中国大学生研究生2000年至2015年遭遇暴力犯罪的调查

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摘要：这是大型研究《中国大学生研究生遭遇暴力犯罪与自卫防身行为的研究》的第一部分。这一部分旨在对中国大学生十几年来遭受暴力犯罪的情况作详尽的研究。而最终期望达到的目的是引起中国大学生和家长以及教育部门对中国大学生遭遇暴力犯罪攻击危险的警觉并在全国对大学生生普及自卫防身科学教育。同时给普及自卫防身科学的课程提供科学依据。本文使用内容分析法来研究从各种媒体上所收集到的一千多个中国大学生遭到暴力犯罪的案例。这些案例来自于作者从二零零年开始到二零一五年四月十四日（最新的一个案例）为止十五年对各网站上有关报导的每日不间断的跟踪，以及从报纸，杂志，电视的报导所收集到的案例，包括少数二零零零年以前的案例。研究结果显示，中国女大学生遭遇暴力犯罪的机会和威胁是男生的四倍；强暴和杀人是各种犯罪中对中国女大学生生命安全的最大威胁；杀人，故意伤人，和抢劫是威胁中国男大学生的最主要暴力犯罪；受害的大学生包括了中专职校，大学，硕士生和博士生所有年级男女学生，并且遭遇暴力犯罪的后果十分严重甚至惨烈；女大学生受害发生最多是在校外，其次依次为住处和校园，找家教找工作的地方，和大街上或乘车时；男大学生遭到暴力犯罪最多的地方是在校内，其次是在住处；男女大学生在白天和夜晚都可能受害。

研究的背景

在当今大部分家庭都是独生子女的中国社会，家里的唯一大学生女儿或儿子就成了几个家庭的核心，成了中国亿万家庭成龙成凤光宗耀祖的唯一希望所在。这些独生子女出不得一点事儿，尤其是生命攸关的大事。而一旦出事，那就不仅仅是这个独生子女本人学业事业和生命的永远无法弥补的损失，同时也给自己和家庭所造成的倾家荡产的经济上的巨大损失，并且给父母家人带来的不可逆转的家破人亡和父母祖辈永远的悲痛和白发人送黑发人的悲惨情景。中国目前有几百万的失独家庭就是前车之鉴。

然而保佑独生子女大学生的安全往往是家长们的一厢情愿，各种能在瞬间夺走一个大学生生命的因素不以家长们的意志为转移。而暴力犯罪是影响大学生生命和财产安全的最大威胁。在当今歹徒横行，暴力犯罪激增的时代，个人安全已经成为每个大学生和每个家庭头等关心的大事。中国暴力犯罪案件的急剧上升已经对大学生们的生命安全和学习生活及未来的事业造成实际威胁。二零一四年九月份十几个女大学生接连失踪遇害就是最典型的警讯。另外，一九九四年清华大学的朱令案件，二零零四年云南大学的马加爵事件，二零一四年复旦大学的黄洋案件，以及更多的人们已经无法一一细数的暴力犯罪案件已经使大学生和家长们产生了巨大的恐惧。二零一四年流

行的名言“谢室友不杀之恩“已经将这种恐惧放到了最大，而且彻底击穿了人们的心理安全底线。

暴力犯罪是一种社会常态，而且是大学生四年在校学习和未来四十年工作和生活的一部分，大学生和家长们必须面对这样这严酷的事实，即他们的独生子女必须面对这些暴力犯罪，而且无处可逃。他们要么学会自卫防身，要么任由自己成为受害者。

每当大学生遭到暴力犯罪攻击案件曝光，媒体上马上就有众多的大师们出现，以他们的经验，或是想象来指点大学生们如何应对这些暴力犯罪。诚然，有些点子可能有实用价值，但大多数建议并没有科学研究证明或支持，那么大学生们听他们的话也只能是后果自负。

为了能让中国大学生能够防范和应对这些暴力犯罪，我们理所当然地需要对大学生进行自卫防身科学教育。因为学习预防和应对暴力犯罪应该成为大学教学的一部分。可是自卫防身科学教育是要以实实在在的科学研究作基础的。为了给中国大学生们提供最科学的自卫防身教育，我们必须对中国大学生遭遇暴力犯罪的情况作一个详细的调查研究，在这个研究的基础上来创造和实施这一门最严谨的生命安全教育。作者曾于二零零二年与北大合作将美国大学 SmarTough 自卫防身学引入北大，并于二零零四年通过“全国大学自卫防身学教师研讨会和培训班”引入全国几十所大学。然而美国大学的自卫防身学是作者以美国大学生的具体情况研发的课程，与中国大学生的需求可能相去甚远。现在应该为中国大学生量身设计一套能满足他们实际需求的中国大学自卫防身科学。可是在引入中国大学十三年来，国内目前尚无对中国大学生遭受暴力犯罪方面的研究，也没见到中国版的大学自卫防身学。唯一有一点关联的文献是有关对中国大学生自卫防身准备状况的小样本调查（谢飞，2014），和对中国色狼教职员性侵中小学女生和受害学生自卫反抗的研究（陈工，刘留，2014）。

这是大型研究《中国大学生研究生遭遇暴力犯罪与自卫防身行为的研究》的第一部分。本部分的研究目的就是对中国大学生十几年来遭受暴力犯罪的情况作详尽的研究。本文最终期望达到的目的是引起中国大学生和家长以及教育部门对中国大学生遭受暴力犯罪攻击的警觉并在全国对大学生生普及自卫防身科学教育。同时给普及自卫防身科学的课程提供大学生们所最需要的智力和武力自卫内容，因为本研究揭示了大学生们的真实需求，而实际需求才是自卫防身科学这门课程最原始最有力的推动力和最坚实的实践基础。这项研究关系到十三亿人中上千万大学生和他们家庭的安全与幸福。无疑应该会得到所有家长们的赞赏与支持。尽管这不是一个能带来经济利益的高科技项目，但是应该有最广泛的社会影响，社会支持和民心支持。

研究方法

本文使用内容分析法来研究从各种媒体所收集到的全部一千多个中国大学生遭到暴力犯罪的案例。这些案例来自于作者从二零零年开始到二零一五年四月十四日（最新的一个案例）为止十五年对各网站上有关报导的每日不间断的跟踪，以及从报纸，杂志，电视的报导所收集到的案例，包括少数二零零零年以前的案例。这一千多个案例是作者所能收集的所有案例。

媒体对案例报导的内容和深度广度有很大的差距。有的案例非常详细，而有的只有一段或几句话。因而下面的分析中案件发生数量的多少并不能代表在实际情况下

的数据，而只代表所报导的数据。本文希望把这些不完整的信息梳理拼凑出一个比较完整的图像，以此描述中国大学生遭遇暴力犯罪的情况。

本项研究参照美国司法（Uniform Crime Report, 2013）对暴力犯罪的分类，从谋杀，强暴，抢劫，和伤人四种暴力犯罪对案例作分析。同时又根据国情加入中国大学生和家长们非常关心的绑架/劫持/拐卖和霸凌两大类共六个方面。

本文从几个角度对所报导的这六大类案例做了综合分析。第一个方面包括所报导的案件和受害人数，和每个案例中的受害者人数。第二个方面包括受害者的年龄，年级，和受害的后果。第三个方面包括男女大学生受害的时间和地点。

报导多名受害者的那些案例因无法计算人数没有列入总人数中。同时包含几种犯罪的案例都按照犯罪种类分别计算。因此在分析中会有各种犯罪数量合计超过报导案例总数的情况。本文使用描述性的研究方法，使用犯罪发生的实际数量和百分比作分析。

研究结果与分析

一. 男女大学生遭到各种暴力犯罪的案例和人数

表一显示了中国大学生受害案例总数和每项暴力犯罪所占比例。所报导的女大学生案例为 817 例，男大学生案例为 203 例。女大学生遭到最多攻击的是强暴，其次是杀人，第三为绑架劫持拐卖，第四是抢劫，故意伤人名列第五，而名列第六的霸凌案例较少。男大学生遭到攻击最多的是杀人，第二是故意伤人，第三为抢劫，第四为绑架劫持拐卖，强暴和霸凌的案件极少。

表二列出了中国大学生受害人数总数和每项暴力犯罪受害者的人数。所报导的女大学生受害总数为 1362 人，男大学生受害者总数为 349 人。女大学生遭到强暴的人数最多，被杀和被抢的人数居第二，被绑架和故意伤人的人数排第三，霸凌最少。男大学生被故意伤害和被杀的人数最多，抢劫和绑架受害人数要少得多，而霸凌和强暴受害者则极少。

由此看来，强暴和杀人是各种犯罪中对中国女大学生生命安全的最大威胁，而抢劫，绑架和故意伤人也给女大学生造成很大的威胁。杀人，故意伤人，和抢劫是威胁中国男大学生的最主要暴力犯罪。

表 1. 所报导的中国大学生受害案例总数和每项犯罪所占比例

	女		男	
	案例数	比例	案例数	比例
杀人案例	237	29.0%	105	51.7%
强暴案例	323	39.5%	1	0.5%
伤人案例	49	6.0%	68	33.5%
抢劫案例	85	10.4%	17	8.4%
绑架案例	109	13.3%	11	5.4%
霸凌案例	14	1.7%	1	0.5%
总数	**817**	**100%**	**203**	**100%**

表 2. 所报导的受害大学生人数总数和每项犯罪的受害人数

	女		男	
	受害人数	比例	受害人数	比例
杀人案例	282	20.7%	151	43.3%
强暴案例	613	45.0%	1	0.3%
伤人案例	117	8.6%	164	47.0%
抢劫案例	207	15.2%	21	6.0%
绑架案例	128	9.4%	11	3.2%
霸凌案例	15	1.1%	1	0.3%
总数	**1362**	**100%**	**349**	**100%**

表三所示结果表明，百分之八十的受害案例是女大学生，百分之二十为男大学生。其中几乎所有强暴受害案例都是女生，只有一例是男生。绑架，霸凌，和抢劫似乎也是女生的受害专利。而杀人案也大部分是女生。只有在故意伤人的案件中，男生略占多数。表四中的男女生受害人数比例也显示出相似的结果。由此看来，不论在案例的比较还是人数的比较上，中国女大学生遭到暴力犯罪的机会和威胁是男生的四倍。自卫防身教育对女大学生似乎更为紧迫和重要。

表 3. 所报导的男女受害大学生案例比例

	所有案例	女		男	
		受害人数	比例	受害人数	比例
杀人案例	342	237	69.3%	105	30.7%
强暴案例	324	323	99.7%	1	0.3%
伤人案例	117	49	41.9%	68	58.1%
抢劫案例	102	85	83.3%	17	16.7%
绑架案例	120	109	90.8%	11	9.2%
霸凌案例	15	14	93.3%	1	6.7%
总数	**1020**	**817**	**80.1%**	**203**	**19.9%**

表 4. 所报导的男女受害大学生人数比例

	所有案例	女		男	
		受害人数	比例	受害人数	比例
杀人案例	433	282	65.1%	151	34.9%
强暴案例	614	613	99.8%	1	0.2%
伤人案例	281	117	41.6%	164	58.4%
抢劫案例	228	207	90.8%	21	9.2%
绑架案例	139	128	92.1%	11	7.9%
霸凌案例	16	15	93.8%	1	6.2%
总数	**1711**	**1362**	**79.6%**	**349**	**20.4%**

二. 遭到各种暴力犯罪的男女大学生年龄，年级，和后果

表五所示结果表明，女大学生六项犯罪合计受害最多的年龄段是 20-21 岁之间，其次是 18-19 岁期间，和 22-23 岁之间。杀人案，强暴案，和抢劫案也呈现出同样趋势。但是绑架劫持拐卖案最多的则是在 18-19 岁期间，和 22-23 岁之间。霸凌案例在女生年龄小时较多，而后随年龄增长而减少。

表六所示结果表明，男大学生在 18-19 岁期间遭受暴力犯罪最多，以后随年龄增长而逐渐下降。但是这主要体现在杀人案例中，在别的犯罪中则没有明显的趋势。所报导的案例样本很小，很难得出权威性结论。

表 5. 中国女大学生受害时的年龄

年龄	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
16-17 岁	1	4	2	1	3	2	13
18-19 岁	20	15	2	4	13	1	55
20-21 岁	29	26	2	7	4	1	69
22-23 岁	19	9		2	12		42
24-29 岁	12	6			3		21
30 岁以上	2			1			3
不明	147	220	29	14	62	7	479

表 6. 中国男大学生受害时的年龄

年龄	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
16-17 岁	2		2				4
18-19 岁	12		1	2	1		16
20-21 岁	6	1	2		2	1	12
22-23 岁	6		1		3		10
24-29 岁	4				2		6
30 岁以上							
不明		71		47		14	5 137

表七中的结果显示，大一女生受害的机率最高，然后是大四，紧随着的是大二大三女生，女硕士生与大三女生接近。女博士虽然受害者人数不多，但考虑女全国女博士生人数较少，因而女博士生受害机率应该算是很高的。中专职校女生应该也和女博士生的情况相似。女大学生受害者中还有几位外国留学生，以及刚刚毕业的女大学生。从单项犯罪来看，被杀害的大一女生最多，从大二到硕士生被杀害人数相近，而其他类别人数较少。被强暴的大一女生也是最多，然后是大四女生。大二大三和硕士生基本相同，职校和女博士紧随其后。故意伤人的案例没有显示出太明显的趋势，但被抢劫的女生随年级的上升而逐年下降。被绑架劫持拐卖案件以大一和大四女生为多。从案例来看，这也许是由于大一女生不谙世事缺乏安全意识所致，因此对女大一新生开展自卫防身教育非常紧迫，同时对她们在大学的四年中或读研时的安全有更为重要的意义。而大四女生可能是由于找工作的紧迫性和压力而容易上当受骗。女生霸凌在职校最多，然后随年级上升而减少，直至大四时消失。大多数案件没有报导具体年级情况。

表 7. 中国女大学生受害时的年级

年级	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
中专职校	3	10		2	1	5	21
大一	33	38	3	7	14	4	109
大二	22	16	5	5	9	2	59
大三	23	12	2	4	4	2	47
大四	18	27	7	2	13		67
未标明大学生	107	198	19	65	50		439
硕士（研究生）	18	14	3	4	2		41
博士	3	9	1	1	1		15
留学生	2	2	1	2	1		8
刚毕业	7						7

表八中的结果显示，大一男生受害的机率最高，然后是大四，紧随着的是大二大三男生，这与女生的情况相同。中专职校排在大三之后，而后是博士硕士生。从单项犯罪来看，从大一到大四被杀的男生人数非常接近，说明被杀的危险在大学四年中始终存在。职校和博士硕士比较接近，人数虽居后，但考虑这三个群体人数很少，因而被杀的机率还算不低。故意伤人在大一时居多，也许上太年轻控制不了自己脾气和行为所致。被抢劫也是大一生居首。绑架劫持失踪案件在大三大四出现，也许与急于找工作而被骗有关，例如被骗去传销。大多数案件没有报导具体年级情况。

表 8. 中国男大学生受害时的年级

年级	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
中专职校	7		1	1			9
大一	13		6	6	1		26
大二	13		1	1			15
大三	10	1			3		14
大四	14		1	1	5		21
未标明大学生	3		9	9		1	22
硕士（研究生）	4						4
博士	6						6
留学生	1						1

表九的研究结果显示，在所报导的每一个案件中只有一名受害女生的情况占了绝大多数。这说明女大学生单独活动时最容易遭到暴力犯罪的攻击。每个案件中有两个受害者的，或者在两个女生同时遭到暴力攻击的机率占第二位。尤其是女大学生和男友恋人同行/同住时也有不低的被攻击的机率。这提醒女大学生们，有男友陪伴固然增加她们的安全感，但也不能完全保证她们的安全。女大学生们也应该自己学会自卫防身，同时在有男友陪伴的情况下也要保持警觉性，避开危险的时间，和远离危险的地带。其他从三名到多名受害者的受害机率从百分之三到百分之十几不等，但没有显示出明显的规律。

表 9. 同一报导案件中的受害女大学生人数

个案人数	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
一个受害者	208	255	35	61	101	13	673
两个受害者	12	18	1	7	2	1	41
三个受害者	5	4			5		14
四个受害者	2	4	2		1		9
五个受害者		1					1
六个受害者		6	1	1			8
七个受害者	1	2	8	3			14
八个受害者	1	1	1	2			5
九个受害者		1		9			10

十个受害者		11		1		12	
十一个受害者		3				3	
多个受害者		14				14	
男女二人	4	4	1	1		10	

表十的研究结果显示出与女大学生非常相近的结果。在所报导的每一个案件中只有一名受害男生的情况也是占了绝大多数。这说明男大学生单独活动时最容易遭到暴力犯罪的攻击。每个案件中有两个受害者的，或者在两个男生同时遭到暴力攻击的机率占第二位。其他从三名到多名受害者的受害机率从百分之一到百分之九不等，但没有显示出明显的规律。

男大学生与恋人同行/同住时也有很高的被攻击的机率。这同样给了男大学生们一个忠告，带女友出去也是有风险的，两人的安全也没有保障。因此也要保持警觉性，避开危险的时间，远离危险的地带。当然更要学会自卫防身以保护自己和女友。

表 10. 同一报导案件中的受害男大学生人数

个案人数	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
一个受害者	81	1	39	13	11	1	146
两个受害者	13		5	2			20
三个受害者	3		6				9
四个受害者	1		3				4
五个受害者	1		2				3
六个受害者	1		8				9
七个受害者	2		2				4
九个受害者			1				1
男女二人	3		2	2			7

表十一展示了所报导的女大学生遭到暴力犯罪后的严重后果，有 237 名女大学生被杀害，89 个女生身受重伤或是残废或被毁容。278 个女生被强暴，而她们还不得不承受身体上的痛苦和可能的怀孕，性病甚至艾滋病传染，以及精神上的巨大压力。有 49 人精神失常，60 人身受轻伤或昏迷。还有女大学生被拘禁捆绑勒索，拐卖到农村给农民做老婆，或被迫跳楼自杀。有人就此失踪，从人间蒸发，估计也是凶多吉少。这个结果警示女大学生们，暴力犯罪实实在在存在于每日生活之中，尽管不会每天都发生在她们身上。但一旦发生，则后果惨烈，是她们和她们的父母都承受不起的损失。女大学生们务必以已经发生在你的同学身上的犯罪作为你的前车之鉴，未雨绸缪，早作准备。

表十二的结果展示了所报导的男大学生遭到暴力犯罪后的严重后果，有 105 名男大学生被杀害，83 个男生身受重伤或是残废。有 43 个男生遭到攻击后昏迷受伤，还有被迫跳楼自杀的，精神失常的，甚至失踪或被拘禁捆绑勒索。这个结果也警示男大学生们，不光是女大学生成为暴力犯罪的受害者，男生也一样。自卫防身，女生需

要，男生也需要。而且按照神会的行为标准，男大学生没不仅自己要会自卫防身，也要会保护自己的女友和未来的女儿和儿子。作为男子汉，这责无旁贷。

表 11. 女大学生遭受暴力犯罪的后果

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数	
被强暴		257		16	5		278	
死	190	20	1	10	14	2	237	
重伤/残/毁容		34	5	32	13	3	2	89
轻伤/昏	3	11	24	13	1	8	60	
精神病	5	37			2	5	49	
脱身		23		6	2	3	34	
拘禁捆绑勒索					16		16	
猥亵/侮辱					11		11	
卖作人妇					10		10	
失踪					9		9	
自杀跳楼			3				3	
被迫卖淫					1		1	
无家可归					1		1	

表 12. 男大学生遭受暴力犯罪的后果

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
死	91		9	5			105
重伤/残	27	1	49	4			83
轻伤/昏	6		32	4		1	43
精神病	3					1	4
自杀跳楼			4				4
失踪					4		4
拘禁捆绑勒索					4		4
被逼作黑工					1		1

除了媒体上所报导的后果外，还有更多的明显的的严重后果。其中包括学业事业上的永远无法弥补的损失，给自己和家庭所造成的经济上的倾家荡产巨大损失，给父母家人带来的不可逆转的家破人亡和父母永远的悲痛，和给亲人带来白发人送黑发人的中国最典型的悲惨情景。中国的男女大学生们，为了你们的生命安全，为了你们

的学业事业，为了父母的安心和全家的完整与幸福，你们应该负起你们的自卫防身责任。学习自卫防身科学是你们避免这些悲剧的唯一利器。

三．男女大学生遭到各种暴力犯罪的时间地点

表十三所示结果表明，女大学生遭到暴力犯罪攻击的地点有五个集中点。发生最多是在校外，第二位是在住处，居第三位的是校园，排第四位的是找家教找工作的地方，最后是在大街上或乘车时。女大学生被杀害最多的地方居然是校园里和住处，而这两个地方理应是最安全的地方。但是校园外，路上，或找工作的地方，也是女大学生应该防范谋杀的地点。对女大学生的强暴在五个地域都经常发生，已经成为一种常态。宿舍住处是女大学生遭到故意伤人最多的地方，也是霸凌发生最多的地点，多是由于独生子女缺乏妥善处理人际关系因而发生冲突所造成。抢劫在五个地域发生的机率差不多。大街上是遭到绑架劫持拐卖的最危险场合。防范在所有地域的暴力犯罪应该是女大学生学习自卫防身的内容之一。

表 13. 女大学生遭受暴力犯罪的地点

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数	合计
校园内其他地点	46	40	8	8	7	3	112	
教室/图书馆实验室	15	13	3	12	4		47	159
宿舍	29	28	22	4	1	7	91	
租房处	12	27	2	2	2		45	
家	14	2	2	3			21	
厕所/浴室	1	8		1	1		11	168
大街上	14	10	3	17	6		50	
乘出租车黑车	11	8	1	7	11		38	
乘火车汽车	4	6	1	3	16		30	
电梯	1						1	119
歹徒家里/律师楼	15	18		1	4	3	41	
找工处/工作/实习	11	37	2	3	5		58	
家教处	7	21		8	1		37	136
校外饭店旅馆等	35	83	8	11	37		254	
公园山野树林	10	8		6	3		27	
娱乐处/音乐会	2			1			3	284

表十四所示结果表明，男大学生遭到暴力犯罪最多的地方是在校内，其次是在住处，在校外和大街上分属第三第四。发生在校内和宿舍的杀人案件和故意伤人案竟然占了绝大多数，因而如何防范辖内的暴力犯罪成为男大学生的当务之急。清华大学的朱令案件，云南大学的马加爵案件，复旦大学的黄洋案件都应该引发男大学生的警觉，别让校园宿舍成为同学之间互相杀戮的战场。希望在毕业时的临别赠言不会再是“谢室友不杀之恩”。

表 14. 男大学生遭受暴力犯罪的地点

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数	合计
校园内其他地点	27		21	8		1	57	
教室/图书馆实验室	6		4	12			22	79
宿舍	37		18				55	
租房处	3			1			4	
家	2		3	1			6	65
大街上	1		3	4	3		11	
乘火车汽车	5		2	3	2		12	23
找工处/工作/实习					1		1	1
校外饭店旅馆等	17	1	8	5	3		34	
公园山野树林	3		1	2			6	40

表十五所列结果显示，女大学生遭到暴力犯罪的时间总的是白天稍高于夜间。夜间的强暴，抢劫，和霸凌的案例高于白天。而发生在白天的杀人，故意伤人，和绑架劫持拐卖高于夜间。这个结果相信出乎人们的意料之外，因为白天安全，夜间危险，女生夜间应该尽量避免单身外出已经成为社会的共识和人民每日生活的常识。自卫防身科学的教师教科书也都这样教学生教读者。本文这一研究结果则向女大学生发出警告，暴力犯罪随时可能发生在你们身上，不论是黑夜还是白天。因此你们的警钟应该是二十四小时长鸣，随时准备自卫防身。

表 15. 女大学生遭受暴力犯罪的时间

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
夜晚	77	131	10	48	13	6	285
白天	103	112	21	32	36	3	307

表十六结果表明，男大学生遭到暴力犯罪的时间总的是夜间稍高于白天。夜间的杀人和抢劫的案例高于白天，而故意伤人的时间则是白天高于夜晚。本文这一研究结果也向男大学生发出忠告，暴力犯罪也可能随时可能发生在你们身上，不论是黑夜还是白天。要随时准备应对暴力犯罪，自卫防身。

表 16. 男大学生遭受暴力犯罪的时间

后果	杀人	强暴	伤人	抢劫	绑架	霸凌	总数
夜晚	49	1	23	14	1	1	89
白天	35		32	5	3		75

综述与结论

1. 中国女大学生遭受暴力犯罪的报导案件有 817 个，受害女大学生人数为 1362 人。中国女大学生遭遇暴力犯罪的报导案件有 203 个，受害女大学生人数为 349 人。女大学生占受害案例和人数的 80%， 男大学生占 20%。中国女大学生遭到暴力犯罪的机会和威胁是男生的四倍。自卫防身教育对女大学生似乎更为紧迫和重要。

2. 强暴和杀人是各种犯罪中对中国女大学生生命安全的最大威胁，而抢劫，绑架和故意伤人也给女大学生造成很大的威胁。杀人，故意伤人，和抢劫是威胁中国男大学生的最主要暴力犯罪。

3. 女大学生六项犯罪合计受害最多的年龄段是 20-21 岁之间，其次是 18-19 岁期间，和 22-23 岁之间。男大学生在 18-19 岁期间遭遇的暴力犯罪最多。

4. 受害的女生包括了中专职校，大学，硕士生和博士生所有年级。大一女生受害的机率最高，然后是大四，紧随着的是大二大三学生和硕士生，最后是博士生和中专生。大一男生受害的机率也高于其他年级。因此对大一新生开展自卫防身教育非常紧迫，这对他/她们在大学四年中或读研时的安全有更为重要的意义。

5. 男女大学生单独活动时最容易遭到暴力犯罪的攻击。但是在两个大学生同时遭到暴力攻击的机率也很高，包括女大学生和男友恋人同行/同住时。

6. 大学生遭到暴力犯罪后的后果极其严重生甚至可以说是惨烈，受害女大学生的经历包括被杀害，受重伤变残废被毁容，精神失常，受伤昏迷，被强暴，拐卖，失踪，和自杀。男大学生最多的是被杀害，受重伤变残废，精神失常，和受伤昏迷。本文还没有研究的更为严重的后果应该包括学业事业家庭经济上的全面的灭顶般的损失。

7. 女大学生遭遇暴力犯罪最多的地点是在校外，第二位是在住处，居第三位的是校园，排第四位的是找家教找工作的地方，最后是在大街上或乘车时。防范在所有地域的暴力犯罪应该是女大学生学习自卫防身的内容之一。男大学生遭到暴力犯罪最多的地方是在校内，其次是在住处，在校外和大街上分属第三第四。发生在校内和宿舍的杀人案件和故意伤人案竟然占了绝大多数，因而如何防范校内的暴力犯罪成为男大学生的当务之急。

8. 女大学生在夜间的强暴，抢劫，和霸凌的案例高于白天。而发生在白天的杀人，故意伤人，和绑架劫持拐卖高于夜间。夜间的杀人和抢劫的案例高于白天，而故意伤人的时间则是白天高于夜晚。针对大学生的暴力犯罪随时可能发生。

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胸腺肽 a1 辅助治疗肝癌 Meta 分析

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【摘　要】目的　探讨胸腺肽 a1 对辅助治疗肝癌的效果，为胸腺肽 a1 用于肝癌的辅助治疗提供临床依据。方法　收集国内外相关文献并进行筛选，以对照组和治疗组的六月生存率和十二月生存率作指标，利用 Revman 5.0 软件进行 meta 分析。结果治疗组六月生存率和十二月生存率 P 值均在 P<0.05 水平，差别有统计学意义。结论胸腺肽 a1 作为肝癌治疗的辅助用药对肝癌发展有延缓作用，可延长患者生存时间，提升患者生存质量。
【关键词】胸腺肽 a1；肝癌；meta 分析

肝癌是临床最常见的恶性肿瘤之一，具有高死亡率和复发率的特点，有文献报道肝癌 2 年复发率可达 50% [1] 。本文对联合应用胸腺肽 a1 治疗肝癌效果进行 meta 分析，以期为临床治疗提供较为明确的询证医学证据。

1　材料与方法

检索胸腺肽 a1 用于肝癌患者治疗的临床随机对照试验。中文检索词包括肝癌，肝肿瘤，胸腺肽 a1，日达仙；英文检索词包括 liver cancer，hepatocellular carcinoma，hepatic carcinoma，thymosin alpha 1，thymosin a1，Ta1。检索数据库包括索 Pubmed (1966-2013.10)、Em-base (1974-2013.10)、中国生物医学文献数据库 (CBM，1978-2013.10)、中国期刊全文数据库 (CNKI，1994-2013.10)，并利用 Google、百度等搜索平台获取相关信息。

1.1　文献的纳入和剔除标准

1.1.1　纳入标准 - 已发表的关于胸腺肽 a1 联合治疗肝癌的文献；文献中对照组经化、放疗或动脉栓塞治疗、手术切除，治疗组在对应对照组治疗的基础上加用胸腺肽 a1；对照组及治疗组为随机
分组；各研究间年龄、性别、疗效分析指标包含职业等基线资料基本一致；资料中的疗效分析指标要含有患者治疗后 6 月生存率和 12 月生存率；文献中相关研究的随访率高于 95%。

1.1.2　剔除标准　治疗组在对照组治疗基础上除胸腺肽 a1 外还有其他干预措施以致不能区别胸腺肽的效应；治疗重点指标不包括生存率；剔除重复发表的文献；治疗方案中胸腺肽 a1 的用法、用
量明显与药学资料不符合。

1.2　纳入研究的质量评估

纳入的研究按 Cochrane 协作网推荐方法 [2] ，评估各试验是否为真正的随机方法；是否对研究对象、治疗方案实施者、研究结果测量者采用盲法；是否有研究对象失访、退出、违背治疗方案并在分析时评分。

1.3　统计学分析　选用统计软件 Revman 5.0 作统计学分析。以 RR (Risk Ratio)作为效应评价指标。使用　Q 检验评价所包含研究的导质性，P≤0.05 认为多个研究结果有异质性，使用随机效应模型；
反之则使用固定效应模型。

