard Montague. The *Handbook* documents the main modern research lines, with their links to computer science and cognitive science. Our authors covered the main logico-linguistic paradigms, such as government-binding theory, situation theory, or game-theoretic semantics, in what we hope is a non-partisan manner. Moreover, the book contains the major descriptive topics and techniques in the field, such as generalized quantifiers, categories and types, temporal expressions, situations and partial logic, dynamic interpretation and inference, feature structures and unification logics. Our purpose with this big

enterprise was also to help create a community, by offering a standard reference facilitating back-and-forth flow of ideas between logic and linguistics.

Fenrong: What is your opinion about the relation between logic and language?

Prof. van Benthem: My views on this have fluctuated a lot over time. The stronger thesis would be that language really has mathematical structure; the weaker claim is just that logic is convenient tool to model phenomena in natural language, and make them visible. In the *Handbook*, you will find both views represented. As for myself, I see natural language as much more than a logical formalism, for instance, because it also represents a process of biological evolution. Logical analysis in my style, no matter how close to my heart, only gives a partial view, of language as an information device, it does not say much about the other functions.

Actually, for me the more interesting contrast nowadays would be different. Logic is primarily about artifacts: languages that are designed by people for some purpose. But natural languages are not designed; they are an ongoing cognitive phenomenon. Now, instead of grand questions about contrasts between the two, I am interested in their contacts. Nowadays, you have all these intermediate languages, designed but nevertheless, actually used. Examples are programming languages for communication between humans and computers, or the professional language used in a law court. I would like to understand how we manage to thrive in this mixture of natural and formal language. Some designed behaviors seem to 'fit' into our cognitive functioning, and are incorporated, others do not. Think of successful games that become part of our lives. To me, understanding such mixtures is a much more fruitful perspective on cognitive science than grand issues like 'Are Machines like Men'? By the way, an aunt of mine used to say that men are certainly machines; the only real open question is if women are...

Fenrong: So you spent 10 years of your life on temporal and modal logic, and then 10 years on natural language. In the 1990s, it seems that your interests were shifting again. Let me turn to your book, *Exploring Logical Dynamics* which was published in

1996. What was going on there?

Prof. van Benthem: First, I should say that the 1990s saw my return to modal logic, partly because of the pressure of having very good students, like Maarten de Rijke, Yde Venema, and others. They expected activities in modal logic from me, and who was I to refuse? Nevertheless, my new interest came with a new twist. Modal logics were increasingly used for studying computation and process structure, especially, in the guise of dynamic logic. So I did work on that. Moreover, this went very well with a broader 'Dynamic Turn' in philosophy and linguistics, making cognitive actions and procedures of interpretation, or reasoning, into primary objects of logical theory. Examples of that trend are belief revision theory, discourse representation theory, or dynamic semantics in the Amsterdam style. I found this very exciting, because it made me aware of aspects of logic that had always hidden in the background of my mind, but never visible in a logical calculus. The book tries to convey the attractions of this new perspective, develops its logical structure, and demonstrates some surprising repercussions –even for apparently standard parts of logic.

Fenrong: What kind of technical results did you get in this book?

Prof. van Benthem: I give a treatment of modal languages which totally centers around bisimulation, and also characterize the expressive power of dynamic logic in terms of safety for bisimulation. Moreover, these languages come in hierarchies of expressive strength, all the way up to full first-order logic. In particular, this modal fine-structure view led to the discovery, together with Hajnal Andréka and Istvan Németi, of the Guarded Fragment, a large and hitherto unknown decidable part of first-order logic, which has been much studied since. This broad technical framework is used to study different process models, varieties of dynamic inference, as well as architectures for logics with both static and dynamic components. Another major interest in the book is the search for low-complexity systems, preferably decidable. One of the surprising repercussions of the dynamic perspective in the book is my analysis of first-order logic as a modal logic, provided you accept a generalization of

Tarski semantics. This reveals a decidable core to standard logic, while the usual undecidability turns out a side-effect of mathematical features of standard models.

Fenrong: In October 1996, the Dutch National Research Organization (NWO) awarded you one of its first annual Spinoza grants, to an amount of 2 million guilders. As far as I know, this award is the most prestigious in Dutch science. Its rewards a very limited number of scientists with a large grant without any conditions attached. You used this grant to set up the project *Logic in Action*. What was that all about?

Prof. van Benthem: Actually, since there were no conditions, I had wanted to do something really spectacular, and buy a tropical island in the Florida keys as my gift to the profession. My idea was that this would serve logic for centuries to come. But alas, common sense prevailed. I then used the money to do three things which I has always liked to see happen at ILLC, but which had not. One was a research project on 'Logic and Games', headed by Paul Dekker and Yde Venema, bringing together modal logicians and semanticists in the study of communication and interaction. Amongst other things, this project has become a bridge between logic and game theory. The second project on 'Computational Logic', headed by Maarten de Rijke, was meant to give our theoretical research in modal and other logics a 'strong arm', i.e., a laboratory for computational experimentation. This has developed into our current Lab for Language and Inference Technology. After the Spinoza project ended, these project leaders all got permanent jobs at our university, so the story goes on. The third and final project was about 'Didactics and Dissemination', headed by Jan van Eijck, already a professor at CWI Amsterdam and Utrecht. It has produced innovative educational software for logic teaching, as well as a book initiative for high school texts on logic, starting with a volume called "Thinking Machines". Moreover, the project allowed us to have many foreign visitors over the years, subsidize dissertation prizes, and so on. It is really nice to be rich, if only for five years!

Fenrong: In 1999, you started the electronic lecture notes *Logic in Games*. Can you explain why games make sense to logicians?