2　结果

2.1　原始数据　按照统一的纳入和剔除标准逐一筛选，并排除重复文献后，共检索到 14 篇文献，包括国内文献 10 篇，国外文献 4 篇。在阅读标题和摘要所含信息的基础上，排除与研究目的不符文献 7 篇；对余下的 8 篇文献阅读全文，在随机分组、盲法使用及干预措施评价后，最后纳入 5 篇符合条件的文献。根据检索所得文献的参考文献进行扩大检索，没有发现新的符合条件的文献。

2.2　六月生存率 meta 分析

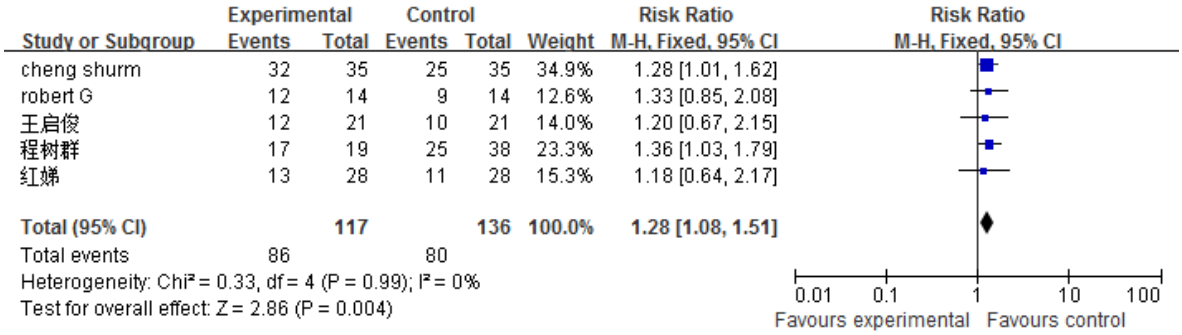

图 1，6 月生存率森林图

第 1 组研究（Cheng S）结果示 RR=1.28，95% 可信区间 1.01-1.62，位于无效线右侧，故认为对于肝癌治疗，辅以胸腺肽类药物治疗优于常规肝癌治疗的方法；第 2 组研究（Robert G）结果示 RR =1.33，95%可信区间 0.85-2.08，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异；第 3 组研究（王启俊）结果示 RR =1.20，95%可信区间 0.67-2.15，无效线右侧，故认为对于肝癌治疗，故认为对于治疗肝癌，两种治疗方案无明显差异；第 4 组研究（程树群）结果示 RR =1.36，95%可信区间 1.03-1.79，位于无效线右侧，故认为对于肝癌治疗，辅以胸腺肽类药物治疗好于常规肝癌治疗的方法；第 5 组研究（欧红娣）结果示 RR =1.18，95%可信区间 0.64-2.17，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异。最后对 6 月生存率的 meta 分析可知，6 月生存率研究的异质性检验统计量为 0.33，自由度为 4，P=0.99；表明异质性检验无统计学意义，认为纳入研究间异质性可忽略，故选用固定效应模型。合并效应量的假设检验输出结果可知：RR 的加权平均估计值 1.24，检验统计量 Z=2.86，P=0.004(<0.05)，因此按 P <0.05 检验水准，差别有统计学意义，总体 RR 的 95%可信区间为(1.09，1.21)，可以认为治疗组所在人群的存活率与对照组所在人群有差异，推断胸腺肽类药物辅助治疗肝癌治疗效果高于单纯性肝癌治疗。

2.3　十二月生存率 meta 分析

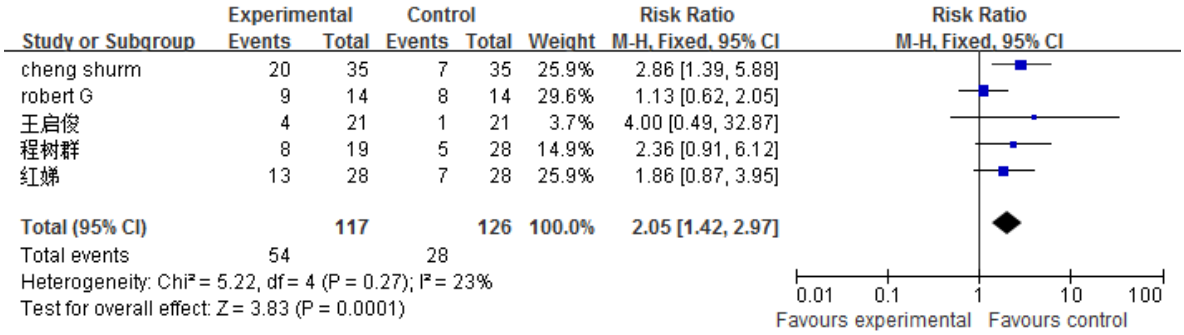

图 2， 12 月生存率森林图

第 1 组研究（Cheng S）结果示 RR=2.86，95% 可信区间 1.39-5.88，位于无效线右侧，故认为对于肝癌治疗，辅以胸腺肽类药物治疗好于常规肝癌治疗的方法；第 2 组研究（Robert G）结果示 RR=1.13，95%可信区间 0.62-2.05，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异；第 3 组研究 （王启俊） 结果示 RR =4.00，95%可信区间 0.49-32.87，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异；第 4 组研究 （程树群） 结果示 RR =2.36，95%可信区间 0.91-6.12，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异；第 5 组研究 （欧红娣） 结果示 RR =1.86，95%可信区间 0.87-3.95，跨过无效线，故认为对于治疗肝癌，两种治疗方案无明显差异。对 12 月生存率的 meta 分析可知，12 月生存率研究的异质性检验统计量为 5.22，自由度为 4，P=0.27；表明异质性检验无统计学意义。

3 讨论

研究发现，胸腺肽 a1 有助于提高机体的免疫功能，已被用于抗肿瘤和抗病毒的辅助治疗。临床实践中常与其他方法如手术、化疗和放疗联合，应用于肺癌、结直肠癌和胃癌等的治疗，对肝癌的治疗也有实验和临床的报道 [3] 。本次 meta 分析发现，胸腺肽 a1 辅助治疗晚期肝癌，与对照组相比能延长患者生存时间，提示胸腺肽 a1 对肝癌发展有延缓作用，能提升患者生存质量。但本次试验中因方法、研究目的的限制，纳入的文献有限，各单个研究的样本量也较小，因此需要更多的高质量随机对照研究予以证实。

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Using the Model-Strategy-Application Approach in Developing Pre-Service Teachers' Pedagogical Content Knowledge and Assessing Their Progress

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The purpose of this research was to contribute to a better understanding of how to enhance pre-service teachers' pedagogical content knowledge (PCK). To achieve this goal, careful attention was given to exploring an effective approach that comprises: Model, Strategy, and Application (MSA). 153 pre-service teachers from six mathematics methods courses (K-8) at two universities participated in this study. Both qualitative and quantitative methods were used to measure teacher learning and understanding of the MSA approach and to identify relationships between components of the MSA model. The results of this study show that using the MSA model can enhance pre-service teachers' PCK. It can be used as a measurable and practical model in assessing pre-service teachers' learning progress in models, strategy, and application. In addition, the findings indicate that the three components of the MSA model are all interrelated and equally important; ignoring one or the other will result in the lack of proficiency in teachers' knowledge.

Key words: pedagogical content knowledge, model, strategy, application, and pre-service teachers

INTRODUCTION

In recent years, many studies have focused on building mathematics teachers' content knowledge, pedagogical knowledge, and pedagogical content knowledge (Shulman, 1987; Fennema, 1992; Ma, 1999; Walshaw, 2002; Hill & Ball, 2004; An, 2000 & 2004). However, research has paid insufficient attention to systematically designing a repertoire of measurable and practical models of pedagogical content knowledge (PCK) that allow pre-service teachers to not only build conceptual understanding, procedural fluency, and competence in application, but also to be able to make connections among the three components. In order to teach mathematics effectively, pre-service teachers must be trained to develop the ability to create

various representations to unpack abstract mathematics content and make meaningful and visible to students the ideas behind the concepts and procedures (National Research Council [NRC], 2001); they also need to perform computations efficiently and know when and how to apply computations and various models in real world situations. To achieve the goals above, this study explored an effective approach that comprises: 1) creating a variety of visual and meaningful mathematics *models* to convey abstract math ideas thru conceptual understanding; 2) developing various *strategies* to achieve fluency in procedures and computations; and 3) developing strategic competence in word problem *applications* for real life situations. In the Model-Strategy-Application (MSA) approach, the three components of conceptual understanding, procedural fluency, and applications form the critical components of PCK in this study.

The following were the research questions in this study: How do mathematics methods courses build a measurable and practical model that can be used to identify pre-service teachers' knowledge and develop their conceptual understanding, procedural fluency, and strategic competence in word problem applications? Is pre-service teachers' knowledge improved by implementing such a model? What are the relationships among the three components of the MSA model?

THEORETICAL FRAMEWORK

The Needs in Making Changes for Pre-Service Teachers' Learning

Evidence from the TIMSS, PISA, and other national and international reports indicate that teaching is one of the major factors related to students' mathematics achievement, and that a major reform is needed in mathematics education (National Center for Education Statistics, 1999; Stigler & Hiebert, 1999). According to the National Council of Teachers of Mathematics (NCTM, 2000), "Effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies" (p. 17). However, many recent studies have revealed that, "U.S. elementary and middle school teachers possess a limited knowledge of mathematics, including the mathematics they teach," and that the mathematical education they received in teacher preparation, "has not provided them with appropriate or sufficient opportunities to learn mathematics." As a result, many pre-service teachers have "weak understandings of the concepts" and "have difficulty clarifying mathematical ideas or solving problems that involve more than routine calculations" (NRC, 2001, p.372). Researchers have indicated that pre-service teachers' knowledge in mathematics content has a great impact on their future teaching (Brown, Cooley, & Jones, 1990; Adams, 1996; Wolf & Reardom, 1996). However, researchers also have found that mathematics knowledge is not the only issue in teaching and learning, and that PCK is also critical (Walshaw, 2002). To improve pre-service teachers' content and pedagogical content knowledge, mathematics methods courses play a vital role in providing opportunities for pre-service teachers to acquire and enhance their knowledge of teaching; therefore, it is essential to find an effective model that builds conceptual understanding, procedural fluency, and competence in word problem solving for mathematics methods courses.

Why the MSA Approach?

The report of *Adding It Up* (NRC, 2001), indicated that "real progress toward mathematical proficiency to be woefully inadequate" (p.11) and "school mathematics in the United States does not now enable most students to develop the strands of mathematics proficiency in a sound fashion" (p. 10). According to NRC (2001), mathematics proficiency has five components: Conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Although recent research has begun to pay attention to building mathematics proficiency, there exists no study that focuses on the three components of the MSA approach for pre-service teachers: model-strategy-application, which makes up the core of the five components of mathematics proficiency. The three components of the MSA are also consistent with RAND's (2003) five indicators of student mathematics proficiency. Among them, conceptual understanding, procedural fluency, and problem solving in application are the essential components of proficiency strands. In addition, the MSA is reflected on the guiding principles of California Mathematics Framework (2005): To achieve balance within mathematics--basic computational and procedural skills, conceptual understanding, and problem solving.

Figure 1 shows a structure of knowledge base that indicates to achieve effective teaching, a teacher must focus on creating a variety of visual ***models*** to aid in addressing and proving mathematical concepts, building ***strategies*** for procedural and computational fluency, and ***applying*** strategies to solve real-life word problems.

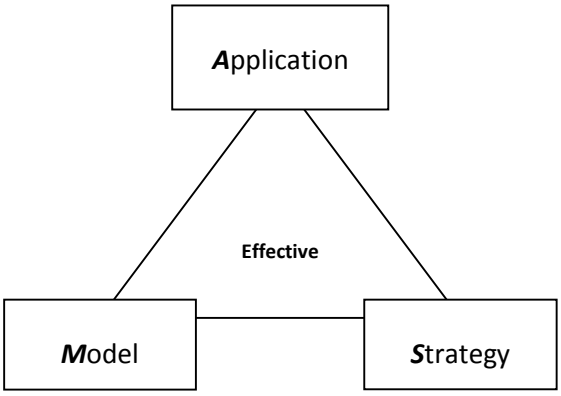

Figure 1: The MSA approach

These three components are interrelated in a triangular network in which the model and strategy components form a foundation for application. The three components of the MSA model build upon each other; thus, ignoring one or another will result in ineffective teaching. Procedural fluency without conceptual understanding will yield non-meaningful and inappropriate strategies for solving applications; conceptual understanding without procedural fluency will yield inefficient strategic applications.

The learning process of the MSA provides pre-service teachers with the opportunity to develop their PCK and abilities of effective teaching. As they focus on the processes of the inquiry of the MSA, they develop the ability of demonstrating understanding, constructing

strategies of computations, and investigating how to use the understanding and strategies to solve real word problems.

Building Conceptual Understanding

In building conceptual understanding, many studies have addressed using various visual models and manipulatives (Fuson, 1986; Thompson & Lambden, 1994; Hiebert et al., 1997), but too little of the extant content probes the close connection between visual representations and abstract thinking (NRC, 2001; An, 2004), which results in students associating mathematics with fun but without a real understanding of mathematical ideas. When using a manipulative, teachers must help students "to see its relevant aspects and to link those aspects to appropriate symbolism and mathematical concepts and operations" (Fuson & Briars, 1990; NRC, 2001, p. 353). The link between concrete manipulatives and abstract mathematical ideas is mathematics representations, appropriate configurations that represent mathematical ideas (Cuoco, 2001; Goldin, 2003). Teachers' knowledge of representations has helped them in teaching mathematics effectively (Wu, 2004). To build such knowledge, pre-service teachers must learn how to create various models and representations that make sense and meaning out of abstract mathematical ideas from a specially designed MSA approach in mathematics methods courses.

Developing Procedure and Computation Fluency

Recent studies show that the importance of developing procedural fluency in mathematics has been largely ignored by research in mathematics education (NRC, 2001). In general, when cross-national studies in mathematics achievement have included samples of U.S. students, the findings have shown that U.S. students show consistently lower performance than their counterparts (e.g., Stevenson et al., 1990, Lapointe et al., 1992), especially in computation skills (Cai, 2000 & 2001). According to the NRC (2001), procedural fluency refers to the ability to perform procedures flexibly, accurately, efficiently, and appropriately. To achieve procedural fluency, students must develop the ability to decompose numbers naturally, use number relationships to solve problems, make sense of the numbers, and learn flexible and intuitive thinking (Howden, 1989; Sowder, 1992; Reys & Nohda, 1994). In May 2005, NCTM issued a new position statement calling for improvement in student computational skills. To achieve this goal, classroom teachers play a key role in applying their PCK by providing different strategies for computation skills and reinforcing students' - computation skills in their daily teaching. In order for pre-service teachers to acquire such knowledge, mathematics methods must be considered essential courses, where pre-service teachers not only acquire conceptual understanding but also learn how to help children grasp appropriate strategies to solve problems flexibly and accurately, and achieve procedural fluency effectively.

Developing Strategic Competence in Application: Word Problems

Strategic competence refers to the ability to formulate, represent, and solve mathematical problems (NRC, 2001). The connections between mathematics and real world situations help students dispel the notion that mathematics is just about the numbers. In

addition, it encourages students' creativity. There are three levels of strategic competence: a) creating word problems according to learners' experience (Wiest, 2000); b) building representations that capture the core mathematical elements (NRC, 2001), which requires students to use representations to convey their mathematical ideas, in word problems; and c) solving problems strategically and flexibly; that is, students must not only be able to solve problems using different approaches but must also be able to solve nonroutine problems (NRC, 2001). Developing students' strategic competence can enhance their conceptual understanding as they construct their own word problems; it can also reinforce their procedural fluency for those effective procedures (Stiegler & Jenkins, 1989) as they try different ways to find solutions. Therefore, strategic competence reflected in mathematical applications in word problems is critical in mathematical learning. It shows the levels of students' conceptual understanding and procedural fluency as well as the ability of applying their understanding and procedural skills in word problem applications. In addition, strategic competence in word problem solving are also being used more frequently as assessment by various researchers (Bartlett, 2000; Callingham, 2003a; Wright, 2003; Bicknell, 2000). For example, Bocknell assessed students' problem-solving skills on different representations of the use of words, symbols and diagrams that explain and justify their responses (2000). These studies indicates that problem solving, an effective mathematics learning approach, promotes cognitive development and assessing student conceptual understanding (Anderson & White, 2003).

METHODOLOGY

Subjects

The participants were 153 pre-service teachers from six mathematics methods courses (K-8) at two universities in the Multiple Subject Credential Program in the West and East coast of the U.S. The criteria of inclusion for subjects were: (a) to be taking mathematics methods courses in spring 2011; (b) to have had at least two mathematics content courses at the college level before taking methods courses.

Procedures

This was an ongoing project for a two-semester period: (a) In Fall 2010, a pilot study was conducted in two mathematics methods courses in order to test the validity and reliability of the instruments; (b) In Spring 2011, the 153 participants were assessed using a pre-test and post-test. During the semester, the MSA approach was taught in all content areas. Participants explored different ways to create pictures to represent their understanding of mathematical concepts, learned various strategies to develop fluency in procedures, and designed word problems that relate to children's real life experiences while applying strategies to solve word problems. Multiple assessments were given during the semester to gauge the participants' understanding of the three components of the MSA approach in order to monitor students' progress and reinforce their PCK.

Data Collection and Instruments

Data on using the MSA approach were collected via two tests. In addition, data were collected from multiple assessments during the semester. The MSA questions in pre- and post-tests were adapted from a study of school-based professional development (Wu & An, 2005). The pre-and post-tests included a set of ten questions on number concepts, fractions, decimals, and percents. Each problem consisted of three parts: design a visual *model* for the problem using a representation; use computational *strategies* (procedures or rules) to solve problems; and create a word problem to represent a real-world *application*.

Data Analysis

A qualitative data analysis method was used to measure teacher learning and understanding of the MSA approach (Lincoln & Guba, 1985) and to identify the emerging themes of the effective approaches from various assessments during the semester. The open-ended responses from pre-service teachers on tests were coded, categorized, and compared for data analysis. A Paired T-Test was used to determine the statistical significance of the results on students' learning progress by comparing the means between pre- and post-tests. The Pearson Correlation Test was used to identify relationships between any two variables among the three components of the MSA model. The reliability and validity of the study were ensured by using triangulation of data, member checks, and peer examinations. The combination of both quantitative and qualitative methods is supported by numerous studies (Cronbach et al., 1980; Fielding & Fielding, 1986). Specifically, the inquiry nature and the complexity of pre-service teachers' knowledge of MSA require an in-depth qualitative study to validate, explain, illuminate, and interpret its characteristics and growth.

RESULTS

The Impact of the MSA Model on Pedagogical Content Knowledge and Achievement

The analyses of students' pre- and post-tests show that the pre-service teachers in this study made substantial progress in their PCK in conceptual understanding, procedural fluency, and application using the MSA approach. The results from Tables 1- 3 reflect the impressive growth of pre-service teachers' PCK in the three MSA areas.

Table 1

Comparison between Scores of Pre- and Post-Tests in the MSA Areas

#	Problems in Pre-/Post-Tests	Procedural Fluency *Strategy*				Conceptual Understanding *Model*				Creating Real-Life Problems *Application*				Word
		Pre-test (n = 153)		Post-test (n = 153)		Pre-test (n = 153)		Post-test (n = 153)		Pre-test (n = 153)		Post-test (n = 153)		
1	11/12 + 5/7 2/3 + 3/5	105	69%	150	98%	6	4%	126	82%	42	27%	137	90%	
2	3 – ½ - 2/3 5/7-1/4	102	67%	150	98%	22	14%	127	83%	54	35%	77	50%	

3	4/5 x 3/7 2/3 x 2/3	109	71%	142	93%	5	3%	115	75%	15	10%	102	67%
4	2/5 ÷ 6/7 1 2/3 ÷ 3/4	100	65%	130	85%	0	0%	85	56%	4	3%	113	74%
5	21.25 + 9.89 + 1.62 1.23 + 0.88	+144	94%	153	100 %	10	7%	143	93%	71	46%	145	95%
6	62.12 – 24.3 – 1.27 – 0.92	129	84%	151	99%	10	7%	146	95%	75	49%	139	91%
7	263.6 x 0.465 0.96 x 0.25	100	65%	131	86%	1	1%	60	39%	11	7%	105	69%
8	24.275 ÷ 1.25 1.20 ÷ 0.24	59	***39%***	131	86%	3	2%	105	69%	10	7%	126	82%
9	Change 7/40 to a percent Change 5/40 to a percent	71	***46%***	136	89%	1	1%	81	53%	31	20%	134	88%
10	Change 1.25 to a fraction Change 1.22 to a fraction	131	74%	141	92%	19	12%	114	75%	23	15%	121	79%

Procedural Fluency. The results from Table 1 show that the MSA approach helped the pre-service teachers enhance their scores by more than 20% in their knowledge in the areas of fraction operations, decimal multiplication and division, and changing fractions to percents. For example, in the pre-test, only 39% of students could calculate 24.275 ÷ 1.25 correctly, while in the post-test 86% of students performed the calculation correctly; in the pre-test only 46% students knew how to change 7/40 to a percent, while in the post-test 89% of students were able to perform the computation correctly.

Conceptual Understanding. Table 1 indicates that the pre-service teachers made great progress in all areas, especially in the areas of fraction addition and subtraction, fraction multiplication, decimal addition and subtraction, decimal division, and changing decimals to fractions and percents. More than a 60% increase in their scores in the above areas is observed. For example, in the pre-test only 4% of students knew how to create visual models for fraction addition like 11/12 + 5/7, while in the post-test 82% of students were able to create appropriate visual representations for fraction addition. Similar growth patterns are also found in fraction subtraction, multiplication, decimal addition and subtraction. However, although the pre-service teachers demonstrated progress in fraction division (0% in the pre-test vs. 56% in the post-test), decimal multiplication (1% in the pre-test vs. 39% in the post test), and changing fractions to percents (1% in the pre-test vs. 53% in the post-test), the growth in these areas is less than 60%, which illustrates the challenges and difficulties the pre-service teachers are facing in these areas.

Applications using Word Problems. Table 1 shows that the pre-services teachers gained notable growth with more than a 60% increase in their scores in applications in their PCK, in the areas of fraction addition and division, decimal multiplication and division, changing fractions to percents, and changing decimals to fractions and percents. For example, 97% of students created word problems for fraction division illogically, with misconceptions, in the pre-test, while in the post-test only 26% of students still had difficulties in creating a correct and logical word problem. In the pre-test, only 7% of students created decimal division word problems correctly. In contrast, 82% of students were able to create word problems in decimal division correctly in the post-test.

The Effect of the MSA Model on Learning Progress

A Paired Sample T-Test was employed to compare the changes and their statistical significance in the pre- and post-test scores. The SPSS output in Table 2 shows that the *p* value .000 in Table 2 is less than 0.01, which indicates a statistical significant difference between the pre- and post-test mean scores on the pre-service teachers' learning progress. Table 2 shows the results of three comparisons: 1) overall result between pre- and post- tests; 2) the results of comparisons in university 1; and 3) the results of comparisons in university 2.

Table 2
Output from the Paired Sample T-Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Total Pre & Total Post	-14.84241	4.44952	.35972	-15.55312	-14.1317	-41.261	152	.000
Pair 2	University 1 Pre & Post	-15.79452	4.07553	.47701	-16.74541	-14.8436	-33.112	72	.000
Pair 3	University 2 Pre & Post	-13.97363	4.62089	.51663	-15.00195	-12.9453	-27.048	79	.000

The Relationships between the Three Components of the MSA Model

The results of data analysis show that there are relationships and connections among the three components of the MSA model. In order to find out the significant relationships between the three components and draw a valid conclusion, a Pearson Correlation was employed separately for both pre- and post-tests. Table 3 shows the SPSS output of the Pearson Correlation for the pre-test, and Table 4 for the post-test. The results in Tables 3 and 4 indicate that the correlation between any two variables among MSA components is significant and that

they are positively related, suggesting that conceptual understanding is associated with procedural fluency, thereby enhancing the skill necessary for applications.

Table 3
The Correlations between the Three Components of the MSA Model for the Pre-Test

		Pre- Procedure	Pre-Model	Pre-Application
Pre- Procedure	Pearson Correlation	1	.154(**)	.281(**)
	Sig. (2-tailed)		.000	.000
	N	1530	1530	1530
Pre-Model	Pearson Correlation	.154(**)	1	.304(**)
	Sig. (2-tailed)	.000		.000
	N	1530	1530	1530
Pre-Application	Pearson Correlation	.281(**)	.304(**)	1
	Sig. (2-tailed)	.000	.000	
	N	1530	1530	1530

** Correlation is significant at the 0.01 level (2-tailed).

Table 4
The Correlations between the Three Components of the MSA Model for the Post-Test

		Post-Procedure	Post-Model	Post-Application
Post-Procedure	Pearson Correlation	1	.375(**)	.260(**)
	Sig. (2-tailed)		.000	.000
	N	1530	1530	1530
Post-Model	Pearson Correlation	.375(**)	1	.244(**)
	Sig. (2-tailed)	.000		.000
	N	1530	1530	1530
Post-Application	Pearson Correlation	.260(**)	.244(**)	1
	Sig. (2-tailed)	.000	.000	
	N	1530	1530	1530

** Correlation is significant at the 0.01 level (2-tailed).

The Learning Progress from the Examples on Pre- and Post Tests

The results of the analyses of the pre- and post-tests show that the MSA approach improved students' PCK in the three components in the areas of fractions, decimals, and percents. The following selected examples demonstrate the pre-service teachers' learning progress in models, strategies and applications.

Examples of Misconceptions on the Pre-Test:

Example 1.

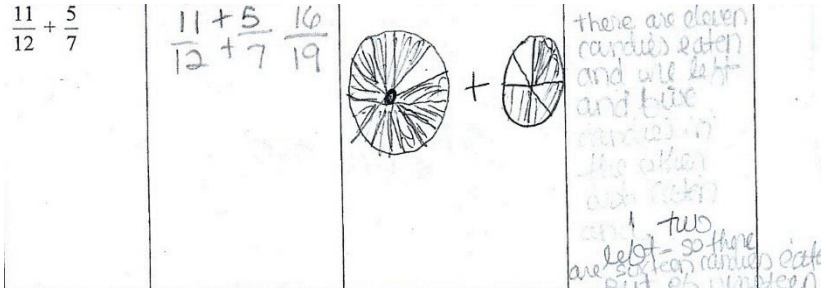

Figure 2. Misconception on fraction addition

Figure 2 shows that the student added the numerators and denominators across directly without finding the common denominator. This error computation indicates the misconception from the visual model: two circles do not have equal parts, which means the two fractions 11/12 + 5/7 do not have like unit fractions. The student did not know that fractions could not be added with unlike unit fractions.

Example 2.

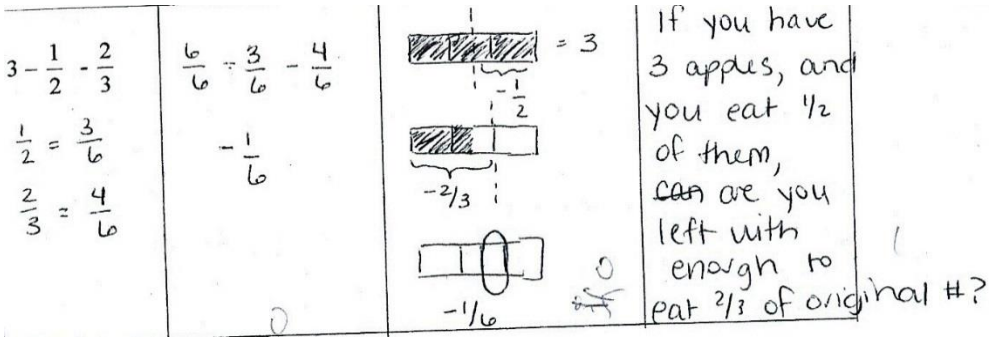

Figure 3. Misconception on fraction subtraction

This example in Figure 3 shows that the student made an error in converting 3 to the fraction 6/6. This error can be associated with a misunderstanding of the visual model. The student misunderstood ½ as ½ of three whole instead of one whole in the visual model, which led the student to create the word problem with misconceptions.

Example 3.

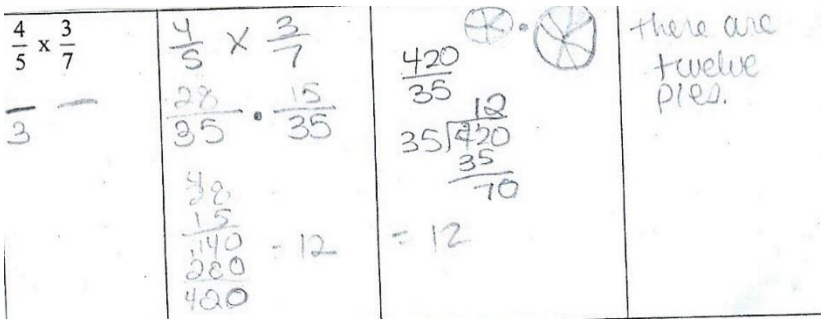

Figure 4. Misconception on fraction multiplication

Figure 4 shows that the student did an extra step by trying to find a common denominator first, which is not necessary and should not be used in multiplication of fractions. Although the student used the rule of multiplication of fractions for multiplying numerators after the first step, he/she did not apply the same rule for denominators. This error demonstrates that the student confused the rules of fraction multiplication with that of fraction addition. Consequently, learning the procedure without understanding resulted in an inability to model a visual representation and create a word application problem for fraction multiplication.
Example 4.

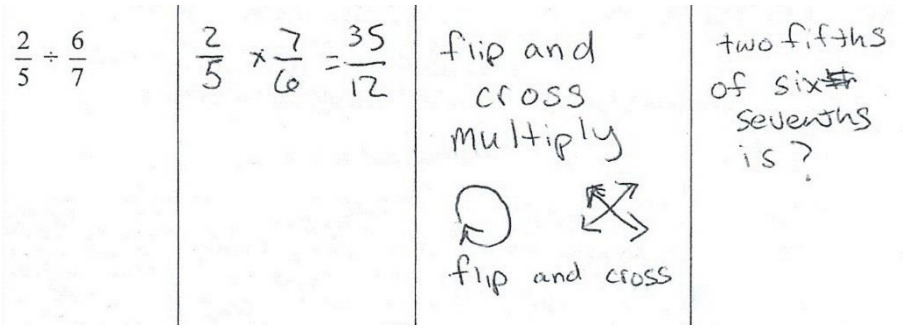

Figure 5. Misconception on fraction multiplication

Example 4 in Figure 5 shows that the student remembered the rule of fraction division "flip and cross multiply" incorrectly, which led to the error in computation. Learning the procedures without understanding resulted in an inappropriate visual representation and an inability to apply the learning in a word problem.
Examples of Learning Progress from the Post-Test:
Example 5.

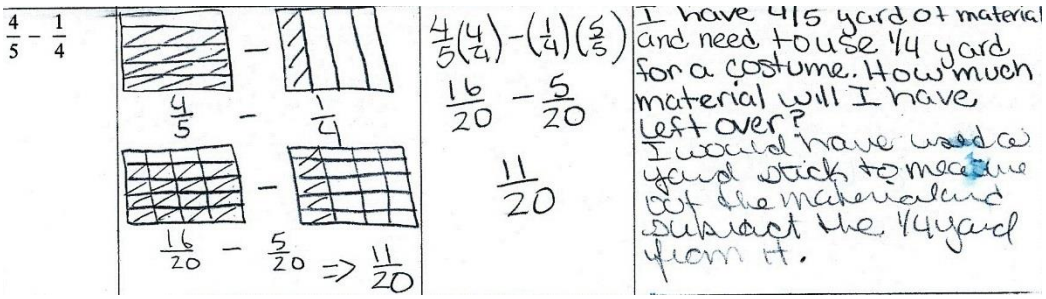

Figure 6. Learning progress on fraction subtraction

The visual model in Figure 6 indicates that the student understood that it is necessary to change the unlike unit fractions 1/5 and 1/4 to a like unit fraction 1/20 in order to subtract these fractions. The conceptual understanding of fraction subtraction guided the student to perform procedures of fraction subtraction correctly and directed the student to create a valid word problem in application.

Example 6.

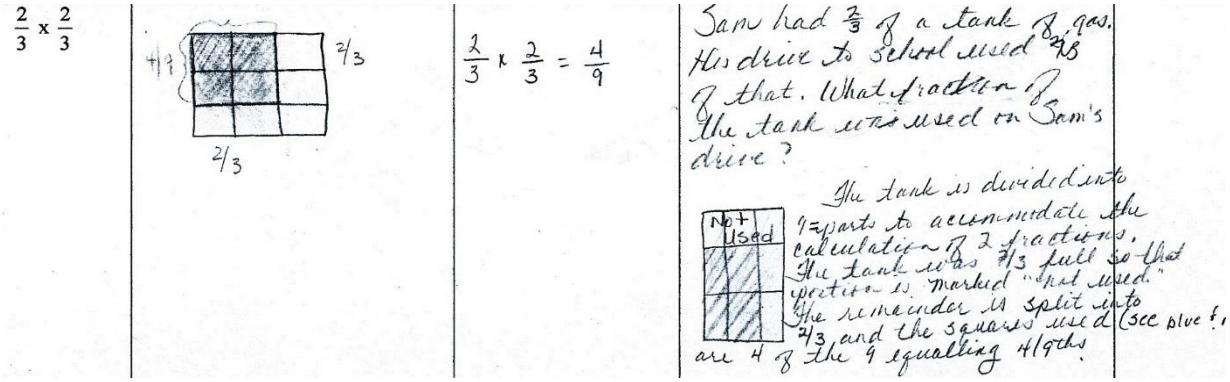

Figure 7. Learning progress on fraction multiplication

Figure 7 shows that the student understood the concept of fraction multiplication and was able to use an area model to represent it. The conceptual understanding not only helped the student arrive at the right solution from the computation but also helped him create a correct word application problem.

Example 7.

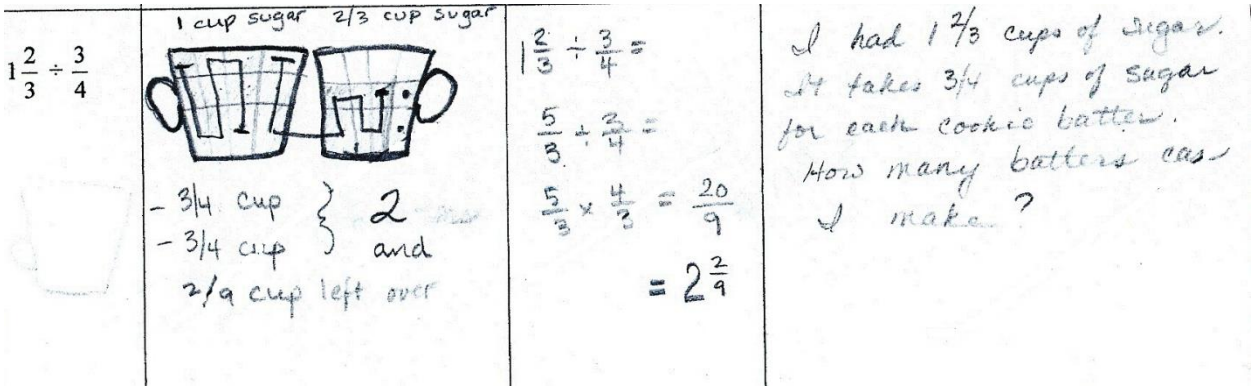

Figure 8. Learning progress in fraction division (caps)

The student created a very interesting and meaningful model for the fraction division problem in

Figure 8. The student understood that $1\frac{2}{3} \div \frac{3}{4}$ means to find out how many $\frac{3}{4}$s are in $1\frac{2}{3}$. The student used a cup with 12 parts to represent one whole, so $1\frac{2}{3}$ has 20 parts (shared areas). The cup model showed that $\frac{3}{4}$ of a cup has 9 parts, and that there are two groups of 9 parts and 2 parts left (shared areas with a dot), which results in $2\frac{2}{9}$ as the solution. The solid understanding of the concept of fraction division assisted the student in calculating $1\frac{2}{3} \div \frac{3}{4}$ in a correct way and also guided the student to create a correct word application problem.

In summary, the results of the analysis of the pre- and post-tests show that the MSA approach helped to improve students' achievement on the tests and enhanced their PCK, which was reflected in their work. This study shows that the MSA model is an effective approach that provides pre-service teachers with a strong knowledge base on how to teach mathematics effectively by focusing on three critical components.

DISCUSSION

Building a Measurable and Practical Model for Assessing Learning Progress

The results of this study show that the MSA approach can be used in mathematics methods courses as an effective structure of knowledge base as well as a measurable and practical model in assessing pre-service teachers' learning progress on PCK in models, strategy, and application. In order to help pre-service teachers learn mathematical concepts with a

deeper understanding, a variety of concrete and/or visual ***models*** must be introduced to convey mathematical concepts; to build fluency in procedures and computations corresponding to the concepts, various ***strategies,*** including basic and specific techniques, must be developed; to learn how to ***apply*** strategic competence in problem solving, different types of real-life word problems must be introduced. The three components of the Model-Strategy-Application approach demonstrate three important aspects of PCK that pre-service teachers need to master: (a) rich content of mathematics knowledge, (b) the approach to teaching and learning mathematics: model for conceptual understanding, strategy for procedural fluency, and application for word problem solving, and (c) the connections between the three components in content and pedagogy. In addition, the focus on the three components - conceptual understanding, procedural fluency, and application - through the Model-Strategy-Application approach in every content area not only provides pre-service teachers with strong PCK base, but also provides mathematics education courses with an effective and quantified assessment tool to measure students' progress in learning and teaching mathematics.

The Effects of the MSA Model on Enhancing Pre-Service Teachers' Knowledge

The findings from this study show that using the MSA model can enhance pre-service teachers' PCK. Table 1 shows that the pre-service teachers' PCK changed greatly with the MSA approach: 25% average growth in procedural fluency, 67% average growth in conceptual understanding, and 58% average growth in application. This indicates that the MSA model is an effective approach that provides pre-service teachers with the opportunity to improve their knowledge and to equip them with a strong knowledge base and proficient skills, both of which are needed to teach mathematics effectively in classrooms.

The following selected students' responses on the effects of the MSA model from the year-end reflection also provide the support for effects of using the MSA model, from students' own views. For example, Sarah analyzed the strengths of using the MSA model:

I think that the strength of this learning model is that we, as future educators, are exposed to diverse methods for solving the same problems. Familiarity with these methods is essential for addressing the diverse learning styles of our future students. This way, if a student is having difficulty solving a problem a particular way, we will have other tools in our belt that may be more comprehensible to that student.

Diana also believed that "one of the main strengths of this learning model was the various types of structures to solve word problems. It also allowed me to learn that because everyone has different ways of learning, there should also be different ways in which they can solve math problems." Glenn added that "I learned that providing more strategies and models for students provides a greater opportunity for all students to have the opportunity to learn. Students have many learning styles and providing more options will go further to addressing all learning styles." Jessica showed an example of the strategies "One of my favorite strategies was the fraction math on the grid chart. I really like seeing how to add, subtract, multiply and divide on the grid paper, and it really helped me [with] understanding fractions." Phana said, "From this model I learned to provide different strategies to develop procedural fluency."

Table 5 provides examples of students' responses on the effects of the MSA model in three areas: Knowledge gained from this model, difficulties before learning the model, and lower difficulty after learning the model. These examples confirm that active learning in the MSA approach as means of helping the pre-service teachers' overcome their deficiencies in content and pedagogical knowledge and changing their beliefs from their views (Klein, 2001, 2002a).

Table 5

Students' Reflections on the Effects of the MSA Model

What have I learned from this model?	Describe what parts were difficult to you before learning this model	Describe what parts are easy to you before learning this model
Heather: The model presented emphasized the importance of building children's conceptual and procedural knowledge, as well as relating math to real world situations through the use of word problems. I found this model extremely helpful, not only in my own understanding of math, but also in my ability to effectively teach math to children.	I have learned a great deal from this model, especially in terms of creating different representations to build conceptual understanding. I had no idea as to the type of visual representation or manipulatives that could be used to teach students about multiplying or dividing fractions. Different examples presented in class both by the teacher as well as by the other students, gave me an arsenal of good ideas to use in my future classrooms.	I now find developing manipulatives and creating word problems much easier than I did at the beginning of the semester. For example, I developed my own manipulatives to help students develop conceptual understanding of fractions and fraction equivalencies. I had no idea how to approach such a task at the beginning of the semester.
Jessica: The math can really be learned from this model. Especially for a visual learner, seeing the model done in class helped me understand how to really work out the problem.	I used to have problems with working out any fraction problems. I was always really afraid to use fractions in any type of computation. Now use the fraction rectangles, it really helped me visualize what was happening with the problem, and how to explain the problem to others.	Mostly, adding and subtracting fractions are the easiest now. Using the rectangle math had really enabled me to understand fractions and how to see it explained.
Christine: Conceptual understanding is an imperative learning model. Students can learn the basics of the problem and solve it through using simple methods of drawing the problem out and presenting the problem in a meaningful way.	Before learning this model, it was difficult for me to apply it. I am so used to solving math problems procedurally. For instance in $40 \div 8$, I would automatically know that it's 5, but conceptually solving it meant that I would somehow have to show $40 \div 8$ visually, showing that there are eight groups in 40, how many are in each group	Now it is easier for me to come up with quick-life math problems that relate to the original problem. In $40 \div 8$, I can easily say that I have 40 stickers, how many stickers will each of the 8 groups get?
Sarah*:* This model taught me the concepts behind math problems that I only knew procedurally. An example is the division of fractions. Simply changing it's reading to "how many times does 2/3	Before learning this model I had a hard time visualizing the division of decimals as well. I wasn't getting the big picture of what was happening during the process. For example, it was strange to me that the final	Simply using pictures of money to illustrate this concept made it more comprehensible to me because I was able to relate it to real life experience.

go into ½," made much more sense to me.	answer was larger than the numbers in the problem.	
Robert: This mode has helped me learn how to break up word problems into steps so that I am now able to work on the problem step by step instead of just trying to solve one huge problem.	Before learning this model I would just see word problems and I would automatically assume they were impossible to solve. I would try to work on it as a whole instead of taking it piece by piece and when I would solve the problem the answer would be wrong because of how I approached it in the beginning.	Now when I see a word problem I can confidently break it into steps instead of trying to solve it as a whole. Once I break the problem up into steps I am now able to see what I am being asked to solve more clearly than before learning this model.

The benefits of using the MSA model are also confirmed by various studies. The use of these visual models to help children understand mathematics is documented by Hiebert, Wearne & Taber, (1991) and Moss & Case (1999). The importance of procedural fluency is addressed by NCTM (2005) and identified as one of the five core components for mathematics proficiency by NRC (2001) and as one of the guiding principles in the California Mathematics Framework (2005). Providing word problems in meaningful contexts in facilitating students' adaptive reasoning and improving their understanding is supported by NRC (2001). According to NRC (2001), mathematics teachers must acquire the knowledge that integrates "knowledge of mathematics, knowledge of the development of students' mathematical thinking, and a repertoire of pedagogical practices…" (2001, p.428). Walshaw (2002) also calls for the "conceptualization of pedagogical content knowledge which recognizes the reciprocal constitution of knowledge and subjective experience" (p.655). However, these types of knowledge are not adequately acquired in most mathematics education courses in the US. The findings from this study provide a new and an insightful perspective to mathematics education courses. The findings indicate that to prepare pre-service teachers with solid knowledge for effective teaching, the MSA model is an effective approach: It not only improves pre-service PCK and builds a solid foundation in its knowledge base, but also provides a concrete and practical model for pre-service teachers on how to teach mathematics effectively in the ways addressed by the MSA model.

The Relationships between the Three Components of the MSA Model

The findings from this study indicate that the three components of the MSA model are all interrelated and equally important; ignoring one or the other will result in the lack of proficiency in teachers' knowledge. The MSA model suggests that with a deep conceptual understanding, students will be able to construct visual representations that help them build mathematics ideas and perform computations correctly, and in turn, it will assist students in using the understanding and skills from procedural development to create and solve word

problems in applications. Consequently, in the process of solving word problems, children have opportunities to build a repertoire of procedures for computation (NRC, 2001) and to further develop their conceptual understanding. However, the evidence from this study suggests that learning mathematics while focusing only on procedures without acquiring conceptual understanding will result in students' inability in applying knowledge to create and solve word problems in applications.

THE EDUCATIONAL SIGNIFICANCE

Since teacher preparation program has been found as one of the major factors relating to students' mathematics learning in TIMSS and other studies, this study's thorough examination of the effectiveness of the MSA approach will be of benefit to mathematics teacher preparation programs in the U.S. as well as other countries. In the article *Research Trends in Mathematics Education,* Walshaw and Anthony indicate (2003) that pre-service sites account for about 11% of the context of all research from 2000 to 2003 in Australasia. Among these studies, many of them reported on pre-service teachers' subject knowledge and the affective domain. Walshaw and Anthony call to take "a step further to shape the nature of curricular and pedagogical decisions and the content of our postgraduate courses" (2003). The NRC (2001) confirms their view that "one of the critical components of any plan to improve mathematics learning is the preparation and professional development of teachers" (p.428). The challenges facing mathematics teacher preparation include looking for new models that have a clear vision and a practical and measurable format to improve pre-service teachers' knowledge. Although the MSA approach places a strong emphasis on PCK, its structure provides a concrete and practical guideline for effective instruction for both pre-service and in-service teachers. The results of this study provide insight on the dilemma in the current debate on teachers' knowledge (Walshaw, 2002; Ball et. al. 2005) and a new means with which to reach a common ground in k-12 math education. In addition, the MSA approach provides mathematics educators with an effective and quantified assessment tool to measure their students' learning progress.

To maximize K-12 students' capacity for learning mathematics, a teacher must learn to balance the three components of the MSA approach. Focusing on one and ignoring another will result in a lower proficiency in mathematics in general. K-12 teachers must possess conceptual understanding, fluency in procedures, and strategic competence in applications in order to effectively help their students attain proficiency in mathematics.

This study examined an effective way to develop pre-service teachers' PCK by using the MSA approach, which builds conceptual understanding, develops fluency in procedures, and improves strategic competence in applications in word problems. Undoubtedly, this inquiry into the knowledge of effective teaching, along with the development of the three parts of MSA in each mathematics content area, especially the examination of the effects of this new model of teaching and the investigation of the measurable and practical assessment mode for pre-service teachers' PCK, will be a significant step for contributing insightful ideas for the development of mathematics teacher preparation programs in the U.S. as well as other countries.

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基于潜在语义分析的中药分类技术

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Abstract: *Modernization of theories of traditional Chinese medicine (TCM) is a key issue for the development of Chinese medicine. As TCM concepts are too vague and lack precise definition, it is difficult to test those theories by modern technologies. Methods of TCM classification are not accepted by Western medicine so far. Because of the diversity and complexity of Chinese herbal medicines, the molecules of Chinese herbal medicines are difficult to be separated, and efficacy is difficult to be verified and classified by biological and chemical methods. In order to verify the scientificity of TCM classification, molecular properties can be studied by their spectrum, and be combined with latent semantic analysis technology and weighting method which are widely used in the Internet search engine. 48 Chinese herbal medicines belonging to four kinds of Chinese herbal medicines: nourishing yin, tonifying yang, invigorating qi, and enriching blood, are analyzed through NIRS, and the results are almost the same as the TCM classification.*

Key words: Chinese herbal medicine, latent semantic, NIRS

中医现代化需要采用科学技术手段检验中医的理论,但相关概念缺乏清晰的定义,许多信息无法用语言传递,也无法运用现代实验手段进行验证,因此,中医现代化过程中遇到很多困难。要将中医的概念清晰化,理论实体化是中医发展过程中需要解决的关键问题。如中医学的根本——阴阳概念缺乏清晰的内涵。滋阴壮阳药物究竟依据何种生理指标进行划分,没有精确说明,无法为实验所验证,因此,这种药物的分类方法不为西方医学所承认。但随着信息科学和计算机技术的发展,可以采用相应技术手段提取这些类别中药的共同特征,明确分类的客观依据,以说明中药分类的科学性。

1 中药分类相关研究

如何提取中药传统分类方法的科学依据是中医药研究的热点之一。部分研究集中于分析中药药效的物质基础,如蛋白质、糖类、脂类、微量元素等物质与药效的关系,尤以微量元素研究居多。胡氏等[1]将 56 味药材分成清热解毒药、辛凉解表药和利水渗湿药 3 类,应用线性判别方法分析 32 种微量元素含量和类别的关系,获得了比较高的准确率。高氏[2]针对 20 种植物药,使用主成分分析(PCA)结合神经网络,建立了钙、锰、铜、锌等 4 种微量元素含量与中药材清热解毒类、活血化瘀类和止血类药物之间的关系,并对测试集中的 3 组数据进行划分。但微量元素只是中药效用物质中的极少部分,

对非微量元素和功效的研究还相对缺乏。另外,还有一类研究中药的功效描述归类问题。彭氏等[3]使用神经网络分析中药复方功效,将中药脾胃类药方库对应约 700 余种药物的相对剂量为输入,输出为专家整理的 133 种不同功效,采用属性归约算法(SARM),实现了中药方剂功效的分析系统。有报道对中药药性理论相关基础问题进行深入研究,选择常用的 1725 种药物,将微凉、凉、微寒、寒、大寒等 1067 种药物归入寒性,将微温、温、热、大热等 658 种药物均归入热性,根据主治功效对药材进行寒热分类[4-5]。这些研究有一定意义,但缺乏客观依据作为药效的分类基础。

药物之所以有效,是因为药物分子基团具备特定空间构型,而不同构型的分子基团对光具有不同的特征吸收频率,我们可以把分子基团的结构特征转换到光谱中进行研究。近红外光谱分析技术可以获得中药功能基团化学结构的有关信息,Chen 等[6]建立了预测甘草中指标性成分浓度的光谱校正模型; 另有研究对三七中有效成分及总皂苷[7-8]、冬虫夏草中甘露醇[9]、氨基酸[10]及黄连中生物碱[11]进行了含量测定,均得到了准确结果。杨氏等[12]选用分光光度法对银杏叶样品中黄酮类化合物进行分析,利用定量分析中的自动优化功能选择出最佳谱图区、最佳光谱预处理方法及最佳主要成分维数,通过交叉分析验证得出相关系数大于 0.90,预测误差相对较小。范氏等[13]以高效液相色谱法测定了 3 个不同产地大黄中大黄素、大黄酚、大黄酸、芦荟大黄素的含量,并用 41 个样品建立近红外光谱模型,用于预测大黄样品中大黄素、大黄酸、芦荟大黄素等主要活性成分的含量,并与高效液相色谱法测定结果相比较,预测均方差最大为 0.139。叶氏等[14]采用傅立叶变换红外光谱法分析了国家药典中 5 种淫羊藿的质量,获得满意结果。

但由于中草药含有包括纤维素和水分等许多共同物质,光谱相似性很高,多种药物光谱之间会产生严重重叠,经典的聚类算法很难将不同药物区分开,更难准确分类。运用各种智能算法通过训练虽然可以对中药的光谱进行分类,但缺乏直观的分类依据。近红外光谱结合潜在语义分析(LSA)的聚类分析技术,可以较好地完成滋阴、壮阳、补气、补血类中药的分类。

2 基于潜在语义分析的分类技术

LSA 是互联网搜索引擎中广泛使用的成熟技术,能提取词与词之间潜在的语义关系,并把每个文档视为以词汇为维度的空间中的点,通过奇异值分解压缩搜索空间,根据词语的语义相关性将文档聚类,检索速度快,查询精度高。在化学成分未完全明了的情况下,应用近红外光谱分析技术对中药进行分析,通过吸收峰的位置和强度间接反映中药的化学构成信息。但中药成分很多,可产生数个吸收峰,即多个维度,难以直接解析。应用 LSA 技术,将每味中药当作海量文档中的一篇,将吸收峰的位置当作文档的关键词,将吸光度当作文档中关键词的出现频率,中药中化学成分的效用相当于词语的语义,一种成分有多种效用相当于词汇的一词多意,相近的功能基团相当于词汇的同义词。我们无需明确每个功能基团的具体结构和效用,采用 LSA 方法可提取相近功能的基团,并将多个波段光谱构成的高维空间压缩到低维空间,使复杂光谱得到简化和解析。根据光谱反映的中药化学基团结构信息对中药进行聚类分析,以信息学的技术手段,将基于经验分类的中药依据光谱运用实证方法予以研究,以判明其科学性。

3 中药近红外光谱分类

以补益类中药为例,中医将补益类药物分为 4 类,即补气、滋阴、补血和壮阳。补气药选麸炒白术、生白术、大枣、甘草、黄芪、人参、山药、西洋参、白扁豆、刺五加、党参、红景天、绞股蓝、太子参 14 味,滋阴药选百合、枸杞子、麦冬(浙)、麦冬(川)、南沙参、石斛、北沙参、墨旱莲、黄精、女贞子、天冬、玉竹 12 味,补血药选白芍、当归、何首乌、龙眼肉、熟地黄 5 味,壮阳药选巴戟天、杜仲、海参、韭菜子(生)、鹿茸、菟丝子、淫羊藿、补骨脂、骨碎补、胡芦巴、韭菜子(炒)、芡实、肉苁蓉、沙苑子、蛇床子、续断、益智仁 17 味。对 4 大类药物 48 种药材进行实验分析,基本涵盖了中医书籍上列出的常见补益类中药。

对上述中药药材的光谱进行聚类分析,每种药材 100 个样本,共 4800 个光谱(以补血类药物当归为例,100 个当归样本的近红外光谱图见图 1),检验 4 类药物是否具备明显的光谱特征差异。对光谱数据直接采用 K-Means 聚类方法将药材分为 4 类。原始光谱分类的正确率仅为 10.83%。采用潜在语义分析方法对数据分析后采用 K-Means 聚类,分类正确率为 31.08%,比直接采用原始数据分类正确率高,但仍不理想。分析分类正确率低的原因,发现药材的不同样本峰位存在漂移,有些甚至不出现峰值。为简化分析难度,避开不同样本间的差异问题,我们将每种药材取 1 个代表性数据进行分析。

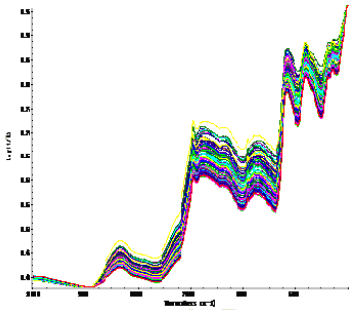

图 1　当归近红外光谱图

3.1　代表性光谱的选择

如果只采用 1 个样本数据,可以使用平均值或中位值作为代表。由于植物成分不均一,存在异常样本, 鉴于异常样本会在平均时引入较大误差,我们采用中位值作为数据代表。PCA 可以找出光谱的中位值,还可根据样本与中心位置的距离大小剔除异常数据。因此,我们运用 Matlab 编程,对每种药材的 100 个光谱数据进行 PCA,选取第一、第二主成分绘图,并对数据进行标号,每种药材选择最靠近中心的数据作为代表。图 2 为壮阳类药物淫羊藿的 PCA 图,82 号样本最靠近坐标原点,选取 82 号为淫羊藿光谱样品的代表。

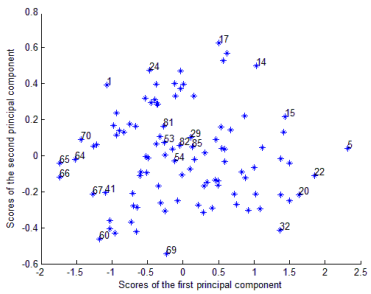

图 2　淫羊藿 PCA 图

48 个药材样本的近红外光谱见图 3 所示。

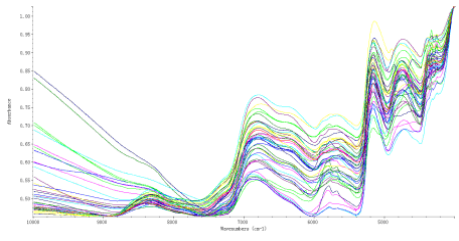

图 3　中药样本近红外光谱图

对药材的代表性光谱数据采用 LSA 方法结合 K-Means 聚类算法,将药材光谱分为 4 类,聚类结果见图 4。分类正确率为 48.33%,仍有待提高。

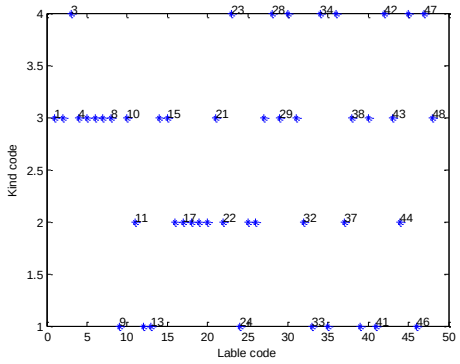

图 4　中药光谱分类结果图

3.2　数据加权处理

由于在无先验信息的情况下正确归类率太低,LSA 技术考虑词语对文档分类的重要性不一致,通过大量文本训练后对数据进行加权处理可以极大地提高分类正确率。同样，光谱中并非每个波段提供的信息都重要,如药材中常见的水分和纤维素等成分权重应该很低,通过训练集统计峰位对应成分对功效的重要性,将 LSA 中的权重定义借鉴到光谱分析中。考虑词语的对文档语义空间贡献程度的不同,LSA 给予权重函数 $W(i,j)$,对词频矩阵 X 进行加权转换,得到新矩阵 X^*,对 X^*进行奇异值分解后进行聚类运算。权重计算公式如下：

$$W(i,j)=LW(i,j)\times GWT(i)\times GWD(j) \qquad (1)$$

局部权重 $LW(i,j)$用来独立描述词语 i 在文档 j 中的重要程度[15]。它有 2 种计算方法：

1)词频(term frequency) tf_{ij} 直接作为局部权重,记为

$$LW_1(i,j)=tf_{ij} \qquad (2)$$

2)采用词频的对数坐标作为局部权重,记为

$$LW_2(i,j)=\log_2(tf_{ij}+1) \tag{3}$$

全局权重 *GWT(i)*用来描述词汇在整个文档集中的重要程度。词语全局权重有 2 种计算方法：

1) GF-DF 词语全局权重

$$GWT_1(i)=\frac{df_i}{gf_i} \tag{4}$$

2) 倒排文档频(IDF)

$$GWT_2=1+\log_2\left(\frac{ndoc}{df_i}\right) \tag{5}$$

文档全局权重 *GWD* 定义为：

$$GWD(j)=\frac{H(term)-H(term\mid doc_j)}{H(term)} \tag{6}$$
$$=1-\frac{H(term\mid doc_j)}{H(term)}$$

其中 $H(term)=-\sum_{i=1}^{m}p(term_i)*\log_2 p(term_i)$ (7)

$$=-\sum_{i=1}^{m}\frac{gf_i}{sgf}*\log_2\frac{gf_i}{sgf},$$

$$H(term\mid doc_j)= \tag{8}$$
$$-\sum_i p(term_i\mid doc_j)\log_2 p(term_i\mid doc_j)$$

$p(term_i\mid doc_j)$是条件“文档 j 出现”成立的情况下“词语 i 出现”的概率,计算方法是：

$$p(term_i\mid doc_j)=\frac{tf_{ij}}{dl_j} \tag{9}$$

上式中各符号定义如下：

tf_{ij}——词语 i 在文档 j 中出现的频数；取药物光谱峰值处对应的吸光度值。

df_i——文档集中出现词语 i 的文档个数；对应某波段上出现峰值的药物个数。

gf_i——在整个文档集中词语i总共出现频数；对应所有药材各波段出现峰值次数的累加和。

$ndoc$——文档集中文档数；对应药材数据总个数。

sgf——在文档集中所有词语出现频数之和,有$sgf=\sum_{i=1}^{m} gf_i$；

dl_j——文档j的长度,即文档j包含的词语总数；对应某药材在全波段上出现峰位个数的总和。

不同定义组合有4种加权方法：加权法1权重为公式(2)、(4)、(6)的乘积，加权法2权重为公式(3)、(4)、(6)的乘积，加权法3权重为公式(2)、(5)、(6)的乘积，加权法4权重为公式(3)、(5)、(6)的乘积。

考虑到词语对分类依据的贡献不同,只在某类文档中出现的词重要度高,在几类文档中都出现的词重要度低,而在所有类别文档中都出现的词对分类没有贡献。考虑词汇在分类依据中的重要度不同,进一步定义词语的重要程度为[15]：

$$W(i,j)=LW(i,j)*GWT(i)*GWD(j)*CATA(i) \quad (10)$$

其中

$$CATA(i)=10*\log_2(4/CATEGORY(i)) \quad (11)$$

$CATA(i)$——词汇i在各类中档中的重要性。本课题中有4种中药,如果1个峰位在4种中药光谱中都出现,则其在辨别类别中作用小,权重低,如果其只在某一类药物光谱中出现,则其重要程度很高。因此,某峰位对应物质的重要性与其在4类中药光谱中出现的类次倒数呈正相关关系。

$CATEGORY(i)$——为峰位出现在4类中药材中的类次。只在1类中出现,$CATEGORY(i)$为1,则其词汇重要度为20,在2类中出现,$CATEGORY(i)$为2,则其词汇中重要度为10,如果峰位在4类中都出现,$CATEGORY(i)$为4,则其词汇中重要度为0。此权重与前面4种权重计算方法一一相乘,两者一起构成8种权重计算方法。如加权法5权重为加权法1定义的权重与(10)相乘,即公式(2)、(4)、(6)、(10)的乘积，其余以此类推。根据8种权重计算方法对数据进行加权并根据LSA方法进行计算后聚类结果正确率如表1所示。

表1　各种加权方法聚类正确率

加权方法	正确率(%)
加权法1	56.25

加权法 2	52.08
加权法 3	56.25
加权法 4	50.00
加权法 5	58.33
加权法 6	47.91
加权法 7	60.42
加权法 8	72.75

可见,第 8 种加权方法聚类正确率最高,达到 72.75%,分类结果见图 5。

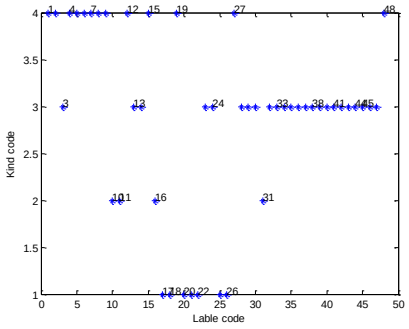

图 5　中药光谱加权分类结果图

4　讨论

根据以上结果,可以发现不同加权方法对分类的正确率影响不同,虽然加权方法普遍提高了分类正确率,但加权法 6 的分类正确率还低于加权前,表明不合适的加权方法也会使分类正确率降低。因此,选择合适的加权方法和算法是提高中药光谱分类正确率的关键。运用 LSA 结合加权法 8 可以达到最大的分类正确率。根据确定的权重系数,可以区分各个波段对光谱分类正确率的贡献,优选出权重高的波段对应的成分作为中药药效的物质基础及作为中药分类的客观依据。但鉴于中药光谱数据库的缺乏,目前还不能确定特定波段对应的确切成分。因此,今后还应进一步改进算法,提高分类正确率,并结合化学实验确定重要特征波段对应的单体成分。

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How to Connect the Opening Problems to the Key Ideas in High School Mathematics Lessons: A Case Study in Shanghai-China

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Abstract. *This case study intends to provide an in-depth examination of the teaching practice exhibited by the expert mathematics teachers in Shanghai high schools to show how Chinese expert teachers coherently connected the opening problems to the key ideas in high school mathematics lessons. Six expert mathematics teachers in five high schools were selected and one lesson of each teacher was videotaped and analyzed using qualitative data analysis methods. The results indicate that the opening problems in the new lessons were carefully designed to naturally connect the prior knowledge and new knowledge while the opening problems in the review lessons were varied throughout the lesson to reveal and string the key ideas. The opening problems play an important role in making the lesson coherent from both content and process aspects.*

Key words: Chinese classroom, instructional coherence, teaching with variation, lesson opening, mathematics opening problems, connection between knowledge

Introduction

Mathematics learners in Shanghai-China achieved the highest mean score in PISA 2012 (Organization for Economic Co-operation and Development [OECD], 2014), which assessed the competencies of 15-year-olds in reading, mathematics and science (with a focus on mathematics) in 65 countries and economies. "To better understand and ultimately improve students' learning, one must examine what happens in the classroom" (Hiebert, Gallimore, Garnier, Giwin, Hollingsworth, Jacobs, Chui, Wearne, Smith, Kersting, Manaster, Tseng, Etterbeek, Manaster, Gonzales & Stigler, 2003, p. 2) since it is widely accepted that teaching makes a difference in students' learning (Brophy & Good, 1986; Hiebert, 1999; National Research Council [NRC], 1999).