Prof. van Benthem: Well, you can always predict my next step from an earlier book. *Exploring Logical Dynamics* just described processes, but it did not explore social multi-agent interaction, like communication, which is really the natural next step. Nowadays I see a social mini-process like asking a question and getting an answer as just as basic in logic as drawing a valid conclusion by a lonely thinker. This is the natural version of the Dynamic Turn, it seems to me now. And the best model for that are games. Games have been popular in lots of disciplines, and some people think all their mathematics is known, with the Nobel Prize for John Nash as a crowning event.

But I think that the story is only beginning. Games are ubiquitous as natural activities. Moreover, they seem cross-culturally stable. I have taught logic games in every continent (including Asia) without ever encountering any barrier. There must be general cognitive reasons for this appeal. Moreover, games are a rich model for interactive cognitive processes about which we have vivid intuitions. Thus, they are attractive to logicians interested in information flow beyond the usual computational models. Games also offer a possibility of experimentation; they are a free cognitive laboratory. We can design games for logical purposes, and see how humans respond. In fact, of course, argumentation and many other logical activities have a game-theoretic flavour. Many of us have had the bitter experience of 'losing' an argument in a group, which is almost as bad as losing a football match.

Fenrong: A monograph *Logic in Games* has been announced many times, but should now be published in 2004. How should we understand this title?

Prof. van Benthem: First, notice the 'should'. I keep publishing new papers in this new area, sometimes even in economics journals – which seems to have raised my prestige somewhat with my more practically oriented sons. But the book is still in flux. Anyway, its purpose is to demonstrate and develop two directions of contact. First, 'Logic in Games' refers to the fact that many logical activities can be cast as games, witness the many existing 'logic games' for semantic evaluation, consistency maintenance, proof, or model comparison. Often, basic logical notions then have to do

with winning strategies for one of the players. The second sense of the title refers to logical structures in general games, such as economic competition, social cooperation, chess, soccer, war, or dialogue. All these activities involve rule-governed action by intelligent reasoning players. In this broader realm, logic helps clarify possible game structures, as well as the mechanics of deliberation by players as the game proceeds. The book has lots of results on logical systems which serve this purpose. Its total proposal is a joint enterprise where logic provides the fine-structure of the more global theory of strategic equilibrium in game theory.

Fenrong: We seem to have covered most of your books. If I look at the topics that we discussed in this interview, I see a logician, a linguist, computer scientist, perhaps even a game theorist. But where is the connection with philosophy?

Prof. van Benthem: I am glad you raise this point, because it is a fair one. To me, there is no longer a clear dividing line between the label 'Philosophical Logic' and issues in surrounding disciplines. If you look at the 20th century history of philosophical issues of meaning, knowledge, or action, ideas travel between fields all the time. In my Stanford 2003 spring course 'Logic in Philosophy' http://staff.science.uva.nl/~johan/298-2003.html), I show this for a number of basic topics, such as compositionality, valid consequence, conditionals, knowledge, and belief. I see philosophy as a 'catalyst' or 'spice' which makes this interdisciplinary mixture work. By contrast, I have become skeptical about more 'philosophy-internal' issues in philosophical logic. These seem like intellectual black holes: they absorb a lot of clever energy, but nothing ever seems to come out.

Fenrong: In the 1990s, you were the founding director of ILLC, and also the first president of Folli. You were awarded an honorary doctorate at Liè ge 1998, and elected a member of the Institut International de Philosophie in 2001.You are the Chairman of NWO's national stimulation program for the Cognitive Sciences. And your CV is even much longer. In 2003, the Universiteit van Amsterdam has appointed

you as University Professor, which is a very prestigious position. What do you think about these awards, and your general reputation? How do you deal with all these interests, and all this busy work, while staying creative in your research?

Prof. van Benthem: I try not to think too much about the questions that you raise here. If I did, I might get seriously alarmed. I am always surprised by biographical descriptions like this. Sometimes I think there are two Johan van Benthems. One is just an individual person, who never grew up much since his student days, who likes to read in a corner, who talks occasionally to students and colleagues – sometimes sense, sometimes nonsense – who pursues some interests one after the other; and who likes to travel around the world to explain to people what he has just understood for himself. But then there is also a second, public Johan van Benthem, who wants to influence the field, who creates public institutions, and who tries to interfere with other people's lives, making his students do this, and his colleagues do that. Sometimes I ask myself how these two very different people get on together...

Certainly the busy public life takes always time from research, but on the other hand it is also helpful, because you get greater exposure to new ideas, especially working with *students*, who can be sources of the most unexpected ideas. My public ego gives me many interactions that enrich my private ego, and stimulate research.

Fenrong: So, you began your research in logic, then language, then information. It looks as if you often spend five years on a book, and then use it to close a chapter of your life. What is the next chapter, and your plan the next five years?

Prof. van Benthem: You have to realize that this five year planning is just a pretense. I look back in my history, then write down the resultant of five years of past work. But I never sit down to plan my next five years, in the style of a plan economy; if only, because I am not very good at predicting my own future. But if you insist, I would say that I want to learn a lot more about connections between logic and cognitive science, i.e., what people really do when they use language or reasoning, all the way to what

goes on in their brains. My being the chairman of this National Cognitive Science Committee reflects a genuine interest. Even so, unlike my faster creative colleague Michiel van Lambalgen, I have not yet published anything in this direction. A good example is what was said earlier about games, and designing new practices that can be inserted smoothly into human behavior. I would love to do joint research on that with empirical scientists, and find out which new practices work and which ones do not, and why. In fact, we are exploring such contacts now with groups in artificial intelligence and experimental game theory.

And more generally, I am becoming interested in doing things with logic that really change people's lives. So you could say that I am getting old, returning to those revolutionary student days that we talked about, when it seemed as if academics could really help to make this world a better place.

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