Existing studies have revealed some features of teaching practices in East Asia (e.g. Hiebert et al., 2003; Huang & Leung, 2005; Leung, 2005; Stigler & Perry, 1988; Wang & Murphy, 2004). When researchers examined the structure and content of the mathematics lessons, they found that coherence was an impressive feature of mathematics lessons in East Asia. For instance, Japanese lessons seemed to focus on one or sometimes two key problems in a lesson, through which the teacher led students into an understanding of mathematical concepts and relationships (Kawanaka, Stigler, & Hiebert, 1998). A recent case study on fraction division revealed that Chinese teachers tried to help students build knowledge connections and coherence through mathematics instruction (Chen & Li, 2010).

On one hand, it is acknowledged that learning is more meaningful when connections are

established (Stein & Smith, 2011) and coherent mathematics lessons can help students better connect and understand conceptions (Fernandez, Yoshida & Stigler, 1992). For example, in California Common Core State Standards for Mathematics (CCSSM) Framework, coherence is regarded as one of the three major principles on which the CA CCSSM is based. It is indicated that instruction should be attentive to learning across grades and should link major topics within grades (California State Board of Education [CSBE], 2013). Recent evidence suggests that the implementation of curriculum is depending on classroom teaching （CSBE, 2013）. The existing studies on the coherence within mathematics classroom in East Asia pay more attention to the whole lesson. However, the opening problems posed at the beginning of the lesson, like that in Japan, may play a decisive role in constructing a coherent lesson. Larson (2002) stated that every effective lesson has a distinct beginning, and two things always happen at the beginning regardless of how a mathematics lesson starts. First, the opening activities are designed to access students' prior knowledge. Second, it is important to share with students the lesson's mathematics objective and the reason for learning it. In well-executed lessons, the teacher poses a problem and ensures that all students understand the context and expectations (Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013). However, few studies revealed how to design appropriate opening problems in teaching practice so that the prior knowledge and key ideas can be well connected, especially at the high school level.

Since expert mathematics teachers are usually better at providing "low threshold, high ceiling" problems, identifying key ideas, presenting them in several ways, and highlighting connections among key ideas (Findell, 2007), this study attended to provide an in-depth examination of the teaching practice exhibited by the expert mathematics teachers in Shanghai high schools to show how they posed mathematics problems at the beginning of the lesson and how the problems coherently related to the key ideas of the lesson.

Related Literature

Coherence in Mathematics Lessons

Coherence is the logical connection that readers or listeners perceive in a written or oral text. When used in linguistics, it means the property of unity in a written text or a segment of spoken discourse that stems from the links among its underlying ideas and from the logical organization and development of its thematic content (Coherence [Def. 5]., n.d.). Wang and Murphy (2004) claimed that coherence referred to the role of unity or connectedness of speech and behavior in the creation of meaningful discourse and could describe the structure of instructional topics as well as classroom behavior and social values. A metaphor of coherence was that a good story is more than just a sequence of events and the events must be organized and interconnected logically (Stein & Glenn, 1982). A good story is easy to understand and remember because each event has meaning in relation to other events and to the protagonists' goals. A mathematics class, like a story, consists of sequences of events related to each other and to the goals of the lesson (Stigler & Perry, 1988). Similarly, Fernandez, Yoshida and Stigler (1992) proposed that a lesson with clear goals and interrelated events is a well-structured lesson and likely to be represented coherently.

There are different ways to approach coherence when teaching mathematics. Teachers could provide their students with a certain coherent vision of mathematics knowledge through

well-structured activity and discourse for the clarity of the lesson objectives (Segiguchi, 2006; Tomlin, Forrest, Pu & Kim, 1997). In the TIMSS video studies, Hiebert et al. (2003) examined a variety of features related to coherence of eight-grade mathematics lessons in different countries although the various dimensions of lesson coherence are not necessarily interdependent, such as shifts among topics, ways in which key ideas were clarified (lesson goal and summary statements) and the (implicit and explicit) interrelation of all mathematical components of the lesson (A rating of 1 indicated a lesson with multiple unrelated themes or topics and a rating of 5 indicated a lesson with a central theme). Especially, they pointed out that "the mathematics content itself can contribute to the clarity and coherence of lessons. Because much of the content was carried through the mathematics problems of the lesson, the clarity and coherence of lessons might have been influenced by the way in which the problems within lessons were related to each other" (p. 76). The problems in the mathematics lessons were classified into four basic kinds of relationships (repetition, mathematically related, thematically related and unrelated) to investigate how mathematics is related over the lesson. The result showed that eighth-grade mathematics Japanese lessons contained a higher percentage of problems per lesson (42 percent) that were mathematically related than lessons in all the other countries.

As mentioned before, Asian mathematics class was distinguished by its coherence in many comparative studies. For example, after observing elementary mathematics lessons in Japanese, Taipei and the United States, Stigler and Perry (1988) found that the logical flow of an Asian class is rarely broken to pursue less mathematically important business. Both Japanese and Taipei lessons devoted an entire forty-minute mathematics class to the solution of only one or two problems and an unchanged topic. Moreover, teachers explicitly pointed out to children the relationships that obtain between different segments within a lesson and between different lessons. Some other studies on coherence were based on video lessons enable the examination of complex processes. For example, the results from TIMSS video studies found that Japanese eighth-grade mathematics lessons focused on presenting new content through solving a few problems (Hiebert et al, 2003). Shimizu (2007) revealed that the feature of "summing up" and the explicit classroom discourse in Japanese lessons can help make the lesson consistent and clear. Another video study found that 90% of the Hong Kong eighth-grade mathematics lessons were judged to be thematically coherent, with the remaining 10% moderately thematically coherent (Leung, 2005). Chen and Li's study (2010) of mathematics video lessons in China on fraction division demonstrated the coherence within and between lessons in terms of its content and process and the teacher's use of classroom discourse. But few studies have talked about the coherence of mathematics lessons at the high school level.

Problems Used in Mathematics Lessons

Mathematics Problems play an important role in mathematics teaching and learning since all mathematics is created in the process of formulating and solving problems (Kilpatrick, 1982) and "a considerable portion of lesson time in every country was spent solving mathematics problems" (Hiebert et al., 2003, p. 41). A problem "is defined generally as a situation in which a goal is to be attained and a direct route to the goal is blocked" (Kilpatrick, 1985, p. 2). A mathematical problem in teaching is appreciably considered as a task in a social-anthropological perspective (Kilpatrick, 1985). Zeitz (2007) differentiated problems from exercises by demanding much thought and resourcefulness before the right approach is found. In the TIMSS video study

(Hiebert et al., 2003), problems were defined as events that contained a statement asking for some unknown information that could be determined by applying a mathematical operation, except for simple questions asking for immediately accessible information.

Schoenfeld (2011) contributed the successful problem solving to four factors: knowledge base, problem-solving strategies, monitoring and self-regulation, and beliefs. Accordingly, students can improve their knowledge, strategies, self-regulation and beliefs through problem-solving. Especially, researchers acknowledged that problems are helpful to establish connections within a lesson. For example, the process of solving problems encourages students in realizing the relevance of their learning experiences, applying knowledge and connecting to prior knowledge (Kain, 2003). Sequences of mathematically related problems might provide good opportunities for students to construct mathematical relationships and to see the mathematical structure in the topic they are studying (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, Olivier, & Human, 1997; NRC, 2001).

It is one of the tacit considerations that how to connect problems to one another and to other aspects of the curriculum when teachers are selecting problems (Hmelo, 1998). Researches showed that mathematics teachers in East Asia did better at this aspect than their west counterparts (e.g. Hiebert et al., 2003; Wang & Murphy, 2004). Japanese mathematics lessons contained the least number of independent problems worked on in each lesson and the longest time spent on each independent problem. Furthermore, a higher percentage of problems per lesson in Japan were mathematically related other than repetitions than that in other countries (Hiebert et al., 2003). These problems were related to a preceding problem in the lesson in a mathematically significant way, including "using the solution to a previous problem for solving this problem, extending a previous problem by requiring additional operations, highlighting some operations of a previous problem by considering a simpler example, or elaborating a previous problem by solving a similar problem in a different way" (p. 76). Korean mathematics lessons are similar with the Japanese ones; most of them began with a meaningful (in context) problem (Grow-Maienza, Hahn, & Joo, 2001). Stigler and Perry (1988) pointed out that the problems used in Asian class served to provide topical continuity across the different segments of a lesson. "In such a lesson, students might discuss the features of the problem, solve the problem using alternative methods, discuss and evaluate the alternative solution strategies, model the problem using manipulatives, and so on" (P. 47). Other studies also found that Chinese teachers tended to devote an entire 40-minute class to the solution of one mathematics problem and discuss a single topic from multiple perspectives (Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999). Yet, existing study findings seem to be mostly disconnected with instructional practice. Few studies have demonstrated the detailed ways to use problems, especially opening problems, to construct a coherent lesson.

Variations in Chinese Mathematics Lessons

It is important to note that sticking to one problem does not imply a boring class that lacks variety (Stigler & Perry, 1988). Gu and his colleagues provided a framework named as *teaching with variation* to show the Chinese way of promoting effective mathematics learning (Gu, Huang, & Marton, 2004). They introduced two concepts of variation：*conceptual variation* and *procedural variation*. The conceptual variation refers to various examples used to clarify the connotation and denotation of concepts so that teachers can constitute "a space of variation for

students to experience critical aspects of the object of learning, and enhancing the understanding of the essential feature of the object" (p. 340). The procedural variation, which is closely related to this study, intends to "pave the way to help students establish the substantive connections between the new object of learning and the previous knowledge" (p. 341).

How can procedural variation help students arrive at solutions step by step and form connections among different concepts? Firstly, Chinese teachers provide a process for formation of concept stage by stage. Secondly, Chinese teachers convert unsolved problems into solved problems. Last but not least, Chinese teachers try to establish a system of mathematics experience through three types of variation in relation to problem solving (Gu, Huang, & Marton, 2004). The first one is *varying a problem* (一题多变)， which means "varying the original one as a scaffolding or extending the original problem by varying the conditions, changing the results and generalization". This kind of variation is often recognized as a method to develop students' capacity of problem posing (Silver, 1994). But in Chinese mathematics classroom, teachers rather than students vary a problem to facilitate students' deep thinking about the mathematical ideas related to the series of problems. The second type is *multiple methods of solving a problem* (一题多解). Ma (1999) reported that students are often encouraged to solve a problem in several ways in Chinese elementary classrooms. There was the same finding in Japanese classrooms that students worked on a problem in a number of different ways (Stigler & Hiebert, 1999). An important segment of the teaching with such variation is to comment on and summarize different approaches. The last type is *multiple applications of a method* (一法多用), which means to apply a method of problem solving to a group of similar problems. All of the three types of procedural variation are considered as mathematically related in the TIMSS video studies (Hiebert et al, 2003). A case study in a seventh grade mathematics lesson in Shanghai demonstrated how procedural variation helps review previous knowledge, introduce and consolidate new knowledge, and learn strategies of problem solving as well (Huang & Leung, 2005).

Taken together, existing studies suggest that a coherent instruction in mathematics classrooms may be one of contributions to students' higher achievement in mathematics in East Asia. The problems used in mathematics lessons provided a kind of coherence to connect segments and show relationships. Chinese mathematics lessons, particularly, consist of procedural variation which leads to the connections among problems, prior knowledge and new knowledge. However, with regard to high school mathematics teaching, the issues how multiple activity segments are constructed by the opening problems in a single lesson and how the central theme is conducted through the variation of the opening problems were barely discussed in the previous studies, and need to be explored.

In this study, the relationships established between the opening problems and the key ideas of mathematics lesson by expert mathematics teachers in Shanghai were analyzed through video lessons to promote further in-depth study on essential instructional practice that may provide guidelines and models on effective instruction to mathematics teachers, especially prospective mathematics teachers. In this study, the term Chinese Expert Mathematics Teachers refers to the highly prestigious teachers with outstanding effectiveness of instruction in school mathematics in China. The mathematics problems in this study include real-world problems and pure mathematical problems, and the key ideas refer to the main concepts, principles and strategies. The opening of a lesson in this study is generally understood to mean the beginning of a lesson before

teaching new concepts or key ideas and usually no more than first ten minutes of a 40-minute lesson.

The purpose of this study was to provide an in-depth examination of the teaching practice exhibited by the expert mathematics teachers in Shanghai high schools to show how they posed mathematics problems that coherently related to the key ideas of the lesson in the opening.

The research question is: How did Chinese expert teachers coherently connect the opening problems to the key ideas in high school mathematics lessons?

Method

Subjects

Six expert mathematics teachers in high school in Shanghai were selected for this study. The criteria of selection were: Each of them is teaching at an experimental and exemplary high school in Shanghai, where only the top 40% graduated middle school students have the opportunity to be accepted. All these teachers are part-time mentors for normal university students and all of the lessons selected for analyzing in this study were the models provided for pre-service or in-service teachers' training activities in recent three years. Most of the teachers have been honored as Superfine Teachers in Shanghai. This title is given to those highly prestigious teachers with outstanding effectiveness of instruction in a particular subject field every four years. The detailed demographic information of six teachers could be found in Table 1.

Table1
Demographic Information of Participants

Teacher	Gender	Born in	Years of Teaching experience	Educational Background	Time of the Honor
WH	Male	1960s	Over 25 years	Master Degree on Mathematics Education	1999(in Shanxi) 2011(in Shanghai)
LY	Male	1960s	Over 25 years	Bachelor Degree on Mathematics	2014
SX	Male	1960s	Over 25 years	Bachelor Degree on Mathematics	/
JR	Male	1970s	Over 20 years	Master Degree on Mathematics Education	2011
SH	Male	1970s	Over 15 years	Master Degree on Educational Management	2014
TW	Male	1970s	Over 15 years	Master Degree on Mathematics Education	2014

Data Collection

The data were collected through video lessons since video offers a promising alternative

for studying teaching besides questionnaires and direct observation (Stigler, Gallimore & Hiebert, 2000). Although videotaping classroom lessons brings its own challenges, the method has significant advantages over other means of recording data for investigating teaching. It enables the study of complex processes and coding from multiple perspectives (Hiebert et al., 2003).

One lesson of each teacher was collected. Three lessons were occurring in the real classroom with no more than 50 students while another three were prepared as a demonstration for prospective mathematics teachers, that is, the students from a normal university were acting as high school students and, at the same time, learned how to teach from the expert mathematics teacher. The two types of lessons are mainly used for prospective teacher education in Chinese normal universities. The six lessons were categorized into two types: new lessons and review (or extend) lessons.

The duration of each lesson was around 45 minutes, more information about the content, grade level, type of the lesson and students of the videos is shown in Table 2.

Table 2
Data Collection of Video Lesson

Teacher	Content	Grade	Type	Students
LY	Operations of Sets	10	New principle	Prospective teachers
WH	Mathematical Induction	11	New principle	Prospective teachers
SX	Monotonicity of a Function	10	New concept	High school students
JR	Revision of Inverse Function	10	Reviewing	High school students
SH	Area of trapezoid with curved edge	12	Extending	High school students
TW	Problem Posing	12	Extending	Prospective teachers

Data Analysis

A case study approach and qualitative analysis methods were used in this study. Each lesson was watched multiple times, and then the lesson was transcribed in the original Chinese first and then translated into English if needed. The lessons were categorized into new and review lessons, then analyzed from both content and process aspects (e.g., Li & Li, 2009; Stigler & Hiebert, 1999; Wang & Murphy, 2004, Chen & Li, 2010) to examine how a teacher coherently connected the opening problems to the key ideas. That is, if the key ideas were all connected to the opening problems and how they were logically connected within a lesson.

From the perspective of content, the video lessons were analyzed moment by moment (Powell, Francisco & Maher, 2003) to reveal the problems and ideas showed by the teachers. The problems given in the opening part of the lessons (the first ten minutes) were coded into *problem for reviewing* prior knowledge and *problem for introducing* key ideas. It should be noticed that there were problems having both codes. At the same time, the ideas (concepts, principles and

strategies) showed in the lessons were coded into *prior knowledge* and *key ideas*. For three new lessons, prior knowledge and new knowledge were recognized during the analysis, and the new knowledge here was regarded as key ideas in the lessons. For three review lessons, the key ideas which were emphasized by the teachers might not be new and might be the same as prior knowledge (see Table 3).

Table 3
Codes of Problems and Knowledge in Lessons

Code	Description	Legend
Key ideas (new knowledge)	Concepts, principles or strategies which the teachers focused on in the lesson	
Prior knowledge	Concepts, principles or strategies related to the key ideas in the lesson	
Problem for reviewing	The problem whose solution needs prior knowledge	
Problem for introducing	The problem whose solution needs key ideas (new knowledge) which the teacher will show next in the lesson	

We further examined the lesson from the process aspect. Coherent Process Diagrams with legends in Table 3 were used to show the relationships between the problems and ideas. The relationships in the new lessons can be divided into three aspects: *review* (the problem is used for reviewing prior knowledge), *introduce* (the problem is used for introducing a new knowledge or key idea) and *practice* (the problem is used for practicing a new knowledge or key idea) while in the review lessons these three aspects cannot be clearly separated.

Results

The results of data analysis of this study show that the opening problems designed by six expert mathematics teachers were all used like a bridge for connecting prior knowledge and key ideas. The function of the opening problems was both to review the prior knowledge and to introduce and practice the key ideas. In the new lessons, the opening problems would not be completely solved until the introduction to new knowledge so that the necessity of new knowledge was clarified. In the review lessons, the opening problem would be varied throughout the lesson for revealing or stringing the key ideas. In all of the lessons, the opening problems play an important role in forming instructional coherence.

The following sections address the findings with detailed descriptions of the six teachers' classroom teaching in connecting the opening problems to the key ideas of the lesson.

The Opening Problems Used in the New Lessons

The results of data analysis show that three teachers in the new lessons provided opening problems for both reviewing prior knowledge and introducing and practicing new knowledge. Although in the new lessons, the teachers posed different numbers of mathematics problems in the opening, the three segments of the lesson, which were reviewing, introducing and practicing, were naturally connected by opening problems. The whole process was coherent.

One problem for connection. At the beginning of the lesson "Operations of Sets" to grade 10, Mr. LY asked students to pose a problem with the numbers in the current date 5/9/2012. After

a while, he showed his own problem:

How many numbers are there in 1, 2, 3, …, 2012, which are neither divided by 5 nor divided by 9?

Although there are different ways to solve the problem, Mr. Li guided students to see the following three sets:

$M = \{1, 2, 3, \cdots, 2012\}$,

$A = \{5, 10, 15, \cdots, 2010\}$,

$B = \{9, 18, 27, \cdots, 2007\}$.

Using a Venn diagram, Mr. LY helped students to acquire the relationship among 3 sets, and then claimed that the knowledge about operations of sets was needed to solve this problem.

After the learning of the new knowledge – operations of sets, Students got the solution of the previous problem.

In this lesson, prior knowledge was reviewed and related to the new knowledge through two connected parts of the opening problem, which was also used for making the new knowledge worthwhile and applicable (see Figure 1). To solve the opening problem, students needed not only to analyze the relationships of the sets but also to do operations. Thus, they were able to notice the connection and differentiation between prior knowledge and new knowledge.

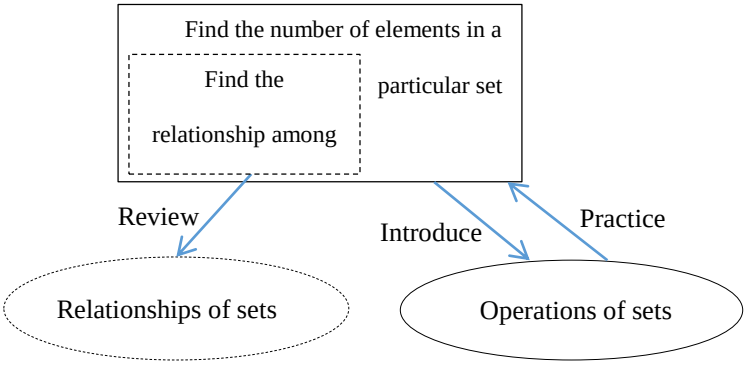

Figure 1. Connection revealed by Teacher LY in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea (new knowledge)*

Problem for reviewing *Problem for introducing*

Two problems for comparison. Teacher WH taught a mathematical induction lesson to grade 11 students. During the first 10 minutes of the lesson, Mr. WH helped students review the concept of induction firstly and then gave two problems for application as follow:

1. $a_1 = 1, a_{n+1} = \dfrac{a_n}{a_n + 1}$, find a_n.
2. $a_n = (n^2 - 5n + 5)^2$, find a_1, a_2, a_3, and a_n.

The answer of the first one was guessed by the teacher and students together as $a_n = \dfrac{1}{n}$ when the first three terms had been figured out as $1, \dfrac{1}{2}$, and $\dfrac{1}{3}$. With the same procedure the answer of the second one was guessed as $a_n = 1$ when the first four terms had been figured out as 1, 1, 1 and 1! But Mr. WH asked what would be a_5, and the counter-example $a_5 = 25$ was founded by students, that is, the conjectures are not always true!

After the discussion of advantages and disadvantages of induction, Mr. WH pointed out that we need a simple and effective way to prove propositions with the positive integer *n*.

After the 14-minute instruction of the new knowledge – mathematical induction, the proof of the previous conjecture for question 1 was finished in 3 minutes.

From teacher WH's design, Prior knowledge "induction" was well reviewed by being used to guess the general formula of two sequences presented in these two problems respectively. At the same time, the necessity of learning mathematical induction that we need a method to prove assumptions with the positive integer *n* was explicitly introduced. Furthermore, the first problem was also used for later application of the new knowledge (see Figure 2). Through the process, the students could realize the relationship between induction and mathematical induction: the former is a method of exploration and the latter is a way to prove the conjecture.

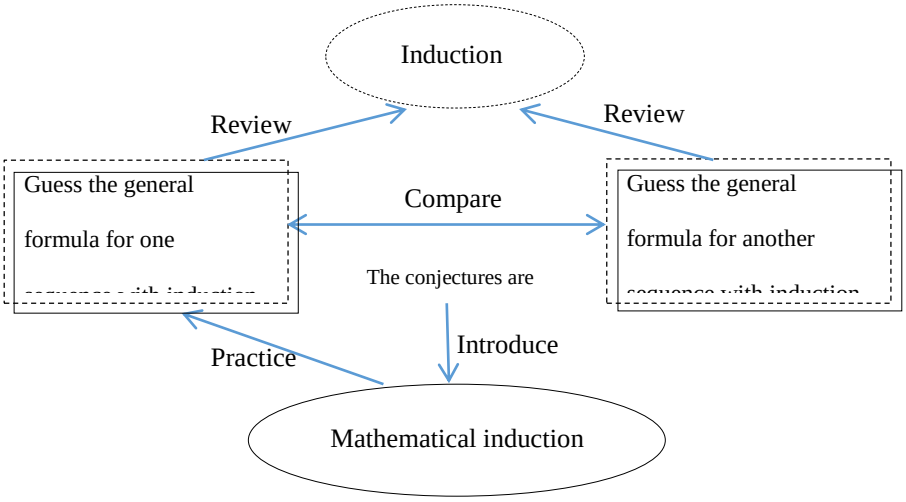

Figure 2. Connection revealed by Teacher WH in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea (new knowledge)*

Problem for reviewing *Problem for introducing*

Three problems for variety. At the opening phase of the lesson "Monotonicity of Functions" to grade 10, three examples were demonstrated consecutively. Mr. SX guided the students to analyze how a variable changed consequently with another in each of the following three examples:

1. Add x liters of C_2H_6O to 1 liter of water, if y is the concentration of C_2H_6O, write a function for the relationship.
2. $y = \frac{k}{x}(k > 0)$.
3. A graph showing the change of temperature during a 24-hour day.

Then Mr. SX told the students that this kind of property is named monotonicity in Mathematics.

After the introduction of the definition of increasing/decreasing function, the three examples above were analyzed again with the abstract definition.

With the three problems demonstrated in the opening of the lesson, the students not only reviewed the prior knowledge about functions, but also experienced the different kinds of monotonicity. The examples here were used for visualizing the abstract new knowledge, and furthermore clarifying and practicing the new knowledge as well (see Figure 3). During the

analysis of the problems, students could experience different ways to explore the monotonicity of a function, such as, real-world context meaning, visualized graph and abstract definition.

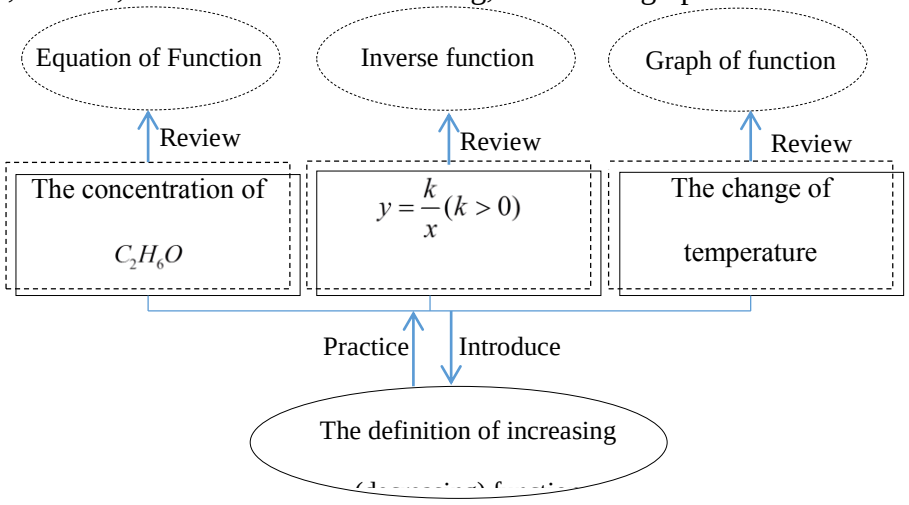

Figure 3. Connection revealed by Teacher SX in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea (new knowledge)*

Problem for reviewing *Problem for introducing*

Summary. In all of the three new lessons, the prior knowledge was connected to the new knowledge through the opening problems for both reviewing and introducing. The first step of solving the opening problem was related to prior knowledge, and the next step of the solution needed new knowledge. Finally, the problem would be eventually solved after the introduction of the new knowledge, so that the necessity of the new knowledge was emphasized. It should be pointed out that the necessity is not always embodied in everyday life but sometimes in the process of mathematical reasoning since most of the opening problems showed here are without real-world context.

The instructional coherence lay in both content and process. Both knowledge reviewing and problem solving focused on conceptual understanding of new knowledge, and the whole process was linked by the opening problem. Furthermore, the three lessons have their own strategies respectively. The first lesson used one opening problem for introducing connection and differentiation between prior knowledge and new knowledge. The second lesson involved two opening problems for comparing and clarifying the context of applying new knowledge. The third lesson consisted of three opening problems for providing a variety of examples of new concept.

The Opening Problems Used in the Review Lessons

The other three lessons analyzed below were not for the instruction of new knowledge but for reviewing or extending the prior knowledge. Three types of variation in relation to problem solving summarized by Gu et al (2004) were used respectively in these lessons to connect the opening problems to the key ideas and make the thematic coherence.

Extend a problem to different variations (一题多变). At the beginning of the lesson "Area of trapezoid with curved edge" to grade 12, Mr. SH guided the students to solve a problem

demonstrated on PPT:

There is a conclusion about conic sections as follows:

AB is a chord of the parabola $y^2 = 2px(p > 0)$, C is the midpoint of AB, the straight line through C and parallel to x axis intersects the parabola at D. If $|y_a - y_b| = a(a > 0)$, then $S_{\Delta ADB} = \frac{a^3}{16p}$

1. Prove the proposition.

Before posing this problem, Mr. SH mentioned that we have learned something about how to find the area of a plane figure like a circle or a Koch snowflake with the infinite idea. It seems that this problem has nothing to do with the theme. In the following time, however, two more problems closely related to the first one were showed on PPT:

2. If E and F is the midpoint of AD and BD respectively, the straight lines through E, F and parallel to x axis intersect the parabola at M, N respectively， find $S_{\Delta AMD}$ and $S_{\Delta BND}$.

3. Find the area of the arch formed with AB and the parabola.

Then a new problem was given:

Find the area of the plane figure formed with $y = x^2, x = 1$, and x axis.

When a student shared his solution of the latter problem with infinite idea, Mr. SH let the students think:

Could you use the previous conclusion to solve this problem?

The infinite idea of finding area of a plane figure with curved edge was emphasized in the lesson. It seems that the opening problem is independent of the infinite idea at first glance. However, along with extending the original problem by varying the conditions and generalization (一题多变), the teacher tried to facilitate a deep thinking about the mathematical ideas related to the series of problems. Finally, the content of prior knowledge and problems were all connected to the key idea (see Figure 4).

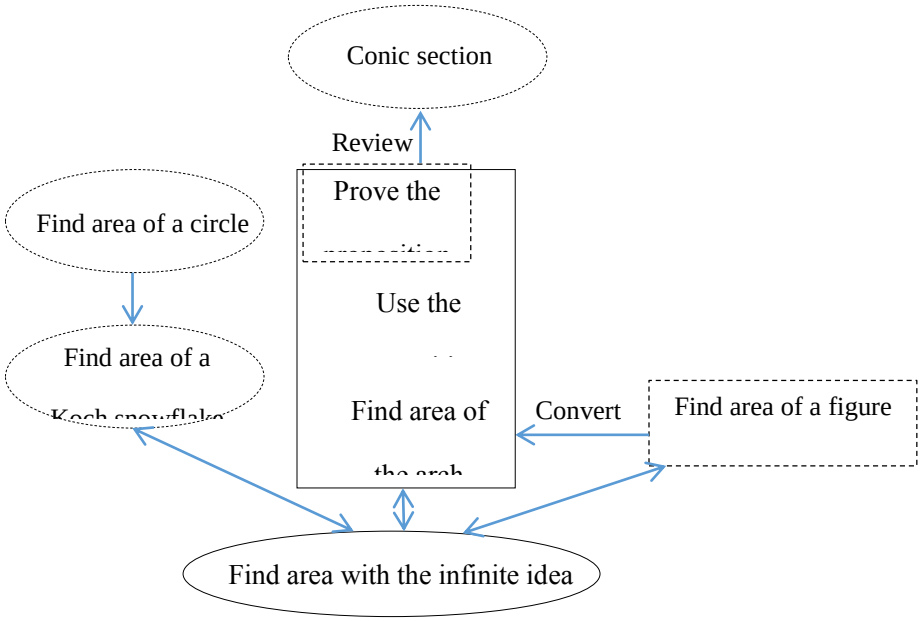

Figure 4. Connection revealed by Teacher SH in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea*
Problem for reviewing *Problem for introducing*

Advocate different methods to solve a problem (一题多解). At the beginning of the review lesson of inverse function to grade 10, Mr. JR gave a problem directly:

If the inverse function of $f(x)=\frac{3x+1}{x+a}(a\neq\frac{1}{3})$ is the same as itself, find the value of a.

Then the students started to work on the problem.

Along with the analysis of the condition and the different strategies of solution throughout the entire lesson, the key ideas of inverse functions were reviewed and listed one by one. Such as, the feature of the invertible function，the steps of finding the inverse of a given function，$f(a)=b\Rightarrow f^{-1}(b)=a$，the images of a function and its inverse are symmetry about the line $y=x$，the relationship between the domain of a function and the range of its inverse. These key ideas were listed successively in the following part of the lesson.

For example, when talking about why a should not be equal to one thirds, the property of the function having its inverse function was recalled and written on the board.

In this case, prior knowledge was reviewed and systemized to some key ideas along with the entire process of problem solving (see Figure 5). Through this kind of variation, which is named *multiple methods of solving a problem* (一题多解), the students were encouraged to solve the problem in several ways and the teacher helped them reveal and connect the key ideas existing in each method.

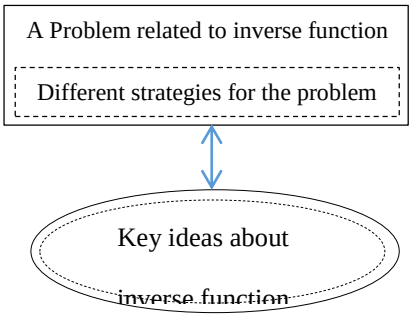

Figure 5. Connection revealed by Teacher LY in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea*

Problem for reviewing *Problem for introducing*

Apply a method to different situations.(一法多用). Every grade 12 student had a handout for learning in Mr. TW's problem posing lesson. Firstly, Mr. TW asked the students to pose a problem with the given context:

The first term and the constant difference of the sequence $\{a_n\}$ is a and d respectively.

After different problems were listed on the blackboard, for instance, "find the sum of the first n terms", Mr. TW did a summary that it is direct problem posing to require a solution or a proof or a judgment based on the unchanged given context.

Using similar ways, Mr. TW further introduced inverse problem posing, analogy problem posing and generalization problem posing.

The main part of the lesson is to use the methods introduced above to pose new problems based on the following context:

O is the vertex of the parabola $y^2=4x$. *OA and OB* are perpendicular chords of the parabola $y^2=4x$. Please prove that the straight line AB is through point (4, 0).

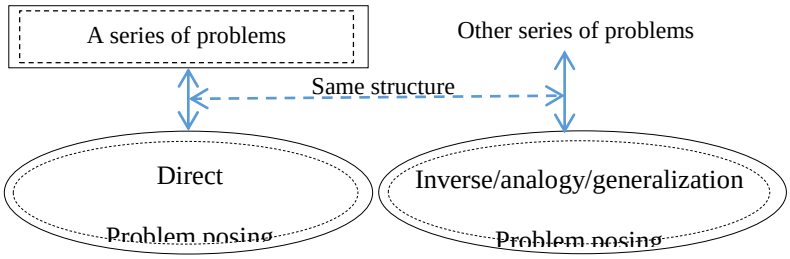

Figure 6. Connection revealed by Teacher TW in Coherent Process Diagram

Notes. *Prior knowledge* *Key idea*
Problem for reviewing *Problem for introducing*

This lesson is distinguished from others because it focused on problem posing rather than problem solving. In the opening part of the class, problems were also used for both recalling the prior knowledge and introducing the key ideas that how to pose problems based on a given context. After the introduction of direct problem posing, the same structure was followed time and again in the remaining teaching process (see Figure 6). When the four ways to pose problems were introduced, the methods were required to be used in another situation. In this kind of variation, which is called *multiple applications of a method* (一法多用), it is the method rather than the problem that is responsible for a link between the teaching segments. It is worth mentioning that the teacher provided a context about parabola in the main part of the lesson, which established a coherent connection among the different ways of problem posing.

Summary. Compared with the previous three lessons for new knowledge, the key ideas embedded in the prior knowledge are the main objectives of the review lessons. All of the problems demonstrated at the opening part of the lesson are responsible for both reviewing and revealing the key ideas. What's more, there are three types of procedural variations of the opening problem in the lesson to declare the key ideas more explicitly and construct each activity segment and knowledge coherent. The first teacher extended a problem to different variations for revealing the key idea gradually. The second teacher advocated different methods to solve a problem for emphasizing all the related key ideas. The third teacher applied a method to different situations for reinforcing the key ideas.

Discussion

This study aimed to examine how the Chinese expert mathematics teachers **coherently** connect the opening problems to the key ideas of the lesson in high schools. The results of this study answered the research question from both the content and process aspects.

Coherent Teaching Content

From the perspective of the content, all the opening problems were devoted to both review the prior knowledge and introduce the key ideas of the lesson. The prior knowledge closely related to new knowledge was reviewed in all lessons because to understand is to know relationships and knowing relationships depends on having prior knowledge (Greenough, Briones, & Klintsova, 2004).

In the new lessons, the solution of the opening problems always contained two parts. The first part was connected to the prior knowledge while the second part of the solution was connected to the new knowledge. Thus, the prior knowledge and the new knowledge were naturally connected by the opening problems. Three types of strategies were used for achieving coherence: *connection*, *comparison* and *variation*. Since new concepts could become enduring and meaningful to the learners only if they were in some way connected to previously learned concepts (Caine & Caine, 1997), the opening problem for connection could help students to realize the relationship between prior knowledge and new knowledge and then get access to understand the new knowledge. Cowley and Underwood (1998) suggested that information is forgotten and becomes inaccessible to memory when it is isolated from systems. The comparison between opening problems can help students to know when and where the new knowledge is useful. Conceptual variation with non-standard and non-concept examples, moreover, can highlight the essence of concept (Gu, Huang, & Marton, 2004).

Some researchers found that in East Asia, such as Japan and China, teachers tended to devote an entire class to the solution of one or two mathematics problem (e.g. Hiebert et al., 2003; Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999; Wang & Murphy, 2004). The similar results were found in this study. It could be summarized more explicitly that the teachers used the minimal number of problems to reveal the key ideas in their lessons in this study. For example, in the lesson of "monotonicity of functions", the teacher provided three opening problems rather than more. With the three problems demonstrated in the opening of the lesson, the students not only reviewed the prior knowledge about functions, but also experienced the different kinds of monotonicity. All of them were therefore necessary since it is imperative for conceptual understanding to vary visual and concrete instances and contrast non-standard and non-concept variations (Gu, Huang, & Marton, 2004).

In the review lessons, three types of variations were found in Shanghai mathematics classroom, which were consistent with the research by Huang and Leung (2005). When *extending a problem to different variations*, the teacher can help students experience the key idea gradually. Through *different methods to solving a problem*, all the related key ideas about one topic can be introduced and emphasized. *Applying a method to different situations* can help students reinforce the key idea of the method. All in all, the variation of the opening problems contributed to the connections between the problems and key ideas in the lesson. The appropriate mathematical tasks allow students for "insights into the structure of mathematics" (Hiebert et al., 1997).

Coherent Teaching Process

From the perspective of the teaching process, few of the opening problems were solved immediately at the beginning of the lesson.

In the new lessons in this study, the opening problems first used for reviewing the prior knowledge and then for introducing the new knowledge. After the introduction to new knowledge, the opening problems would be used again as a practice of the new knowledge. When showing that the opening problems cannot be completely solved just with prior knowledge, the teachers indicated the necessity of learning new knowledge and encouraged the motivation of the students because students are best motivated to work on problems they perceive as being meaningful or relevant (Caine, Caine & McClintic, 2002). "To master a concept, it is helpful to allow students to experience the process of the formation of the concept and in particular to realize the need of introducing the new concept" (Gu, Huang & Marton, 2004).

In the lessons of reviewing or extending prior knowledge, the discussion related to the opening problems was launched throughout the entire lesson. The connections among problems and key ideas were revealed step by step as the discussion went deeper with the procedural variation whose function is to pave the way to establish the substantive connections (Gu, Huang & Marton, 2004). From the detailed examination in this study, it was found that the patterns of connecting were slightly different when teachers used different kinds of variation of problem solving. In the lesson of *varying a problem* (一题多变), such as Mr. SH's class, the key idea was uncovered gradually with the process of variation and eventually clarified until the last variation; in the lesson of *multiple methods of solving a problem* (一题多解), such as Mr. JR's class, the key ideas lied in and connected by the multiple methods of problem solving; in the lesson of *multiple applications of a method* (一法多用), such as Mr. TW's class, a common method played the role in connecting different problems meanwhile the teacher could also use a common problem for connecting different key ideas.

Conclusion

In summary, the opening problems play an important role in making the lesson coherent from both content and process aspects. In this study, the opening problems in the new lessons were carefully designed to naturally connect the prior knowledge and new knowledge while the opening problems in the review lessons were varied throughout the lesson to reveal, reinforce and string the key ideas.

It does not mean that all of the lessons in Shanghai or in China are taught the same way as those presented here. However, Shanghai, the largest Chinese city by population and a global financial center, is one of the frontrunners in education in the country. Correspondingly, the expert mathematics teachers in Shanghai, to some extent, could represent the skillful mathematics teachers in China. The features of connections in these lessons by the expert teachers might be used as exemplars or guidelines in achieving coherence in lesson openings for teacher training and teacher education programs, especially for pre-service teachers and novice teachers learning in mathematics classroom teaching. Since the excellent teachers are always hired by the top schools, and the students in such schools have a relatively higher level of achievement than regular school students in China. Direct instruction approach used by these expert teachers in this study may not be generalized to other kinds of instruction model, but the strategies of achieving coherence in this study might be insightful for teaching mathematics lessons at all levels.

The implications of this study show that the opening problems are vital for a mathematics lesson. The effective opening problems should be coherently connected to the key ideas and be varied with different levels, which eventually lead students to conceptual understanding and problem solving. Further studies need to investigate the lessons from other aspects of coherence such as discourse with more sample size.

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The Comparison of the Preconceptions about Dividing Equally between U.S. and Chinese First Grade Students in Elementary Schools

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Abstract: *The study investigated the preconceptions about dividing equally of U.S. and Chinese first grade students in elementary schools. 255 students from 7 classes at 2 schools of U.S. and China participated in the study. The findings showed that different first grade students had different understanding about dividing equally in U.S. and Chinese elementary school. Chinese students' performance was better than U.S. students' performance on the simple, medium, and complex problems about dividing equally. U.S. and Chinese students had three types of responses when they met complex problem about dividing equally. U.S. students had stronger critical thinking to the complex problem than Chinese students. The study provided a rigorous and empirical way to measure students' preconceptions and provided statistical evidence of comparison of preconceptions about dividing equally between U.S. and Chinese students.*

Key words: preconceptions, divide equally, elementary mathematics, Cross-national comparison

Introduction

In the last several decades, a number of researches have paid attention to the students' preconceptions, also known as ideas held before instruction (Gilbert & Swift, 1985; Good, 1991; Gowin, 1983; Hashweh, 1988; Johnstone, McDonald, & Webb, 1977; Millar, 1989; Piaget, 1929）. Most of the researchers focused on physical, chemical and biological sciences （Wandersee, Mintzes, & Novak, 1994）. Some researchers have used problem-solving test to measure students' prior knowledge in mathematics learning （Davis and Pitkethly, 1990; Kieren, 1993; Mack, 1990; Hunting & Sharpley, 1991）. This study was designed to compare the preconceptions about dividing equally between U.S. and Chinese first grade students in elementary schools.

Theoretical Framework

Research on Preconceptions

There were some terms about preconceptions, such as misconceptions, alternative conceptions, prescientific conceptions （Gilbert & Swift, 1985; Good,1991; Gowin, 1983; Hashweh, 1988; John, McDonald, & Webb, 1977; Millar, 1989）. Some reseachers categorized the preconceptions from different perspectives (Driver & Easley, 1978; Chaffee, 1991). Yu (2010) pointed out that preconceptions could be divided into three types based on the assumptions about science teaching (Gilbert, Osborne, &Fensham, 1982). Three types included: (1) the preconceptions which consists with scientific conceptions; (2) the preconceptions which need to be enriched or cut; (3) preconceptions with errors (Yu, 2010).

The most frequently used techniques for externalizing preconceptions are problem-solving test (Browning & Lehman, 1988), clinical interviews (Osborne & Gilbert, 1980; Pines, Novak, Posner, & Van Kirk, 1978), concept maps (Novak & Gowin, 1984; Novak & Wandersee, 1990), classroom discussion (Nussbaum & Novick, 1982), open-ended and multiple-choice response items (Tamir, 1989).

Most of the researchers focused on the preconceptions in physical, chemical and biological sciences （Wandersee, Mintzes, & Novak, 1994）. Some researchers paid attention to the preconceptions in mathematics （Kieren, 1993; Davis & Pitkethly, 1990; Mack, 1990; Hunting & Sharpley, 1991）. Three perspectives were talked about by these researchers: (1) what were the students' preconceptions （Ault, Novak, & Gowin, 1984; Novak & Gowin, 1984; Hunting & Sharpley, 1991）? (2) why did the students form these preconceptions （Hunting, 1991; Posner, Strike, Hewson, & Gertzog, 1982）? (3) how could these preconceptions be changed to scientific conceptions (Ausubel, 1963; Basili & Sanford, 1991; Bloom & Borstad, 1990; Hunting, Clarke, Lovitt, & Pepper,1991; Posner, Strike, Hewson, & Gertzog, 1982）?

Research on Dividing Equally

Dividing equally, also known as sharing out and fairly, partitive division, dealing , etc, is the basic of division and fraction. The connection between sharing and division is a reasonable one because in both the action of sharing and the operation of division a quantity is divided into equal-sized (Kornilaki & Nunes, 2005). Some researches asserted that the origin of children's understanding of division was to be found in the early schema of sharing (Anghileri, 1997; Dickson, Brown, & Gibson, 1984; English & Halford, 1995; Fischbein, Deri, Nello, & Marino, 1985; Greer, 1992). Dividing equally and fraction are connected tightly. Streefland （1993）pointed out that the act of fair share was a source for fractions figures. Kieren (1993) said that dividing equally was central to the development of fractional number knowledge.

The process of dividing equally, also known as the dealing procedure (Davis & Pitkethly, 1990), by which children systematically allocate items into equal shares has been reported in studies by Davis and Pitkethly (1990), Hunting (1991), and Miller (1984). Davis and Pitkethly (1990) documented that Dealing was a primitive form of partitioning which generated equal shares. Some researches focused on the process of counting. Pepper (1991) tried to support a correlation between success in counting and sharing. They pointed out that counting was more widely used not only for the verification of share sizes but also during the process of sharing （Pepper & Hunting, 1998). Gelman and Gallistel (1978) proposed five counting principles, including one-to-one principle. Pepper (1991) asserted that the activities of both counting and sharing revealed one-to-one correspondence.

Researches indicated that children could solve sharing problems before the related mathematical operations and procedures were taught in school (Hunting & Sharpley, 1988a, 1988b; Sebold, 1946). Some researches showed initial concepts of dividing equally were constructed from intuitive actions (Mack, 1990; Streefland, 1991; Kieren, 1993; Saenz-Ludlow, 1992). Intuitive mechanisms (Davis and Pitkethly, 1990) were variously called: primitive knowledge (Kieren, 1988); informal knowledge (Mack, 1990); pre-mathematical knowledge (Kieren, 1993); prior knowledge (Saenz-Ludlow, 1992). Riess (1955) suggested that life experiences, such as the apportionment of food, may facilitate the early development of what it meant to share.

Many previous cross-national researches (Chen & Stevenson, 1989; Cogan, Torney-Purta, & Anderson, 1988; Fuson & Kwon, 1991; Lynn, 1982; Robitaille & Garden, 1989) "have provided a large body of knowledge about students' mathematical achievement in different cultures and about which cultural and educational factors might influence their learning of mathematics" (Cai & National Council Of Teachers Of Mathematics, 1995, p. 5). Some researches focused on examining cross-national similarities and differences in cognitive aspects on mathematical problem solving (Becker, 1992; Cai & Silver, 1994; Cai & National Council Of Teachers Of Mathematics 1995; Mayer, Tajika, & Stanley, 1991). Most of the researchers used quantitative methods to compare the mathematics learning between U.S. and Chinese students. Some researches focused on specific mathematics problems and applied qualitative research methods to analyze similarities and differences of cognition between U.S. and Chinese students（Cai & National Council Of Teachers Of Mathematics, 1995; Cai & Hwang, 2002; Cai, 2004; Cai & Lester Jr., 2005; Cai & Wang , 2006; Huang & Cai, 2011). Based on the theory of preconceptions, this study used both quantitative and qualitative methods to compare the preconceptions about dividing equally between U.S. and Chinese first grade students in elementary schools.

The research questions asked were:

(1)What are the first grade students' preconceptions about Dividing Equally in elementary schools?

(2)What are the main similarities and differences about the preconceptions of dividing equally between U.S. and Chinese first grade students in elementary schools?

Method

Participants

Participants were 255 first grade students from 1 Chinese elementary school in Hangzhou, China and 1 U.S. elementary school in Southern California. All students' preconceptions about dividing equally were assessed via a problem-solving test (Browning & Lehman, 1988). Table 1 shows the students' demographic information.

Table 1

Students' Demographic Information

Nationality	City	Totel number of students	Male	Female
China	Hangzhou	152	83	69
U.S.	Southern California	103	50	53

Data Collection and Instrument

Data were collected by problem-solving test, including 3 problems. Problem 1: please justly divide these pencils to four students(see Figure 1). Problem 1 was a simple problem about dividing equally. The students would be tested to divide 8 pencils to 4 children equally. Problem 2: please evenly divide these cakes to three plates(see Figure 2). Problem 2 was a medium problem about dividing equally. The students would be tested to divide 15 cakes into 3 equal groups. Problem 3: now there is one more cake, please evenly divide these cakes to three plates (see Figure

3). Problem 3 was a complex problem about dividing equally. The students would be testd to divide 16 cakes into 3 equal groups.

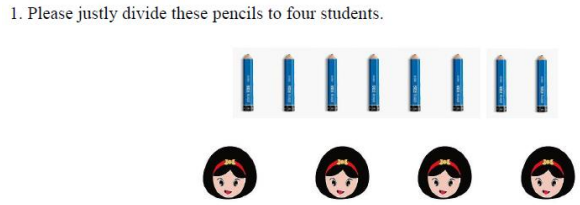

Figure 1. Problem 1

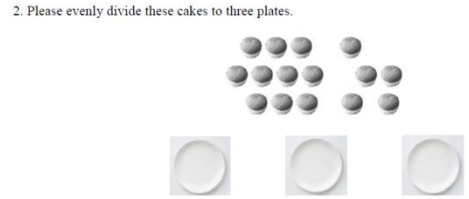

Figure 2. Problem 2

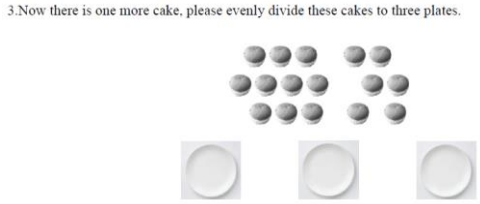

Figure 3. Problem 3

Data Analysis

Both quantitative and qualitative methods were employed to examine the research questions. Based on the categorization of Pepper & Hunting (1998), the students responses on preconceptions about dividing equally were categorized into five types. Table 2 shows the categories. Type 5 just appeared in the responses to Problem 3. The students' responses to Problem 3 were diversified since Problem 3 was a complex problem about dividing equally. There were more specific categorization of the responses to Problem 3(see Table 3）.

Table 2

Categories of Five Types of Preconceptions about Dividing Equally

Five Types	Rubric	Interpretation
Type 1	0	Didn't do it
Type 2	1	Couldn't share fairly
Type 3	2	Shared fairly, but didn't share out (shared some cakes fairly, but didn't share all cakes)
Type 4	3	Shared out and fairly (shared all cakes fairly)
Type 5	4	Divided the 16th cake into 3 parts

Table 3

Categories of Five Types of Preconceptions about Dividing Equally for Problem 3

Five Types	Rubric	Interpretation
Type1	0	Didn't do it
Type2	1	Couldn't share fairly
Type3	2	Shared some cakes fairly, but left more than one cake
Type4	3-1	Thought it couldn't be divided equally
	3-2	Shared 15 cakes fairly, but left the last one cake
Type5	4-1	Divided the 16th cake into 3 parts
	4-2	Divided the 16th cake into 3 equal parts

Results

The results of this study revealed the students' overall and different performance of preconceptions about dividing equally on the simple, medium and complex problems between U.S. and Chinese first grade students.

Students' Preconceptions about Dividing Equally on the Simple Problem

U.S. and Chinese students' overall performance. Problem 1 was a simple problem about dividing equally. Students were asked to divide 8 pencils to 4 children equally. Table 4 shows that most of the students (85.9%) could complete the task; 6.3% of students could share 4 pencils to 4 children but they didn't share another 4 pencils fairly; 6.3% of students could not divide 8 pencils to 4 children equally and only 1.6% of students didn't do the task.

Table 4

Students' Responses to Problem 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 Didn't do it	4	1.6	1.6	1.6
	1 Couldn't share fairly	16	6.3	6.3	7.8
	2 Shared fairly, but didn't share out	16	6.3	6.3	14.1
	3 Shared out and fairly	219	85.9	85.9	100.0
	Total	255	100.0	100.0	

The comparison between U.S. and Chinese students. Comparing the students performance of preconceptions about dividing equally on simple problem between U.S. and China, Table 5 shows that the proportion of Chinese students (95.4%) who could divide 8 pencils to 4 children equally was more than that of U.S. students(71.8%). The result of independent t-test (see Table 6) shows that the performance of Chinese students （Mean=2.95，SD=0.252）had higher

mean scores than that of U.S. students （Mean=2.50，SD=0.884）on the simple problem about dividing eqally. Table 7 comfirms the differences in mean scores between U.S. and Chinese students. There is a statistically significant difference in mean scores between two groups (T(253)=5.963, P=0.000<0.05）.

Table 5

U.S. and Chinese Students' Responses to Problem 1

			Frequency	Percent	Valid Percent	Cumulative Percent
China	Valid	0 Didn't do it	0	0	0	0
		1 Couldn't share fairly	1	.7	.7	.7
		2 Shared fairly, but didn't share out	6	3.9	3.9	4.6
		3 Shared out and fairly	145	95.4	95.4	100.0
		Total	152	100.0	100.0	
U.S.	Valid	0 Didn't do it	4	3.9	3.9	3.9
		1 Couldn't share fairly	15	14.6	14.6	18.4
		2 Shared fairly, but didn't share out	10	9.7	9.7	28.2
		3 Shared out and fairly	74	71.8	71.8	100.0
		Total	103	100.0	100.0	

Table 6

Group Statistics

	China 1 U.S. 2	N	Mean	Std. Deviation	Std. Error Mean
Problem 1	1	152	2.95	.252	.020
	2	103	2.50	.884	.087

Table 7

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Low	Upper
Problem 1	Equal variances assumed	180.635	.000	5.963	253	.000	.45	.076	.303	.602

	Equal variances not assumed	5.053	113.293	.000	.45	.089	.275	.630

Students' Preconceptions about Dividing Equally on the Medium Problem

U.S. and Chinese students' overall performance. Students were required to divide the cakes (15 cakes in total, students had to count the number of cakes by themselves) into 3 plates equally on Problem 2. Table 8 shows that more than two third (75.6%) of students could divide the cakes into 3 plates equally and 2.7% of them could divide parts of the cakes into 3 plates equally; 18.8% of the students did not divide 15 cakes into 3 plates equally and 2% of them didn't do the task.

Table 8

Students' Responses to Problem 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 Didn't do it	5	2.0	2.0	2.0
	1 Couldn't share fairly	48	18.8	18.8	20.8
	2 Shared fairly, but didn't share out	7	2.7	2.7	23.5
	3 Shared out and fairly	195	76.5	76.5	100.0
	Total	255	100.0	100.0	

It was not difficult to find that the distinctive difference between Problem 1 and Problem 2 was the number of objects. Pepper & Hunting (1998, p. 181) found that "tasks such as sharing 12 crackers between two dolls could be successfully completed without the use of counting skills, whereas tasks that involved large numbers of items may encourage the use of counting". The number of cakes on Problem 2 was more than 12, and counting skills were carried out in the process of dividing equally. The proportion of students who could share out and fairly decreased on Problem 2. It could be explained that the students lacked of the ability to count numbers orderly. For instance, in Figure 4, the student wanted to use connected lines to divide the cakes into 3 plates equally, but the students could not divide equally because 2 cakes were covered by the connected lines and they were invisible for the students. The study found that 7 students counted the number of cakes by marking out (see Figure 5). The students marked out the cake when they counted it. This way seemed effective since all the 7 students using this way had sucessfully divided the cakes into 3 plates equally.

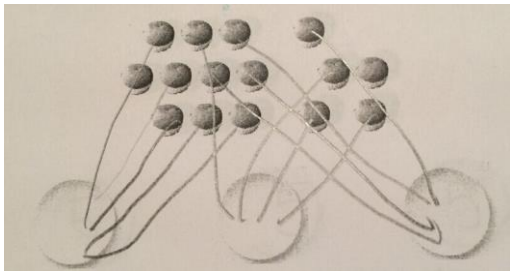

Figure 4. Counting disorderly

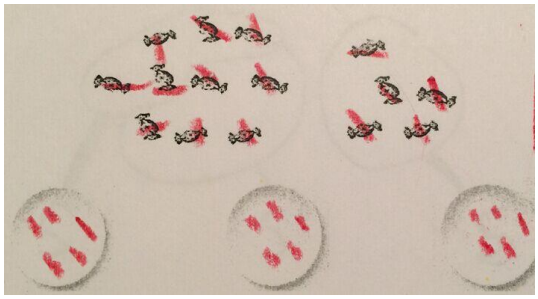

Figure 5. Counting orderly

The comparison between U.S. and Chinese students. Table 9 shows the proportion of U.S. students (63.1%)and Chinese students (85.5%) who could shared out and fairly on Problem 2 were all down, compared that of Problem 1. While the result of independent t-test (see Table 10) shows that the performance of Chinese students （Mean=2.70，SD=0.735） had higher mean scores than that of U.S. students （Mean=2.29，SD=0.976）on the medium problem about dividing eqally. Table 11 comfirms the differences in mean scores between U.S. and Chinese students. There is a statistically significant difference in mean scores between two groups (T(253)= 3.845, P=0.000<0.05）.

Table 9

U.S. and Chinese Students' Responses to Problem 2

			Frequency	Percent	Valid Percent	Cumulative Percent
China	Valid	0 Didn't do it	2	1.3	1.3	1.3
		1 Couldn't share fairly	19	12.5	12.5	13.8
		2 Shared fairly, but didn't share out	1	.7	.7	14.5
		3 Shared out and fairly	130	85.5	85.5	100.0
		Total	152	100.0	100.0	
U.S.	Valid	0 Didn't do it	3	2.9	2.9	2.9
		1 Couldn't share fairly	29	28.2	28.2	31.1
		2 Shared fairly, but didn't share out	6	5.8	5.8	36.9
		3 Shared out and fairly	65	63.1	63.1	100.0
		Total	103	100.0	100.0	

Table 10

Group Statistics

	China 1 U.S. 2	N	Mean	Std. Deviation	Std. Error Mean
Problem 2	1	152	2.70	.735	.060
	2	103	2.29	.976	.096

Table 11

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Problem 2	Equal variances assumed	40.663	.000	3.845	253	.000	.41	.107	.201	.624
	Equal variances not assumed			3.645	177.747	.000	.41	.113	.189	.636

Students' Preconceptions about Dividing Equally on the Complex Problem

U.S. and Chinese students' overall performance. Problem 3 required students to divide 16 cakes into 3 plates equally. This problem was a complex problem based on Problem 2, and it was challenging for the first grade students to divide the 16th cake into 3 equal parts. Table 12 shows that almost one tenth of students (11.4%) didn't do the task. Have of students (42%) couldn't divide 16 cakes into 3 plates equally. 5.5% of students divided some cakes(less than 15) to 3 plates equally. 5.9% of students criticized the problem who thought 16 cakes couldn't be divided into 3 plates equally. One third of students (29.4%) shared 15 cakes into 3 plates fairly, but remained one cake. 5.9% of students had divided 15 cakes into 3 plates equally, and tried to share the 16th cake fairly. Among them, only 2.4% of students could divide the 16th cake into 3 equal parts.

Table 12

Students' Responses to Problem 3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 Didn't do it	29	11.4	11.4	11.4
	1 Couldn't share fairly	107	42.0	42.0	53.3
	2 Shared some cakes fairly, but left more than one cake	14	5.5	5.5	58.8
	3-1 Thought it couldn't be divided equally	15	5.9	5.9	64.7
	3-2 Shared 15 cakes fairly, but left the last one cake	75	29.4	29.4	94.1
	4-1 Divided the 16th cake into 3 parts	9	3.5	3.5	97.6
	4-2 Divided the 16th cake into 3 equal parts	6	2.4	2.4	100.0
	Total	255	100.0	100.0	

The comparison between U.S. and Chinese students. Table 13 shows in the complex situation, almost one third of Chinese students (32.9%) and half of U.S. students (55.3%) couldn't divide the cakes equally. On the other hand, a small part of students (9.2% of Chinese students and 1% of U.S. students) could divide the 16th cake into 3 equal parts. 14.6% of U.S. students thought that Problem 3 couldn't be answered, and they criticized Problem 3. While no Chinese students did that. In addition to, the proportion of Chinese students (13.8%) who did not do the task increased faster than that of U.S. students (7.8%).

Table 13

U.S. and Chinese Students' Responses to Problem 3

			Frequency	Percent	Valid Percent	Cumulative Percent
China	Valid	0 Didn't do it	21	13.8	13.8	13.8
		1 Couldn't share fairly	50	32.9	32.9	46.7
		2 Shared some cakes fairly, but left more than one cake	8	5.3	5.3	52.0
		3-1 Thought it couldn't be divided equally	0	0	0	52.0
		3-2 Shared 15 cakes fairly, but left the last one cake	59	38.8	38.8	90.8
		4-1 Divided the 16th cake into 3 parts	8	5.3	5.3	96.1
		4-2 Divided the 16th cake into 3 equal parts	6	3.9	3.9	100.0
		Total	152	100.0	100.0	
U.S.	Valid	0 Didn't do it	8	7.8	7.8	7.8
		1 Couldn't share fairly	57	55.3	55.3	63.1
		2 Shared some cakes fairly, but left more than one cake	6	5.8	5.8	68.9
		3-1 Thought it couldn't be divided equally	15	14.6	14.6	83.5
		3-2 Shared 15 cakes fairly, but left the last one cake	16	15.5	15.5	99.0
		4-1 Divided the 16th cake into 3 parts	1	1.0	1.0	100.0
		4-2 Divided the 16th cake into 3 equal parts	0	0	0	100.0
		Total	103	100.0	100.0	

Comprehensive analysis of three problems. In order to further investigate the students' preconceptions about dividing equally on the complex problem, the study made a comprehensive analysis of all three problems' responses. The study mainly analyzed Problem 3' responses of those students' who correctly completed Problem 1 and Problem 2. There were 182 students who could share out and equally on Problem 1 and Problem 2, occupying 71.4% of the total. It could be inferred that these students had almost correct preconceptions about dividing equally.

Table 14

The Students' Responses to Problem 3 Who Correctly Completed Problem 1 and Problem 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 Didn't do it	18	9.9	9.9	9.9
	1 Couldn't share fairly	61	33.5	33.5	43.4
	2 Shared some cakes fairly, but left more than one cake	9	4.9	4.9	48.4
	3-1 Thought it couldn't be divided equally	15	8.2	8.2	56.6
	3-2 Shared 15 cakes fairly, but left the last one cake	65	35.7	35.7	92.3
	4-1 Divided the 16th cake into 3 parts	8	4.4	4.4	96.7
	4-2 Divided the 16th cake into 3 equal parts	6	3.3	3.3	100.0
	Total	182	100.0	100.0	

Table 14 shows that when the complex situation (the 16th cake appeared) was created on Problem 3, students replied in different ways: (1) almost half of the students could not divide equally, including those who didn't do the task, those who could not share fairly and those who shared fairly but not share out (more than one cake without being divided); (2) more than one third students who shared fairly but left the 16th cake （see Figure 6）. (3) 7.7% of students could share out and fairly. These students could further divide the 16th cake into 3 parts after they shared the first 15 cakes fairly（see Figure 7）.These students could deeply understand the nature of dividing equally. (4) 8.2% of students criticized Problem 3. They wrote in the questionnaire: "It can't work" "You can't divide them evenly" （see Figure 8）. It was noteworthy that the students who criticized the problem were all U.S. students.

Figure 6. Shared 15 cakes fairly and keep the 16th cake remained

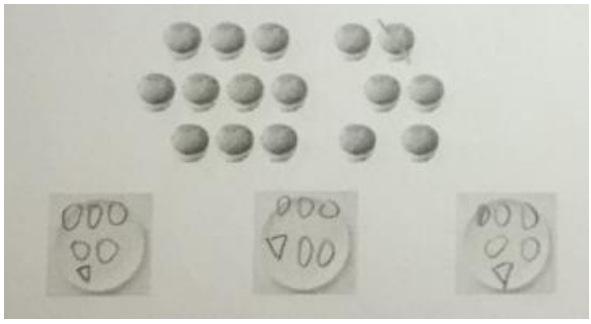

Figure 7. Divided the 16th cake into 3 equal parts

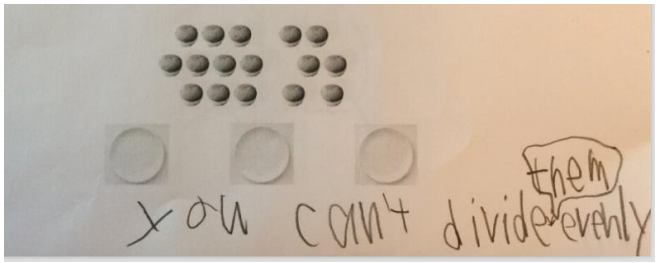

Figure 8. Thought it couldn't be divided equally

Discussion and Implication

The Similarities between U.S. and Chinese Sudents' Preconceptions about Dividing Equally

Different first grade students' preconceptions about dividing equally were at different levels in U.S. and Chinese elementary school. Chen (2013) categorized the preconceptions into three types: (1) the preconceptions were completely different from scientific conceptions; (2) the preconceptions were partly consistent with scientific conceptions; (3) the preconceptions were completely consistent with scientific conceptions. The study categorized the preconceptions into five levels via comprehensive analysis on all three problems: (1) the students who did not do all three problems lacked of the preconceptions about dividing equally; (2) the students who could not share out and fairly on all three problems had the incorrect preconceptions about dividing equally; (3)the students who could complete 1 problem at lease and could not complete other problems had some deviation in understanding the scientific conceptions about dividing equally; (4) the students had almost correct preconceptions about dividing equally who could share out and fairly on Problem 1 and Problem 2, but could not divide the 16^{th} cake into 3 parts on Problem 3; (5) the students who could share out and fairly on all three problems had completely correct preconceptions about dividing equally.

Teachers should do more effort to diagnose and understand the students' preconceptions before the class since different students' preconceptions were in different levels.

U.S. and Chinese first grade students had three types of responses when they met complex problem about dividing equally. Students were required to divided the cakes (16 cakes in total, students had to count the number of cakes by themselves) into 3 plates equally on Problem 3 which created a complex situation based on Problem 2. This was a typical cognitive conflict for the first grade students. Facing this cognitive conflict, both U.S. and Chinese students had three types of responses: (1) the students gave incorrect responses; (2) the students didn't know how to response; (3) the students broke through the barriers, made correct responses, and ultimately understood the deep nature of dividing equally.

Posner, et al. (1982) proposed the learning conditions about the theory of conceptual change, pointed out that "discontent for the previous concept" was a prerequisite for the change of the concept. The creation of cognitive conflict was the best method to help the students produce "discontent for the previous concept". Therefore, teachers should know the students' preconceptions, and create reasonable cognitive conflict, and guide students to understand the nature of conceptions.

The Differences between U.S. and Chinese Students' Preconceptions about Dividing Equally

The U.S. and Chinese first grade students had different performance about dividing equally. Chinese students' performance about share out and fairly was better than U.S. students'

performance on the simple, medium, and complex problems about dividing equally. From Problem 1 to Problem 3, the complexity of the problems increased. However, more Chinese students than their U.S. peers could divide equally on all three problems. Although the proportion of the students who could do well in dividing equally decreased from Problem 1 to Problem 3, more Chinese students got better performance on all three problems.

There are some differences between U.S. and Chinese mathematics curriculum in elementary schools. For example, the concept of division is taught in Chinese second grade while U.S. teachers usually teach the concept in the third grade. From the findings of this study, Chinese first grade students got the better preconceptions about dividing equally than U.S. first grade students, which is probably helpful to understand the different arrangement in mathematics curriculum between two countries since dividing equally is the foundation of division.

The U.S. and Chinese first grade students had different attitude to complex problem. When confronting the cognitive conflict on Problem 3, which required students to divide 16 cakes into 3 plates equally, some U.S. students criticized the problem while some Chinese students left it blank. 14.6% of U.S. students criticized Problem 3, but none of Chinese students did that. In this case, Some Chinese students who did well in Problem1 and Problem 2 chose to leave it blank on Problem 3 when they confronted the cognitive conflict.

The different attitude to complex problem between US and China gives an insight to educators from China, that teachers should lead students to criticize the problem and develop their critical thinking when students are confronted with cognitive conflict.

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MUC2 基因表达与益生菌拮抗大肠杆菌 K1 株黏附侵袭肠上皮的关系研究

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Abstract: ***Objective*** *To investigate MUC2 expression induced by probiotics and E. coli K1(E44) in Sprague Dawley（SD）rats and its effects on the inhibition of probiotics in the adherence and invasion of E44 strains to intestinal barrier.* ***Methods*** *SD rats were orally administered the probiotics, E44 or probiotics +E44 on a daily basis for seven days and MUC2 expression was determined by RT-PCR. MUC2-targeted shRNA plasmid expression vector(shRNA MUC2) and a negative- control shRNA NC were respectively transfected into Lovo cells. The MUC2 knockdown efficiency was determined using qRT-PCR, and then competitive exclusion assays were used to detect the inhibition of probiotics in the adherence and invasion of E44 strains.* ***Results*** *MUC2 mRNA were up-regulated in SD rats which intragastric administration of probiotics. Conversely, in rats with E44, MUC2 was significantly lower than the control group. The expression of MUC2 in Lovo cells transfected with shRNA MUC2 was significantly silenced as compared with the negative control and the mock control cells. The interference efficiency was 57.7% and the inhibition of probiotics in the adherence and invasion of E44 strains was significantly lower than the untreated group. After MUC2 silencing, the relative adhesion and invasion rate of E44 were 56.64% and 66.64% as compared with the control group.* ***Conclusion*** *The up-regulation of MUC2 by probiotics in SD rats Colon could be one of the protective mechanism of antagonistic bacteria translocation. After silencing MUC2, the inhibition of probiotics in the adherence and invasion of E44 strains to intestinal epithelial cells was significantly reduced.*

Key words: MUC2, shRNA, Probiotics, *E. coli* K1(E44), Adhesion and invasion.

粘蛋白(Mucin)是一类由上皮细胞分泌的高分子量糖蛋白[1-3]；在体内分布较广泛，主要存在于胃肠道、呼吸道、泌尿生殖道表面细胞及其分泌的粘液中。在正常的组织上皮起细胞保护和润滑功能[4]，粘蛋白在组织和血液中还有细胞粘附、参与淋巴细胞循环、参与

细胞间通讯和信息传递、维持细胞的极性、参与抗原呈递和淋巴细胞活化作用等[4-6]。在癌细胞中具有促使癌细胞对正常细胞的黏附作用和减少癌细胞间的粘附力，并且通过位阻现象使癌细胞逃避免疫识别等[7]。其中Mucin2 (MUC2)是构成肠道粘液层的主要成分。一般认为该蛋白在肠道的表面形成一层粘液层发挥润滑和拮抗致病菌的肠道粘附和侵袭的作用[8-10]。

研究证实益生菌在加强肠道屏障功能方面具有重要作用并可以预防和辅助治疗许多新生儿感染性及过敏性疾病[11]。最近已有研究者首次证明乳酸菌LGG能显著抑制*E. coli* K1株在新生儿大鼠肠道粘附与侵袭从而显著减低菌血症与脑膜炎发生率[12]。如将益生菌用于早期新生儿脑膜炎的预防，可克服广谱抗生素的诸多缺点。

但是，目前对益生菌、致病菌和肠道粘蛋白基因表达之间的关系研究较少。MUC2在致病菌侵袭肠屏障中的作用机理仍不清楚。本研究在建立体外动物模型的基础上，验证益生菌和*E. coli* K1（E44）对MUC2基因表达的影响。同时揭示益生菌能否拮抗E44诱导的结肠粘蛋白基因表达的下降，发挥其拮抗致病菌粘附侵袭和易位作用；另外利用脂质体Lipofectamine™ 2000将构建好的稳定表达shRNA MUC2的质粒转染人结肠癌Lovo细胞干扰MUC2基因，以了解粘蛋白MUC2基因沉默与*E. coli* K (E44)粘附侵袭肠屏障之间的关系，为研究MUC2基因在益生菌拮抗致病菌粘附侵袭肠上皮细胞中的作用及机制打下基础。

1 材料和方法

1.1 主要材料和试剂

1.1.1 实验动物 2日龄Sprague Dawley(SD)乳鼠连同母鼠1窝（南方医科大学实验动物中心）。

1.1.2 细胞系、菌株与载体 人结肠癌Lovo细胞、大肠杆菌(*Escherichia coli*)K1致病株E44 本室保存，真核质粒表达载体PGU6/GFP/Neo购自上海吉玛公司。

1.1.3 试剂 DMEM培养基和胎牛血清均购自Hyclone公司；MRS培养基、Lipofectamine™2000、Opti-MEM购自invitrogen公司；质粒小提试剂盒、无内毒素质粒中提试剂盒购自OMEGA公司；TRIzol总RNA提取试剂、DNA Marker、逆转录试剂盒及荧光定量

PCR相关试剂盒均购自大连宝生物工程有限公司(Takara, Tokyo, Japan)；DEPC处理水，RNA样品保存液购自东盛公司；PCR反应引物由上海生工生物工程技术服务有限公司；氯仿、异丙醇其余试剂为国产分析纯。

1.2　试验方法

1.2.1 动物分组及处理 把2日龄Sprague Dawley(SD)乳鼠随机分成益生菌组、益生菌+致病菌组、致病菌组和对照组，每组3只，益生菌、益生菌+致病菌组乳鼠每日灌胃剂量为10^8CFU/只。致病菌组和对照组每日灌胃等体积无菌PBS；到5日龄时对益生菌+致病菌组乳鼠同时灌胃益生菌和*E. coli* K1（E44）株（10^8CFU/只），对照组仍灌胃等体积无菌PBS；待48 h后，取其结肠，放入PBS洗去残留血液，并将其放入RNA样品保存液中备用。

1.2.2 结肠MUC2 mRNA检测 Trizol法提取组织RNA，按试剂盒说明逆转录合成cDNA，RT-PCR半定量法检测MUC2基因表达，GAPDH为内参基因。PCR反应引物为：MUC2(forward) 5′-ACAAAAACCCCAGC AACAAG-3′ and (reverse) 5′-GAAGTCGGGACAGGTG ATGT-3′，扩增片段长度372 bp；GAPDH(forward) 5′-GAGACAGAAACTTTCGA AGC-3′ and (reverse) 5′-GAAGTCTGTGGT ATCCAATCC-3′， 扩增片段长度84bp。PCR反应条件：94ºC预变性5min，94变性30 s，55ºC退火30 s，72ºC延伸90 s，共30个循环，72ºC延伸10min，4ºC保存。PCR产物用2%琼脂糖凝胶电泳鉴定，并进行凝胶电泳灰度分析（使用Biorad软件），用目的基因的光密度值与内参照条带的光密度值做半定量分析。

1.2.3 质粒转染 人结肠癌Lovo细胞采用含10%胎牛血清、100U/ml青霉素、100U/ml链霉素的DMEM高糖培养基,于37 ºC、5%CO2的培养箱中培养。细胞接种于12孔培养板内,待细胞生长汇合达到70%~90%时进行转染。转染前1d换用不含抗生素和血清的培养基。取1.6ug质粒和4.0ul脂质体Lipofectamine™2000分别稀释于100ul Opti-MEM中,室温静置5 min；然后将两者混合,室温再放置20 min,均匀加入培养孔内6 h后,换含10%胎牛血清的DMEM培养基。24 h后，在倒置荧光照相显微镜下观察转染细胞的绿色荧光情况。

1.2.4 荧光定量PCR检测干扰后MUC2 mRNA表达 细胞转染48 h后，收

集细胞，Trizol抽提细胞总RNA。取2ug总RNA进行逆转录后进行PCR反应,β-actin为内参。SYBR® Premix Ex Taq™ II (Perfect Real Time) Kit(Takara, Japan)，PCR反应体系为25ul，MUC2(forward)：5′-AACGGCCTGCAG AGCTATTC-3′ and (reverse)：5′-ATCTTCTGCATGTTCCC AAACTC-3′，扩增片段长度80bp。β-actin(forward)：5′-CCCTGGCACCCAGCAC-3′ and (reverse)：5′-GC CGATCCACACGGAGTAC-3′，扩增片段长70bp。用Mx3000P Real-time PCR扩增仪进行PCR反应,扩增条件为:95 ºC变性30 s；然后95 ºC 5 s，60 ºC 30 s，40个循环。每组重复3次，通过$2^{-\triangle\triangle Ct}$表示MUC2的相对表达量，以Lovo为对照细胞。

1.2.5 致病菌E44对Lovo细胞的粘附侵袭实验 黏附实验和侵袭实验采用竞争性排除法，将人结肠癌Lovo细胞株接种于12孔板（corning公司）中，细胞密度达80%，用灭菌的PBS漂洗2次。黏附实验：每孔加10^8CFU益生菌与10^7CFU E44株共同孵育2.5 h，对照组用等体积培养基代替益生菌与等量致病菌共同孵育。侵袭实验：每孔加10^8CFU益生菌与10^7CFU E44株共同孵育2.5 h，对照组用等体积培养基代替益生菌与等量致病菌共同孵育。黏附侵袭实验步骤如前研究所述[13,14]。细胞用培养基洗3次，粘附实验加200μl的0.5%Triton X-100，孵育8 min裂解细胞（此浓度TritonX-100在半小时之内不会影响细菌活性），加入250μl蒸馏水，反复吹打后吸出样品，做梯度稀释后涂利福平平板计数菌落数，实验重复3次。侵袭实验用含有100μg/ml庆大霉素的培养基孵育1 h，以杀死细胞外的细菌，之后与黏附实验步骤相同，加200μl的0.5% Triton X-100，孵育8 min裂解细胞，加入250μl蒸馏水，反复吹打后吸出样品，做梯度稀释后涂利福平平板计数菌落数，实验重复3次。

1.3 统计学分析

结果用均数±标准差表示，统计方法采用SPSS 13.0统计软件中的单因素方差分析(one-way ANOVA),方差不齐时进行变量转换。

2 结果

2.1 益生菌致病菌诱导肠道MUC2基因表达

各组SD乳鼠分别经益生菌、E44或益生菌+E44处理完成后，提取肠道组织总RNA，RT-PCR法检测益生菌致病菌诱导的乳鼠肠道MUC2基因表达情况，结果显示，与对照组比较，致病菌组乳鼠MUC2基因表达显著下降（P<0.01）,益生菌组表达显著上调（P<0.01）。益生菌+致病菌组基因表达则无明显差异（P>0.01）.与致病菌组比较，益生菌+致病菌组基因表达有明显差异（P<0.01）（图1，图2）

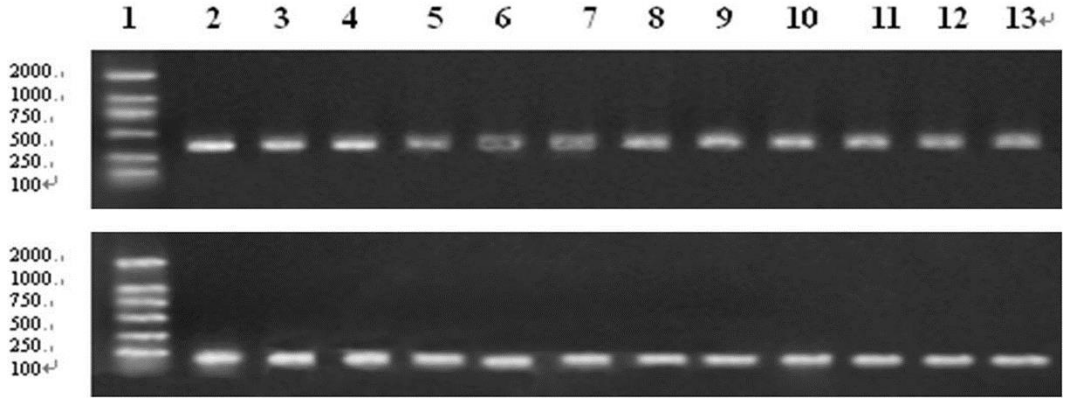

图1：不同处理组乳鼠肠道MUC2、GAPDH基因的表达

Fig.1: The expression of MUC2、GAPDH in rat colonic of the intestinal tract makes direct contact

with different microbiotas

1：Takara DL2000 marker；2-4：益生菌组；5-7：E44株组；8-10：益生菌+E44株组；11-13：正常对照组.

Lane 1: Takara DL2000 marker; Lane 2-4: Probiotics group; Lane 5-7: E44; Lane 8-10: Probiotics +E44; Lane 11-13: Control.

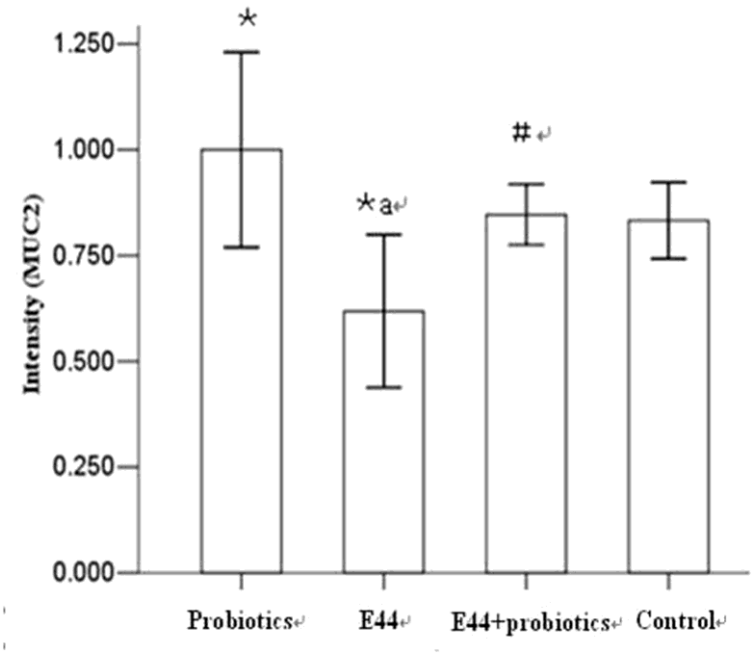

图2：MUC2 mRNA转录水平的观密度变化

Fig.2: Effects of probiotics and *E. coli* K1(E44) strains on MUC2 expression.

注：* vs.对照组，P<0.01；[a] vs. .益生菌+E44组，P<0.01；[#] vs.对照组，P>0.01.

Note: * vs. Control, P<0.01; [a] vs. .probiotics+E44group, P<0.01; [#] vs. Control, P>0.01.

2.2 转染绿色荧光蛋白质粒间接估计转染效率

Lovo细胞转染靶向MUC2基因的shRNA真核质粒表达载体(shRNA MUC2) 48 h后，在荧光显微镜下观察可见绿色荧光，通过计数同一视野未激发荧光时细胞总数及激发荧光时带有绿色荧光细胞个数，计算带有绿色荧光的细胞的百分比=（绿色荧光细胞数/总细胞数）×100%，即转染效率。本实验转染效率约为65%-85%(图3)。

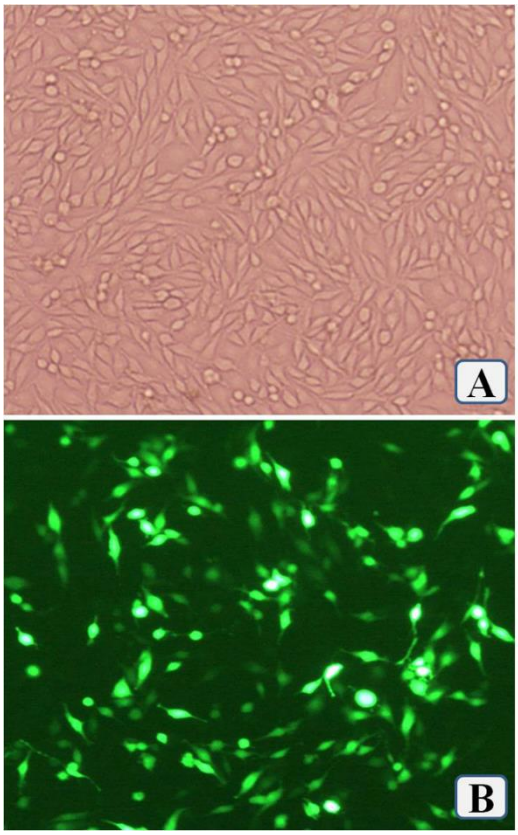

图3 A: 光镜下观察shRNA MUC2质粒转染Lovo细胞；B: 荧光显微镜下观察shRNA MUC2质粒转染Lovo细胞并估算其转染效率约为65%-85%；

Fig.3 A: Lovo cells transfected with shRNA MUC2 observed via light microscope;

B: Lovo cells transfected with shRNA MUC2 observed via fluorescence Microscope;

The transfection efficiency of the experiment was approximately 65%-85%..

2.3 MUC2基因mRNA表达的变化

重组质粒(shRNA MUC2)转染Lovo细胞48 h后，提取细胞RNA进行检测，其对Lovo中MUC2 mRNA的抑制情况如qRT-PCR结果显示。以Mock Transfection 为对照（calibrator），管家基因为Normalizer，ΔΔCt=(Ct目的基因-Ct管家基因)实验组－

(Ct目的基因-Ct管家基因)对照。通过相对定量方法$2^{-\Delta\Delta Ct}$来检测MUC2基因的knockdown作用。

在设置的3组试验中，shRNA MUC2实验组的MUC2相对表达率为42.3%，与空白组（Mock control）比较，有显著差异(P<0.01),其干扰效率为57.7%。阴性对照组shRNA NC的MUC2相对表达率，与空白对照组相比无统计学差异(P>0.05)（图4）。

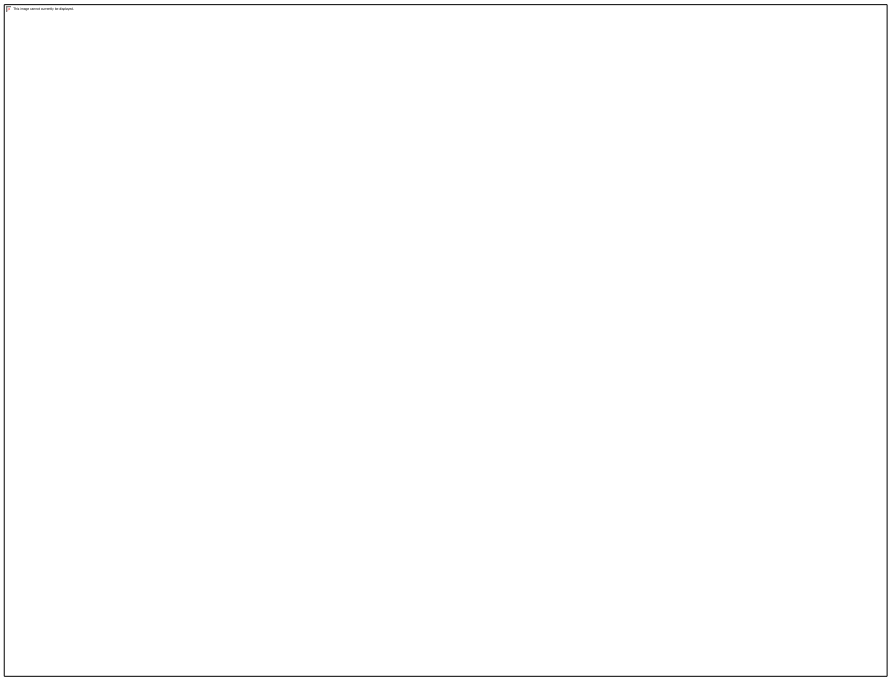

图4 转染shRNA MUC2后qRT-PCR检测Lovo细胞MUC2 mRNA表达水平

Fig.4 Expression of MUC2 in Lovo cells after transfection with shRNA MUC2 by qRT-PCR

注：* vs.对照组，P<0.01;

Note: * P<0.01compared with Mock control.

2.4 MUC2基因沉默后，益生菌对E44粘附侵袭Lovo细胞的抑制作用

采用竞争排斥实验方法来检测MUC2基因干扰前后益生菌干扰E44粘附侵袭Lovo细胞的效果。以对照组E44粘附侵袭率作为100%，以此标化益生菌共同孵育时E44的相对粘附侵袭率，如图5，图6所示，MUC2干扰前,益生菌明显抑制致病菌粘附侵袭Lovo细胞(P <0.01)，

E44相对粘附率为9.47%，E44相对侵袭率为19.2%；MUC2干扰后益生菌对E44粘附侵袭肠上皮细胞抑制作用不明显，加益生菌共同孵育组与对照组E44相比，E44对肠上皮的粘附侵袭作用明显提高，E44相对粘附率为56.64%，E44相对侵袭率为66.64%（图5，图6）。细菌粘附侵袭实验证明干扰MUC2基因后益生菌抑制E44粘附侵袭Lovo细胞的作用显著降低。

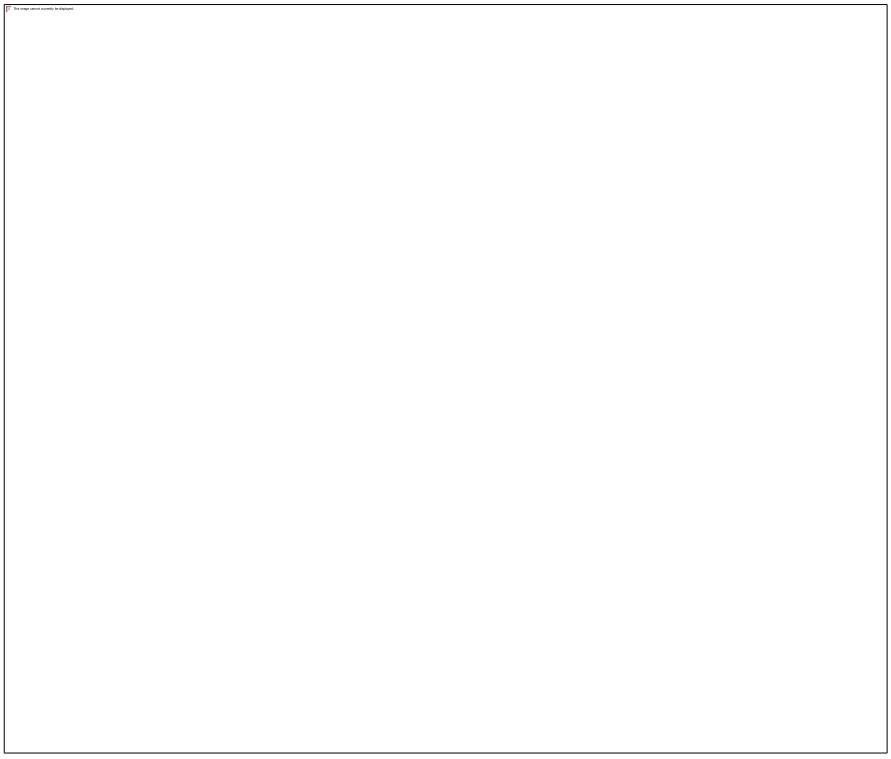

图5 MUC2基因干扰前后益生菌对E44粘附Lovo细胞的拮抗作用

Fig.5 The antagonism of the probiotics on the adhesion of E44 to Lovo cells before/after transfection with synthetic shRNA targeting human MUC2.

注：* vs.对照组E44，P<0.01；# vs.对照组 Probiotics+E44，P<0.01

Note：* vs. Control E44，P<0.01；# vs. Control Probiotics+E44，P<0.01.

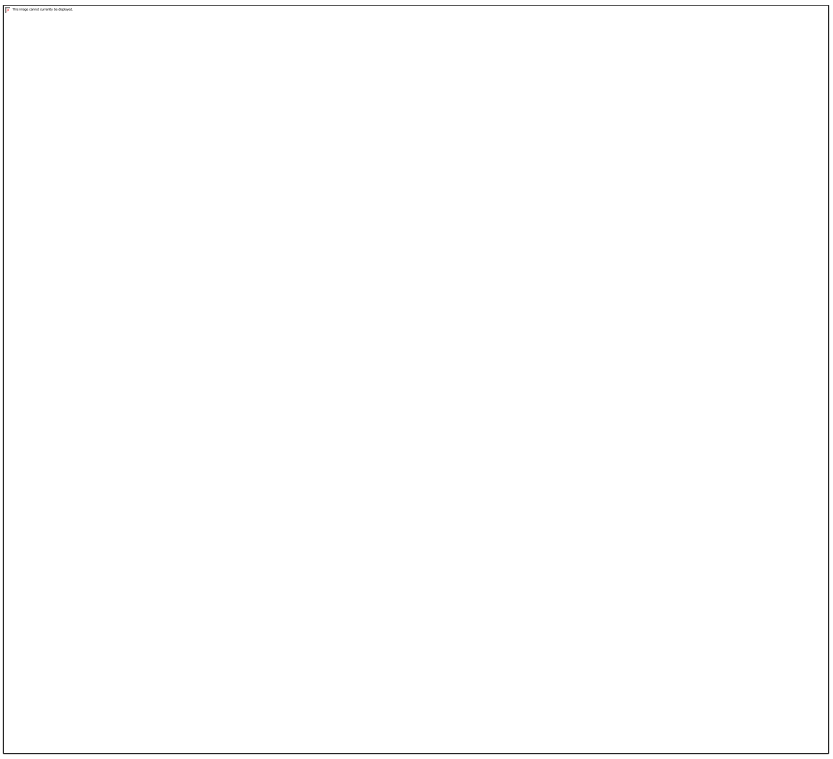

图6 MUC2基因干扰前后益生菌对E44侵袭Lovo细胞的拮抗作用

Fig.6 The antagonism of the probiotics on the invasion of *E*44 to Lovo cells before/after transfection with synthetic shRNA targeting human MUC2.

注：* vs.对照组E44, P<0.01; # vs.对照组 Probiotics+E44, P<0.01.

Note：* vs. Control E44, P<0.01; # vs. Control Probiotics+E44, P<0.01.

3 讨论

肠上皮细胞和共生的微生物群落以及肠腔粘液层，共同构成了肠道的第一道生物屏障，粘蛋白是构成肠道粘液层的主要组成，起到保护肠道预防致病菌损伤的作用。在正常情况下，MUC2 100%表达于肠道黏膜上皮，而在大肠肿瘤中表达降低。目前已在多种上皮来源的肿瘤及肠道疾病中发现粘蛋白的结构及功能发生改变，出现粘蛋白的异常表达，其异常表达与临床预后相关。

益生菌在加强肠道屏障功能方面具有重要作用，体内外研究证实，益生菌可以诱导粘蛋白分泌和上调基因表达，拮抗致病菌肠道粘附侵袭和易位作用。致病菌的肠道定植易位也与Mucin基因表达相关,预防性益生菌治疗，如乳酸菌LGG菌株，可增加MUC2的表达以减少细菌易位。Matter 等人在最近的研究中报道，与对照组相比，新生儿先天性巨结肠组患儿MUC2蛋白质的表达明显降低，而患肠炎急性期的患儿则不能检测到MUC2[15]。

本研究以具有拮抗致病菌易位肠上皮细胞的益生菌和能致新生儿脑膜炎的*E. coli* K1株为研究对象，在建立体外动物模型的基础上，验证益生菌和*E. coli* K1(E44)株对结肠主要粘蛋白基因MUC2表达的影响。结果显示益生菌组乳鼠肠上皮细胞MUC2基因表达明显上调，灌服*E. coli* K1组MUC2基因轻度下降，共同灌服组基因表达无明显变化。证明益生菌诱导MUC2基因明显上调可能成为其拮抗致病菌易位的保护机制之一。

RNAi是由双链RNA（double-stranded RNA，dsRNA）诱导的序列特异性的转录后基因沉默机制。导入的dsRNA，可被Dicer酶切割成为21～23 bp的双链siRNA，双链siRNA与核酶复合体结合形成RNA诱导沉默复合体（RNA-induced silencing complex，RISC），双链siRNA解链形成21～23nt的siRNA从而激活RISC，激活的RISC通过碱基配对定位到与siRNA互补的同源mRNA上，特异性的降解mRNA而抑制相关基因的表达[16-19]。由于使用RNAi技术可以特异性剔除或关闭特定基因的表达，所以该技术已被广泛用于探索基因功能和传染性疾病及恶性肿瘤的基因治疗领域。

本实验将构建成功的MUC2-shRNA表达质粒shRNA MUC2，通过脂质体Lipofectamine™ 2000转染人结肠癌细胞Lovo细胞，该质粒可在细胞内介导MUC2 shRNA的合成，合成后的shRNA在细胞内内切酶的作用下自动被加工成为siRNA，与MUC2 mRNA特异性结合，从而降解MUC2 mRNA，导致MUC2基因沉默，继而建立Lovo-MUC2-RNAi瞬时转染细胞模型，为后续的体内外功能学试验创造了条件。

黏附和侵袭是致病菌与宿主细胞发挥作用的关键步骤，也是其穿透肠屏障的先决条件，*E. coli* K1株必须跨越肠屏障才能引起血源性感染[20-21]。为明确MUC2基因干扰后，益生菌能否抑制E44株黏附并侵袭肠上皮细胞，我们采用Lovo细胞为体外模型，通过竞争性排斥方法检测MUC2基因沉默后，益生菌对致病菌E44粘附侵袭肠上皮的抑制作用，结果显

示MUC2 mRNA表达干扰后，益生菌抑制致病菌粘附侵袭Lovo细胞的作用不明显，为阐明MUC2基因在人结肠癌细胞中的生物学功能及进一步研究该基因与益生菌、致病菌的关系作用奠定了实验基础。

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一、淡化物质拥有，突出社会共享

哪一天我们回首20世纪，会搞不明白为什么我们从那时起开始拥有那么多东西。猛一看来这并没有什么不好。千百年来人类生活都不过从手到口，直到20世纪西方的工业经济发展，并最终带领世界其余地方开始物质拥有化生活，使人们拥有诸多消费品：如冰箱，汽车，电视，电话，电脑，等等。美国小布什之所以赢得了2004年总统连任，相当程度上靠他宣扬“物质拥有的社会”：提出“美国人物质拥有越多，美国的活力就更多。”

物质拥有社会在腐烂，有时其腐朽像皮肤癣一样，挥之不去。即便在小布什总统刚刚宣布它的诞生，物质拥有社会已经开始从内而外腐烂。它的夭折从Napster网上音乐共享业务开始。互联网提升了音乐和数字化的分享能力，使社会每个人都拥有唱片和音像光盘完全成为多余。然后网上音乐共享效应（Napsterization）几乎蔓延到所有其他的社会媒体，到2008年，那个支撑物质拥有社会的华尔街金融架构--房产次级抵押贷款和信用违约掉期，已经在我们的头顶上崩塌下来。物质拥有社会并没有使美国变得多末至关重要，反而它就要毁掉这个国家。

也许我们都在探索着生活。如果你没有工作时，你不可能会去买诸多大件物品，即使你有了一份工作和一所房子，你也不会再有获得第二抵押贷款或次级贷款的好运气了，靠银行贷款已经没法帮助您满足物质消费之痒。年轻人尤其如此，谁能负担得起繁杂的物质拥有社会？他们大多人是生活在衰退的经济边缘，在经受着美国约20％的高失业率的冲击和折磨。

然而正是这些年轻人却在走向与传统消费形式不一样的新潮流，那是一种社会协作消费方式：通过网络来分租，出借，甚至共享商品，而不是去买它们的拥有权。你可以看到一些网上正在崛起的大企业，像Netflix公司，其20多万用户在支付一定的费用后基本上共享DVD音像公司的所有产品，或像Zipcar汽车租用公司，使其 50 多万成员有机会利用网络来分享汽车的使用时间。

然而，这些公司，虽然成功，基本上是基于互联网时代的旧的汽车和录像租赁业务模式的升级。真正的协作消费创新精神从一些网上新创公司中可以发现，如布鲁克林的 SnapGoods，帮助人们通过互联网租用商品。或者如 Airbnb，这使人们出租个人居家多余部分给过往旅客。当然：这里还有一个绚丽的绿色元素，其创意在于，当社会共享或协作消费更多的东西时，这意味着少生产或不浪费东西，高效利用基础设施和产业。这对社会和谐发展有利，让地球更美好。对一个人而言，它甚至使你的自我形象更好。透过 SnapGoods 网站租用业务租用一天电钻，比买一个来用，不但便宜很多，更使生活轻便和智能化。对城市中居民的邻居多和空间小的生活方式来说，物质共享会让生活更完美。

但真正的协作消费意识给人们带来的利益是社会化和人性化。在过去一个住家分散的时代，我们可能不知道住在街那边的人。而今天在网上可以分享事物的时代，即使我们是与刚刚在网上认识的陌生人交流，也让我们感到在做一种对社会有意义的联络。雷切尔.波茨曼，《我的东西也属于你》的共同作者说：社会成员和同行之间的共享“涉及到社区结构的重现。”他说：协作消费的崛起，“在基于网络的社会中是完全可行的，因为人们彼此可以互相信任。”(Botsman)

人们的社会本性渴望能信任人，并被人信任， 社会研究发现，当人们托管或利用他人的事情或物品时，神经递质催产素使人们的愉悦神经得到激发。这就是造成社会共享之美的深层因素，或许它可能证明，利用社会共享之便比购买物质拥有权更持久。

通过社会共享模式来替代现有的基于资源的经济模式， 我们可以共享那些我们并不需要占有的，一时或暂时使用的个人设备或资源。信息技术和网络社区的发展， 使我们在可扩展缩放的范围内组织各种共享社区，通过共享从物质到非物质的资源，成就一个更美好的未来。

例如，在网络社区，人们可以发现你家附近的店家或朋友愿意借给或出租给你需要一用的东西。通过社区共享，你会发现可共享的东西实在不少：从白糖，巧克力，到学校没有开设的网络公共课程。如果你愿意分享家中多余房间和床铺，可替代酒店，包你走遍世界各地， 还发展新朋友和新友谊。通过网络社区你还可以储蓄和共享技能和时间，例如，恰巧你在北京或汉堡，需要有人来帮助你购买资料或翻译新闻稿件，你将能够利用你存入网络社区时间和资源，无需兑换金钱或雇人。

马里兰大学政治经济学家兼作家加尔艾珀珞（*Gar Alperovitz*），也是民主合作联盟的联合创始人，在他刚刚发表的新书《那么，必须做什么》，回答了笼罩着西方未来社会的大难题：“我们怎么能在我们的日常生活中，在我们的工作和我们的社区中实现真正的民主？怎样才能解决我们面临的众多危机，建立生态与经济上可持续发展的公司和企业，使我们的生活更加充实？我们怎么做才有助于克服不平等和不公正？ ”

艾珀珞列举了四种策略，组合起来可成为一个长期国家战略，可奠定一个更强大和更民主的经济。他的策略一是“进化性重建”，即通过更加民主的经济形式，如合作社，土地信托和社会企业的广泛发展；二是“市与州发展的棋盘式布局”，涉及公众银行，公用事业，土地所有制的发展等；三是 “危机变革” ，指因危机推动的举措，如打破银行的权力，改革医疗产业等， 四是“大危机变革”涉及大型企业的国有化（如 AIG 和通用汽车） 。(Alperovitz)

这些举措，莫非似曾相识，具有中国特色？只是这一切需要在智能科技（云计算，大数据）的平台上来实现。因此，发展智能化社会共享模式，对中国来说可能是无须更舷易辙的快车道，是政治和经济改革的重合线路。也许中国特色之路，未必非要走向世界大同。或许心有灵犀，即可峰回路转，进入智能化、可共享社会的桃花源。

二：国家治理现代化需要公共、开放、智能化平台

中国 30 年改革时至今日，诱人的改革红利使中国的政治经济体制改革可谓人心所向，令人翘首以待。然而改革进入纵深境地，一步失误亦可导致全盘皆输，这令顶层改革的舵手和设计师们举棋不定，深感举步唯艰，已经不是简单地通过做蛋糕和分蛋糕之争就可以解决的问题。回想 30 年前的经济改革初期，许多改革方案从头开始。改革的关键是全民动员，任何简单有力的方法和行之有效的方针都可以令人激动，年年可制造GDP增长的神话。邓小平的“摸着石头过河，让一些人先富起来，谁不改革谁下台”等口号一言九鼎，无不令人欢欣鼓舞。然而时至今日，改革已进入攻坚期、深水区，诸多矛盾和问题错综复杂地交织叠加在一起。改革需要有科学，完备，和智能化的载体和平台，才能推动制度更加成熟、定型，为人民幸福安康、为社会和谐稳定、为国家长治久安提供更完备、更稳定、更管用的制度体系，才能在国家治理体系和治理能力现代化上形成总体效应、取得总体效果，才能有效破解经济社会转型升级的发展难题，以及成功应对现代化过程中的风险考验。现代化国家治理体系是复杂而庞大的体系，体系的周密运转必然需要有公共、开放、智能化的国家治理平台，通过各领域、各行业无缝对接的

服务模式，形成一个囊括各种政府职能，实现改革开放目的，服务社会各个领域，并适合社会各阶层参与的科学治理环境。

李克强总理指出，“改革是最大动力，也是最大红利。要始终坚持让人民群众在改革中受益。要建立更加公平有效的体制机制，注重利用增量带动理顺利益关系，让全体人民共享改革发展成果，”（中国政府网）笔者认为这也是搭建国家综合治理平台的发展目标，即通过一个公共、开放、智能化的，从中央到地方的合作与服务平台，高效传递改革动力，为全国人民提供服务与获取红利，通过公民共同参与以及社会共享资源和成果，快速营建和谐发展的环境，形成一种发达社会的完整运作机制。

建立公共、开放、智能化平台便于改革的实施。顶层设计至关重要，但先进的、现代化的执行方法和模式是发挥制度作用的关键环节，执行力度和效率是制度力量的具体体现。国家治理体系的顶层设计和实施将会涉及数千个公式和参数，数百个功能机构与执行部门，多行业的智囊和咨询机构，从上到下，从中央到地方的通力协作，以及全国人民在各个层面的支持与参与。这样复杂的系统需要智能化，网络化，大数据化，和大信息化的技术架构。否则，就连统筹庞杂的地方治理机构都会顾此失彼，难怪会导致“政令难出中南海”的窘迫局面。

在技术层面，开放型智能平台通常应由多数据中心联合驱动，足以支持各种开放的应用程序，各行业和板块的专业系统，以及大规模的内容市场。平台上各种应用程序要经过严格的专家评估，广泛的用户测试和试用，性能稳定后通过云端和网络快速传递和推广到各运用领域及消费者。现代化发展的生态环境要求这样的综合智能平台应具有非常大的规模和非常高的流动性，适宜各行各业的新应用程序不断引入，而效率低下的旧程序则可快速退役。现代化发展的规模化运作要求平台服务内容也将以非常高的速度大量产生，并随着时间的推移根据市场和用户需求进行安全存储和迅速更新。智能化基础配套设施要求对敏捷性的资源分配，可扩展性，可靠性，问责制和安全性都有可靠保证。平台追求高效的成本效益，要求其基础设施是流动的、柔性的，各种应用工具乃至整个系统均可以容易地复制，重新利用，重新编程，以及添加新的功能。系统的智能化管理和控制应保证平台使用低能耗和低运营成本来提供高效的资源使用率和高度可用性。这种基于云计算的虚拟基础设施架构是开放结构的，开源的，允许各种子系统的联网，对接和整合，以便支持快速推出新应用程序以及提供配套资源的配置方案。

在应用层面，开放型智能化国家治理平台主要包含下列模块：1）智能城市管理模块， 2）智慧教育模块，3）法律，政策，与制度模块， 4） 国民经济可持续发展模块， 5）外交环境与国家安全模块，以及 6）国家发展战略模块。平台架构建设不必求全，不必同时，可以根据发展需要从地方和部委子平台作起。以智能城市管理为例，该模块包括智能化城市发展，智能交通，智能健保，智能安保，及智能环保等子平台。应该选择有广泛推广价值的城市试点，开发这些可独立操作的开放型智能化平台，既要保证独立运行的可用性，又可以嵌入智能城市管理

综合系统，共享资源，形成科学的、行之有效的载体，为智能化城市发展提供综合数据，参量，和质量保证。

当今世界，在城市或国家范围内运用大型智能化平台，是科学技术发展的大势所趋。以风靡美国和欧洲的云端智慧教育为例，基于教育云计算（教育云）的智慧教育具有高度可扩展、可持续跨校、跨区、跨国和连接全球网络的优势。云端智慧教育具有多重优点：从低成本、时空分享、灵活应用、虚拟化到动态性、安全性、灵活性、全天候支持、不依赖地域等。混合云数据中心架构融合多种云端服务，通过10+GB校区高速网络，连接学校教学资源和设施，集成多种教学采集与管理系统，形成一种可以灵活缩放的混合教学社区，方便教师、学员在学校、家庭和社区随时随地开展教学活动。

通过智慧教育平台，教师可在线实施言传身教、解疑、辅导等教学活动，触及每个学生。学生可参与或接受校外乃至国外的课堂教学内容，他们在课堂内外可积极参与各种学习讨论，并与教授及助教跨地域或跨时区交流和互动。这使学生的学习将更多样化和人性化，大大丰富教学内容，提升教育质量。例如，中国大学的商学院可以利用云端混合教育平台，充分利用全球开放课程和美国教学资源优势，依托尖端技术成果与先进的智慧教育模型，与美国著名大学相关学校和专业合作，跨国跨区培养新型工商管理专业人才。

目前，在西方和东方技术发达社会里，智能平台创新活动在蓬勃发展，从电子商务，智能物流，社交网络，在线教育，物联网系统，到远程办公，个性化电子（安卓系统和苹果 IOS 系统），云计算系统（思杰虚拟平台）等，不仅挑战甚至取代原有传统模式，而且跨越国家、地区、专业几及行业界限，创建新的业务发展环境。当今技术革命的发展，比以往工业革命的发展更快，规模更大，涉及面更为广泛。

中国特色的社会主义核心价值，必须建立在孕育中国文化的优良传统意识形态上。这体现了中华文化的积淀和中华民族对国家发展最深沉的精神追求，代表着中华民族独特的精神标识，是中华民族生生不息、发展壮大的精神滋养，也是走向现代化、建设现代市场经济的精神资源。在中华民族传统文化中，凝聚着一个伟大民族几千年传承的集体记忆和集体呼唤，形成了独特的民族传统意识形态。因此，中国的政治与经济体制改革必须包含和发扬光大优秀而深沉的中华传统。这些中华文化基因和精神元素同样需要通过一个公共、开放、智能化的合作与服务平台得到彰显。因此，智能化国家治理平台可以作为智能社会主义对中华传统伦理和精神的传承。

中国治理体系的目标是发展与完善中国特色社会主义，所要展开的观点可以说是纵横交错、相互关联,至少包括经济、政治、文化、社会、生态、党建等各条战线的治理；包括民主、监督、法制、规范、文明、协商、科学、道德、社会主义核心价值等各个要素的建立和运用；包括从中央到地方到基层各个层级的治理等。最近在高层有一个新颖的、也是古人曾经提出的观

念，将国家治理比喻为如烹小鲜，奢谈“烹鲜学”。这个提法的跨度太大了，也太笼统了，如果没有智能化超级国家治理平台，恐怕连原料都搞不清楚，何以治大国家如烹小鲜？

在 21 世纪，任何治理体系、治理能力都要实现现代化。现代社会是经济全球化、政治多元化、生活多样化、社会信息化的时代。我们的治理体系、治理能力要适应这四化的要求，才算是现代化。能够代表先进的生产力，代表先进文化，运用现代化手段，包括大数据背景下的新型互联网等，才能称得上现代化。在这里，社会信息化是关键，没有先进的技术架构，没有云计算，大数据，虚拟与流动的信息掌控，大型云数据中心的超级引擎，就不能建立治理大国的基础架构，不能真正实现社会信息化。

发展公共、开放、智能化平台，科学地推进市场改革。我国目前的市场体系存在几个突出问题：一是条块分割形成碎片化的市场格局；二是部分市场还没有对所有主体平等开放；三是由于部分行业的垄断导致竞争性缺失；四是市场尚未建立在公平透明规则的基础上；五是商品市场发展比较快，但要素市场，特别是资本市场非常落后。这些问题也是东、西方世界所共有的，是经济发展模式基于自由市场的通病，关键在于社会资源共享不畅，开放性社会协作失调，以及有效的管控与协调机制的缺失。改革是科学化的进程，需要优化的管理环境，以及灵活的危机排除机制。深化改革要从发展公共、开放、智能化市场与政务管理平台开始，使现有的法律法规和改革的目标在同一平台上相互参照，形成统一开放、竞争有序的社会与市场体系。

习近平最近指出，我们要“建立公开统一的国家科技管理平台，构建总体布局合理、功能定位清晰、具有中国特色的科技计划体系和管理制度，以此带动科技其他方面的改革向纵深推进，为实施创新驱动发展战略创立一个好的体制保障。通过统一的国家科技管理平台，建立决策、咨询、执行、评价、监管各环节职责清晰、协调衔接的新体系。”（人民日报海外版）这虽然是对国家科技资源整合的顶层设计，但也标明新的国家改革的战略和思维：以现代科技创新与发展的动力来带动改革，建立开放的、综合的国家治理平台。保证在国家范围内构建布局合理、功能定位清晰的国家治理体系和管理制度。

21 世纪的今天，智能化平台席卷全球教育，管理，商务及市场。随着工业革命的步伐加快，在日新月异的技术革命背景中，社会经济发展模式已从缓慢的生态进化激发到跳跃式的环境更新。纵观世界工业革命的发展路径，从 19 世纪争夺地盘，到 20 世纪抢占市场，再到今天 21 世纪共建平台，深度经济改革和国家治理现代化要把基于新一代技术创新：高速网络、云计算、大数据的智能平台作为国家综合治理的政策载体和运行机制。这将保证改革沿着安全航道向纵深高速发展。

三、意识形态的智能化创新

世界进步了，观念要不断更新，意识形态要适应经济发展与社会新常态。回首过去的一个世纪，世界经历了天翻地覆的变化，从封建社会到资本主义的机器工业时代，后来进到原子能时代，然后到了全面科技发展时代，再到当今的信息科技飞跃时代，社会发展经过多次飞越，进而向着更加智能化的社会迈进。回首过去的 30 年，中国的改革开放发生了巨变。然而改革开放每推进一步，都在呼唤着意识形态的跟进。全面深化的改革在某种意义上讲，其目标就是要把国家治理提升到既符合执政党的自身发展，又符合当代世界政治文明潮流的高度。试想，中外发展史上任何的外来的或传统的意识形态，如果不及时更新和跟进，如何能适应当今社会发展的新常态，又岂能放之四海而皆准？时代不同了，现代的社会，不能再墨守陈规，中国改革要保持时代进步与民族特色，要走顺应世界潮流，和与时共进的创新之路。

1. 智能化创新的文化与环境

现代社会的创新文化支持人类的创新思维，使他们从知识积累中不断提取新的经济营养和社会价值，并通过产生新的环境，改进企业和社会的产品，服务和流程。健康的创新文化支持研究与创新，支持价值共享和信仰的相辅相成，支持全球性知识合作及智慧集成。创新文化的蓬勃发展使社会能够充分利用人类科学研究结果和创新生态系统的现有优势，激发并促成时代的更新。创新是社会性行为，虽有大有小，但人人都可以学到并参与，不只是社会精英所专有的天生才能，而是可以人人学会并应用的技能。在西方创新型企业中，创新被当作是一个企业核心技能，同时又是一个持续的过程，成功的创新型组织不把创新作为特殊的，独一无二的活动，当作与质量，领导力，生产力一样，是对企业发展很有价值的的必要条件。

智能化创新引领时代的步伐。例如，人类早期机器思维方式向着当今智能思维方式和大数据思维方式转变，因而有效地推进了大数据时代的到来。随着物联网、云计算、社会计算、可视化技术等的突破性发展，智能化创新正在带动智能思维：大数据平台能自动搜索所有相关的数据信息，并进而类似人脑一样主动、立体、逻辑地分析数据、做出判断、提供见解。这无疑也就具有了类似人类的智能思维能力和预测未来的能力。智能与智慧科技是大数据时代的显著特征，大数据时代的思维方式也要求人们从基于机器的自然思维转向基于信息的智能化思维，不断提升社会计算能力和智能化水平，从而获得具有洞察力和新价值的东西。

智能化创新作为智能社会主义新意识形态的动力，是经过准确定义的和具体可测的。本文中智能化的定义是以智能（SMART）作为首字母的 5 个词组来定义和表述。这 5 个英

语词组的首字母合在一起就是 S.M.A.R.T。**具体说来，智能**以 S（Services）作为服务导向，以 **M（Modularity）作**为平台模块组合，以 **A（Agility）作**为策略与目标的敏捷实施，**R（Renovation）作**为观念与模式创新，以 **T（Technology）作**为先进技术的推广运用， 它们合在一起即为智能化（**SMART**）。简而言之，智能化社会侧重于现代智能化创新的这 5 个重要特性和运作方法：1）坚持服务社会的导向，2）善于模块化平台组合，3）精于目标的敏捷实施，4）敢于制定改革创新策略，和 5）专于发展世界先进技术。

智能社会在东西方社会中的定义不尽相同，但我们可以引以为鉴。例如，英国的智能社会目标是充分利用现代技术的潜能与动力，使国民有更大的生产力；把资源重点用于重要的经济活动和社会关系；最终改善全社会健康，幸福和生活质量。他们把智能社会定义为：一个成功地发挥信息技术潜力，高效运用联网设备和全球信息网络，以改善公众生活为目的的社会环境。他们提出的智能社会的 5 个要素是：数据化的信息文化；科技化的知识公民；网络化的执行机构；现代化的管理设施；和开放化的市场平台。（参见：Levy, “Towards a smart society”）

在西方现代社会，创新被视为一个持续发展的过程，而不是特殊的，独立的活动。现代社会和企业组织注重创新型发展，例如，美国现代化企业把创新看作持续的企业文化和企业发展的力量源泉，把创新能力与质量，领导力，产量看得同等重要。他们的做法是：1）建立好思路和新想法的管理与跟踪机制； 2）启动各种信息交流研讨会，协调跨业务、跨部门的创新；3）寻找与具体创新任务（如：策划）相适配的创新顾问；4）把创新与其他关键工序连环相扣，包括财务，商务和技术引进等。

这些创新型企业更把创新视为系统与机遇，体现出灵活创新的风格，采用各种新发现并抓住机遇。他们的做法是：1）不断监测并发现企业内部的创新能手，让他们去带领新方案，逼他们落实于行动。2）头脑开放，对外界的好想法，他们会想方设法与内部的项目挂钩。3）不断试验新概念，做一事，进一步，从中学会很多东西；4）积极与思路相近的，互不竞争的公司合作，从中发现新的观念和趋势。

2. 智能化创新的中国特色

结合中国改革开放新常态，智能社会意识形态应立足三个代表：代表社会文明，代表中华多元文化，和代表现代社会进步与发展。意识形态创新要引领中国的改革开放，思想观念的进步和中国社会发展。意识形态创新的方式与路径，既要避免因循守旧，又要防止诉诸于暴力和革命运动。以史为镜，意识形态不能及时地、持续地推陈出新在中国近代历史上留下严重后果：经常引起暴动与革命，从太平天国，五四运动，到马克思主义，斯大

林社会主义的引入，归其原因就是当时中国传统文化和观念的严重陈腐与滞后。然而这在以创新为发展动力的智能社会主义的发展过程中应该会及时避免。意识形态的智能化创新靠的是社会所认可的先进模式能够持续地、逐步地取代传统的和现有的落后模式，完全不必靠打破既有传统和消灭异己势力的大革命或暴动模式来完成时代变革。智能化创新采用的是推动现代社会进步的技术革命模式：其推陈过程应包括对现有模式的拆解，切割，反相，重组和改造；而其出新过程靠的是更为先进的智能化创新的方法和策略，这在下面第三部分要具体阐述。

改革开放后中国领导人 30 年来针对意识形态的发展必要性，提出继续革命的理论。习近平指出："中国的社会主义建设，分为改革开放前 30 年和改革开放后 30 年两个历史时期，本质上都是中共党领导人民进行社会主义建设的实践探索。"（德国之声中文网）改革开放前，社会主义建设的实践探索主要以坚持和借鉴前苏联社会主义革命和建设经验，缺乏自我创新与发展，使中国社会遭受巨大灾难，导致社会主义濒临崩溃的边沿。改革开放后，党内意识形态的发展经历了几个重要阶段，邓小平实事求是，根据中国实际情况出发，建立改革开放和中国特色的社会主义理论、之后江泽民继承改革开放的成果，创立了三个代表思想、胡锦涛提出科学发展观，中共在坚持马克思主义观点的同时，把坚持和发展中国特色社会主义的意识形态创新提到前所未有的高度。

总结中国社会主义建设前 30 年和后 30 年的经验教训，对中国第五代领导人来说都是创新性思维和反思。无论前 30 年和后 30 年，虽然经验不同，但都已是中国共产党历史的经验。而把改革后的 30 年也作为一个发展阶段进行总结，是习近平总书记要求全党坚持继续革命的重要实践。登高而望远，更上一层楼。社会在发展，历史的经验不能照搬，意识形态也不能固步自封。

意识形态建设要接地气，适应中国社会和文化发展的特点。与落后观念一样，意识形态如果不接地气也要靠边站，接地气指的是既要传承中华优秀传统，又要接近当代民间草根文化。随着改革开放和思想的解放、大众意识观念也在不断更新，科技进步、市场经济发展、创新 2.0 的逐步展现引发了与时共进的创新社会形态。因此，这种新常态呼吁意识形态的跟进，必须适应社会变革的需要及其带动的社会大众道德观念、爱好趣味、价值审美的变化，以及文化多样化的发展趋势。

智能化创新与开放性思维难舍难分，创新必然要求开放，要求我们突破传统思维定势和狭隘眼界，多视角、全方位看问题。开放性思维与形而上学思维是根本对立的，后者把事物彼此割裂开来、孤立起来、封闭起来，使思维具有保守性、被动性和消极性。纵览改革前后各 30 年的经验教训，坚持开放性思维本质上就是要反对形而上学，反对教条主义和坚持实事求是的科学态度。当执政党具备了开放性思维的头脑和能力，就能够不断地有

所发现、有所发明、有所创造、有所前进。创造性是人类思维的本性，是人类思维得以发展和进化的内在活力和内在根据。例如，目前中国科技界所推崇的互联网思维，就是与新时代发展相适应的开放性思维。是互联网行业中企业生存与强大的法则，包括 1）用数据驱动运营；2）免费功能刷新，增值服务作为主业务；和 3）微创新，快速迭代。互联网企业只有遵循这些法则，坚持创新，才不会被淘汰。

智能化创新离不开科学思维方法。科学思维有三个要素：思维的理性化，推论的逻辑化和结论的实证化。理性思维与知识获得之间的关系是哲学家们反复思辨的对象。科学思维实践包含了二个方面：一是方法，二是态度。理性的科学方法就是指要应用合适的现象和事实，以符合逻辑的推理方式，导出相应的结论。理性的态度是指在材料收集，推理过程和作出结论的各个环节中能保持客观，审慎，理智和深思熟虑，更不能感情和意气用事。

现代科学是一种完整的科学体系，既包含科学知识又包含科学思维。然而对大多数人而言，一提到‘科学’就会想到狭义的科学知识和技术发明，例如数学，物理学，化学，和生物学或计算机，互联网和航天登月等等；广义来讲，科学知识当然也包括社会科学和一部分人文科学。科学思维指的是学者们如何从观察现象出发，通过严密的科学思维，得到正确的结论，最后成为我们今天所学的科学知识。正确的科学的思维方式正是获得科学知识的前提。如果我们仅仅学了科学知识，没有独特的科学思维方式，就不可能产生出原创性，突破性的新知识。

3. 智能化创新线路图

智能化创新是现代社会发展的必然途径。智能化（SMART）创新文化促进了西方文明，已经在西方国家的企业组织与社会项目管理中广为实践，并大大提高了企业与组织的绩效。美国著名的管理学专家保罗·迈尔在 《态度决定一切》 中介绍了创新型企业设定智能化（SMART）创新目标的五项指标。（Meyer）这种可程序化的创新文化模型仅由五个简单、易懂、好学、实用的智能指标所构成，这五个智能化目标法则分别以首字母为 S.M.A.R.T. 五个英文单词组成。S（Specific）代表具体化，M（Measurable）代表可测性，A（Attainable）代表可行性，R（Relevant）代表相关性，T（Time-bound）代表定时性，分述如下：

具体化（Specific）要求创新目标是具体的，不是普通的，要清晰无误，不能含糊不清。要使团队的目标具体化，就要准确告诉他们所期望的是什么，为什么很重要，要涉及那些人，发生地点在哪里，以及重要特点是什么。设定这样的具体目标一般要回答 5W 的问题：是什么（What,什么项目），为什么（Why,目标是什么理由，完成目标的好处），

在哪里（Where,发生在什么地点），是何人（Who,谁将参与），有那些（Which,什么要求和限制）等。

可测性（Measurable）指标要求用具体标准来测量要实现创新目标的进度。如果一个目标是不可测量的，就不可能知道执行团队是否能成功地完成其进度。衡量进度能帮助团队不脱轨，并按时达到其预期的阶段目标，而团队也能及时体验完成任务和获得成就的喜悦，并受到激发，不断努力，达到最终目标。可测量的目标要回答这样的具体问题：1）价值多少？2）多少人参与？3）什么时间完成？4）所有指标是否可量化。

可行性（Attainable）指标强调创新目标是真实可行的。可行的目标会吸引团队去实现。目标不能空泛、渺茫，既要力所能及，又要有挑战性，不然便会失去意义。只有当你感到一个目标的意义重大，你才会想方设法去实现它。目标的可行性通常会回答如何做的问题：例如，1）目标如何实现？2）在各种限制条件下，目标的真实性如何？

相关性（Relevant）指标强调所选择的创新目标要至关重要。至关重要的目标将会带动团队，部门，和组织一起前进。一个目标只有对准组织的发展方向，支持组织的其他目标，才是密切相关的目标。很多时候，要实现一个目标，你需要组织内的多种支持：需要资源，需要有人站台，需要有人破除障碍。因此，你的目标必须与你的老板，你的团队，你的组织密切相关，因为你需要获得他们的支持。

定时性（Time-bound）指标强调该创新目标要在一定时限内落地，就是要限定完成目标的日程。承诺完成限期会帮助团队届时集中努力去完成目标。智能化（SMART）目标的这项指标是为了防止目标的拖时和误期，因为在组织机构中的每天都会有干扰和危机出现。有时限的目标就是为了建立一种完成任务的紧迫感。具体说来，有时限的目标通常会回答这些具体问题：1）什么时候完成？2）从现在起 6 个月后能做什么？3）从现在起 6 周后要做什么？4）今天我能做什么？

美国创新型企业通过建立创新目标的程序化和常态化，将之作为竞争利器，利用创新使自己与众不同。他们鼓励创新的做法有 4 点：1）在各个业务部门定期开展培训，集思广益；2）在企业规划和战略部署中注意使用创新方法；3）以公司的核心竞争力为出发点，不断创新；4）在产业并购中引用创新方法作为一个重要部分，依此发掘与分析并购目标的增长潜力。

结论：

智能社会主义脱颖而出，是一种意识形态的新思维。随着信息技术的发展和现代化网络社会重组，从智能物质增值，智能物质管理，到智能社会的管理与协调，智能社会主义模式

将无以伦比的优越，融会东方与西方世界。相比之下，资本主义基于工业化无序发展和自由化市场盲目竞争的经济发展模式作为落后的生产力将在西方世界被自然淘汰。智能社会主义的共享观念与社会协作理想在世界范围内将取代靠机器榨取劳动和借资本滋生利润的资本主义的价值观念。基于智能化资源共享，知识共享，权利共享，产品共享及社会共享的社会广泛协作模式将远远超越基于压迫与反抗的阶级斗争模式。当资本主义被淘汰，缺乏对立面的共产主义斗争哲学将变得虚无缥缈，终将退出现代社会的主流意识形态。

正如科学思维为现代社会发展构建了强大的深层架构，智能化创新为智能社会发展编制了先进的路线图。随着智能化创新的持续发展，人工智能（AI），商业智能（BI），治理智能（GI），和运营智能（OI）等社会智能要素都可以在功能，量化和程序化方面得到不断拓展和提升。不久的将来，更多的象 AI，BI，GI，OI，的专业智能模块将会如海潮般涌现，经过进一步的智能化（SMART）创新合成，量变势必引起质变，即可成就明日智能世界的智慧文化环境。在创新文化，智能文化，智慧语言和智能科技的交织作用下，以目前智能科技发展每 18 个月倍增一代的更新速度，到改革开放的下一个 30 年完成之际，智能科技将经过 20 代的翻番，届时，一个美好的明日智能社会将会更加璀璨夺目，屹立在世界的东方。展望未来，一个基于共享、开放，智能化平台的智能社会主义轮廓如东方红日，呼之欲出，她将为西方文明所青睐，也为东方世界所瞩目。

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How To Make Professional Consultant Presentations

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Peter Drucker said "Communication is always "propaganda". In other words, it always makes demands that the recipient become somebody, do something, or believe something."[i] As a consultant, you want to sell your consulting service to the client to convince them that hiring you is one of the best decisions that they have ever made. Besides your professional work, a persuasive and impressive presentation would be the other selling point to make the propaganda "hit the spot".

Why Communications Skills are Critical

Why are communication skills so important? Warren Buffett once offered advice to a group of business students. He said communication skills would increase their value by 50 percent. "Right now I'll pay $100,000 for 10 percent of your future earnings. If you have good communication skills, see me after class and I'll pay you $150,000".[ii] According to Buffett, the communication skills are the "soft skills" that translate into hard cash. I used to work at a TV Station in China, and almost all my colleagues admit that Mr. Chen, the editor for a legal program, was the smartest and most talented guy at our station. He always came up with the most "fresh" ideas and impressive proposals. However, because he was not a public speaker he was not considered by the senior management team for promotion to producer. He would rather put his thoughts in a proposal to the producer instead of presenting it at a meeting, and he barely spoke at meetings to express his innovative thoughts. Everyone knew that his producer counted on him very much, but the producer never worried about being replaced by him, as he was lacking a very important skill, which is presenting.

In the consulting industry, presentation skill is crucial. As a successful consultant, you need not only the capability to complete the assignment professionally, you also need to have the ability to present your wonderful work to your client. If you present your project very well, besides the monetary award, you may get more referrals.

Good News about Communication Skills

The good news is that communication skills and especially presentation skills can be learned. Peter Drucker said "Communication,…. It always appeals to motivation. If, in other words, the communication is congruent with the aspirations, values, or purposes of the recipient, it is powerful"[iii]

To motivate your audience effectively, you need to focus on (1) professionalism, (2) organization, (3) preparation, (4) practice and (5) presenting it with enthusiasm.[iv] Let's look at each of these in turn.

Be a Professional

McKinsey & Company is considered as one of the most prestigious and most expensive management consulting firms, with over 9000 consultants working in 60 countries. Many of McKinsey's alumni become CEOs of major corporations or hold important government positions[v]

This is how Marvin Bower, the godfather of McKinsey and Company understood the level of professionalism that the consultant should have. This is a quote from the McKinsey website:

"Bower held both a JD and an MBA from Harvard University. He adamantly believed that management consulting should be held to the same high standards for professional conduct and performance as law and medicine[vi]

The Guardian newspaper said, "at McKinsey hours are long, expectations high and failure not acceptable"[vii]. All consultants at McKinsey hold themselves to a higher standard as a professional. Presentation is the opportunity to show your professionalism to your audience. Always dress in appropriate business attire, arrive early, have a smile on your face and greet your audience. Make sure your handouts have no typos or grammar errors. A short and to the point PowerPoint will make your presentation look more professional. The consultants at Mckinsey follow the same rules to create their PPTs, such as using muted colors for slides with no spectacular animations, with only very simple and clean data graphs displayed on the slides.

Organization: Sometimes Hard to Live with; but Always Impossible to Live Without

The purpose of a well organized and high quality presentation is to satisfy your client. The purpose is not to make you feel good about your plan for the presentation. Drucker knew that we had to look at the quality through the eyes of the customer, because it is the customer alone, whose willingness to pay for a good or a service converts economic resources into wealth. What the business thinks it produces is not of first importance. What the customer thinks he is buying, what he considers value, is decisive---it determines what a business is, what it produces, and whether it will prosper [viii]. Once your client is convinced and tells you that your presentation is exactly on what they need to know, and they are very happy about hiring you, this is exactly what they need, you win, both monetary reward and reputation.

The key elements of organizing a presentation are to answer some very basic questions: Why are you making this presentation? What do you hope to accomplish? Who is your audience? How you would succeed in the presentation? You must plan to inform your client of the methodology that you used to come to a conclusion on the recommendations. Therefore, the objectives of the presentation should inform, convince, get the recognition, or to build a relationship.

Organization: Here is a template of a Marketing Plan Presentation structure[ix]:

- Introduction
- Purpose/Goals
- The General Situation
- Problems, Opportunities, and Threats
- Competitive Advantage (s)
- Grand Strategy
- Marketing Strategy

- Marketing Tactics
- Implementation and Control
- Conclusions/Recommendations

The structure of the presentation is very important for a successful presentation. Make your presentation structure clear and logical, so your audience can follow and understand you better.

It's all about Preparation

In the spring of 1970, The Apollo 13 spaceship faced repeated crises as it circled the moon, while most of NASA's ground control center almost gave up hope for the survival of the Apollo 13 spaceship crew. The director of the flight operations, Gene Kranz, assembled the NASA team to try every possible way they could think of to eventually bring the astronauts safely back to the earth. His motto was "Failure is not an option".

In the consulting industry, failure is not an option either, moreover, as a consultant, you'd better not wait until some accident happens during your presentation to "rescue" yourself, as it would be too late and too risky to ad lib. Drucker wrote that the best plan is only a plan, merely good intentions, unless it "degenerates" into work. [x] This is absolutely true for the consulting presentation. You need to be prepared as much as you can in advance to ensure everything will work out okay, take necessary actions, or make modifications efficiently in order to reach the intended goal

Visual aids are important. More power point slides don't make you look professional because the audience is not expecting to see your whole report in your PPT. Storytelling displays your expertise, which is also a compelling way to keep your audience concentrated on what you are talking about. Make your slides simple and clear with short titles and descriptions on them, and make sure that the font is big enough to let your audience see it. Videos and images will make your presentation "colorful" and vivid.

Have printed copied of your power point (If your audience size is large, prepare enough copies that everyone can at least share with someone else).

I once had a boss who told us a story of his very first presentation experience in his early 20s that he was pretty sure that he had memorized every single word that he would say before the presentation, but his brain was empty right after he stepped on the stage. He pulled out the note card and read everything on it. It was not a successful presentation after all, but in this case, he at least had the notecard to complete the presentation.

Do research on your audience and the presentation site.

Find out the age, education, and background of your audience to make sure you have the best communication channel between you and your audience. You should not focus too much on explaining the high-tech issues in front of a group of people who don't have the relevant background. When you get a chance, take a quick review of the seating arrangement to make sure you stand at the best place where the audience can see you and the screen clearly, as well as listen

to you with the minimum distraction when you present. [xi]

Practice, Practice, Practice

The more you practice your presentation the more confident you'll become. Good time management, live rehearsal and demonstration will help you build confidence to give a successful presentation.

Peter Drucker said that "Time is the scarcest resource, and unless it is managed nothing else can be managed." [xii] Controlling the time is very crucial to an effective presentation. When I worked as a journalist at Dalian TV Station in China, SARS (severe acute respiratory syndrome) first broke out and spread in the city. We decided to do a live program interviewing patients in the hospital that was treating the SARS patients to let the public know more about the disease and how well those patients were been taken care of. It was a challenging or even a risky interview, because those patients are still highly contagious, and according to the officials of the hospital, our reporters were only allowed to stay in the hospital for 1 hour with full protection, such as mask, gloves and a hazardous material suit. We spoke with the interviewees over the phone in advance to make sure what they would say as to follow our time table. We calculated the time carefully and made the time table for every segment to make sure we made full use of this 1 hour live program without any gaps. It was a very touching and impressive live program, and our experienced reporter filled in a gap with 2 minutes of improvisation because an interviewee said very little due to nervousness. For a live show on TV, we can't shorten it by or exceed even 1 second, as every program, even a 10 second commercial has been precisely calculated and scheduled when it's on air. A time error would be a disaster to the technicians because there would be either a gap with no signal or an upcoming program being cut out. A professional consultant should also always stick to the time limit that a client has allowed for the presentation.

Rehearsal with a Live Audience and Video Taping Yourself

People devote 90% of their preparation time to content. Yet studies show that only 10% of audience response is based on a presentation's content. [xiii] People are more affected and motivated by a presenter's presentation skills, such as facial expression, eye contact, gesture, pace, and volume of the voice. This is why Apple founder and former CEO, Steve Jobs' presentations were always touching and emotionally connective. He spent a lot of time on rehearsal until he looked casual and natural.

Ask your spouse, other family member, or close friends to watch your rehearsal, remember to pretend it is a real one, not to just go over the slides with them. At the same time, videotaping yourself, so you and your "audience" can watch it afterwards with you to praise or criticize you. Be ready to hear and be open to lots of criticism and don't lose your confidence. You would be the one to decide which areas that you need to improve in. It would be great if you can practice at the location that you are going to present at, so you can familiarize yourself with the environment there.

Live Demonstration Needs to be Live

If there's some demonstration to be done as a part of the presentation, always prepare for any live demonstrations by actually doing them yourself or, with a team member. If there are video links inserted in the slide, make sure all of them work. I remember when I was in college and one of my classmates couldn't open the link on the slide for the video during the presentation, so he had to copy and paste the link on the browser. He accidently clicked the link twice because he was getting anxious, and it turned out two videos were opened at the same time on YOUTUBE, but with different commercials. When he tried to close one of them, he accidentally closed both…. Therefore, always assume that everything that could go wrong would go wrong during the real presentation. That way you can avoid the threat or at least prepare for it ahead of time.

How to Overcome Nervousness

I was an intern as a teacher in a high school teaching ideology and morality, and I had 60 students in my class. I memorized everything that I needed to say before my very first class, as it was my first time to teach after 4 years of study at the Normal University. I was very excited and nervous, which made me finish my whole class in 30 minutes, and I had nothing for the student to do for the next 20 minutes. Fortunately, students liked me, and they asked me to sing songs with them until the school was dismissed as they had never seen such a young teacher connecting with them that much in class. I was all sweaty after the class, and I thought that I could've done this better by controling my pace, or having more interaction with my students to make my timing better. To overcome nervousness, videotaping yourself would definitely help, as you may assume that thousands of your audience are watching the monitor in the other room, which makes you feel intense. However, you'll get used to it after your second rehearsal. This is the same training that I had when I worked at the TV Station in China. When I got used to doing the live reporting and learnt to only concentrate on the camera in front of me, I could even ignore the staring, waving hands and funny faces that came from the bystanders. Visualizing everything that would happen during the presentation the night before the presentation, would help to build confidence by thinking positively. Another strategy would be lying down without doing anything else, but going through the presentation from start to finish, and "seeing" how happy the client was because of your excellent job. [xiv] I actually use the split-focus technique, which is to visualize the presentation while I physically do something else. [xv] I whisper my presentation when I'm taking a shower, or looking into the mirror when freshening up, or walking around the neighborhood. Instead of being distracted during rehearsal by thinking too much about how the audience would react while I stood up in a room, I felt more relaxed if I was physically doing something else during rehearsal. And this kind of "distraction" helped me better handle other disturbances during my real presentation.

With Enthusiasm You Can Move the World

Every consultant needs to have outstanding presentation skills in order to update the client about the progress or to pitch a potential client. Moreover, presenting is a "conversation" between your client and yourself, in which both parties find the connection and mutual benefit. According to Drucker, "communications, in other words, may not be dependent on information. Indeed the most perfect communications may be purely shared experiences, without any logic whatever." [xvi] Use appropriate eye contact, facial expressions, gestures and movements to communicate with your client. Be loud enough to show your confidence about how well you know your stuff. Talk to your client and have the conversation and discussion going on during your presentation. Use storytelling skills and your personal perspective make your presentation go across to their brain and heart.

Show your empathy and listen to your audience's questions, and control your own presenting time in order to answer questions, and build more connections with them. Remember your client is your friend, not your enemy that you are trying to demolish, even though they might sometimes snipe at you, but they are still friendly snipers. [xvii] Therefore, try not to get into an argument with a client, and not give long-winded answers so as to lead to more in-depth questioning and arguments.

With 8 years of journalism experience at a TV Station in China, I thought I knew how to present myself to the public, however, to present in front of the consulting client as a consultant, is absolutely different from talking to the camera. Professionalism, planning, preparation and practice as well as learning how to overcome the nervousness definitely helped me go through the conversion from actor to an effective communicator as well as through 12 consulting projects and making team presentations to 12 clients during my MBA study at the California Institute of Advanced Management.

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张治中对国家和民族的历史贡献

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今年 10 月 27 日，是中国近现代史上著名的政治家、军事家、战略家，杰出领导者和伟大爱国者张治中先生诞辰 125 周年纪念日。在中华民族致力于实现伟大复兴中国梦的历史时刻，缅怀这位抗日名将，“和谈将军”，重温他对国家和民族的历史贡献，是具有非凡意义的。

张治中是一个有血性、有勇气、有谋略、有能力的高级将领。抗日名将，优秀军事家。

1932 年“1.28 淞沪会战“。当时，屯据在上海的日军依仗武器先进，蓄意挑起事端，大举攻击我上海守军并取得连胜。在此危急时刻，张治中将军主动请缨参战并领导新组建的第 5 军支援第 19 路军，取得了“庙行大捷”等一系列胜利。粉碎了日本侵略军妄图一举占领上海吴淞要地的战略部署，并迫使他们改变全面进攻策略，最后在各国调停之下不得不签订停战协议。“庙行大捷”痛歼日寇 3000 余人，给予日本侵略军致命一击。此次胜利，是自日本帝国主义于 1904 年在旅顺发动日俄战争取得胜利，在事实上侵占中国国土，并在 1931 年“9.18”事变后全面侵占我东北以来，中国军队对抗日本侵略军取得的第一场战役胜利。此役为中国军队赢得了国际声誉，无情打破了日军不可战胜的神话，极大的鼓舞了中国军民抗击强敌的精神和勇气，也沉重地打击了日本军国主义的野心和信心。

1937 年的“8.13 淞沪会战”。日本侵略者在发动 1937 年“7.7 事变”后，积极谋划对全中国的军事进攻。他们妄图通过速战速决，一举摧垮中国政府和军队，进而占领全中国。张治中将军作为京沪警备最高军事长官，面对国内恶劣形势和日本侵略军企图，始终保持高度警惕，积极制定御敌计划，做了充分的战争准备。始于 1937 年 8 月 13 日的淞沪会战，中国军队先后投入总兵力达 75 万余人，日本侵略军也投入近 30 万精锐，是中国抗战过程中最大规模的战役。此役历时三个月，歼灭日寇 6 万余名。由于日军武器装备先进，训练精良，战斗力强大，而中国国力、军力皆不济，最后以中国军队从上海全面撤退告终。

张治中将军从战前筹划战事准备，制定御敌之策，到开始指挥将士对日全面开战，直至九月中旬被调离前线。面对强大敌人和不利形势，他精心筹划，周密组织，不畏凶险，奋勇抗敌。敌军依仗武器先进、不断增兵，战场形势不断恶化。而国内最高指挥者寄幻想于列强参与调停，故迟疑多变，使得部队指挥和调动乱象频出。张治中为此忍辱负重，殚心竭虑，付出巨大，以至于身体倦极而病，不得不退出战场。

但是，“8.13 淞沪抗战”，成功的粉碎了日本侵略者妄图速战速决解决中国战事的战略构想，为全国、全民族抗击日本侵略，争取了有利的战略时机。张治中的高超指挥和勇敢决心，为中华民族在世界列强中赢得荣誉，也提振了全民族抵御外强侵略的信心和决心。

纵观张治中将军的军事生涯，共五次统兵为帅。两次淞沪战役奠定了他作为军事家，抗日名将的地位。第一次淞沪会战，他慷慨留下遗书，表明“尽忠国家的最大决心”并立下“必以誓死之决心，为保卫祖国而战”的誓言。(1)

两次“淞沪会战”，张治中均为主要领导者和指挥者，为中国全民族抗战贡献居伟。张治中将军这样具有高度爱国情怀，有血性、有高超指挥艺术、有谋略的军人也是当今中华民族军人的楷模。

张治中先生目光远大、心胸宽广、勤于思考、勇于实践，是具有强烈民族意识的政治家。

对内，他始终主张和平解决国内政治分歧，促进全国和解，倡导发展经济，振兴民族和国家。他带头垂范，以实际行动深刻影响了一大批国民党内的政治人物，在当时国民党内部形成了一股主张政治与和平解决国内斗争的政治势力。他两次作为国民党主要代表，主导国共和谈，积极推进国共合作。为了国内和平，他三去延安，巧妙利用美国的政治支持，为国内和平做出巨大贡献。当毛泽东到重庆谈判时，他为了保障和谈成功和中共主要领导人的安全，把自己在重庆上清寺的桂圆官邸让出来供毛泽东日常办公和休息。毛泽东赞扬他：“你是真正希望和平的人”(2)。为了和平解决国共政治分歧和军事斗争，他四次给国民党最高领袖上书，公开主张，坦陈利弊，敢于直言，不计较个人荣辱得失。

他在湖南主政时期胸怀全局，革除时弊，厉行改革，助共抗日，打击投降主义和分裂主义，为全国抗战作出正面示范。“西安事变”时，他坚持认为国家不能在全民族抗战期间陷入分裂和群龙无首的局面。坚决拒绝以何应钦为首的主战派的拉拢，拒绝担任讨逆中路军总指挥，坚持和平解决方针，为和平解决“西安事变”起到了重要作用。

他主张开放政治和实行民主共治，主导民族和解和睦政策，成功解决新疆分裂事件，维护了国家主权。他始终重视教育，无论在哪里主政，都能推出一系列具有前瞻性和革命性的教育政策，对当地，对全国都产生现实和长远影响。他在新疆排除干扰和阻力，成功营救出落难被囚的共产党人 131 人，并将他们安全护送至延安。这些人里有很多人日后都成为了国家建设骨干，尤其是新中国航空业的中坚力量。他积极促成包括新疆在内的和平解放，为大西北和平与建设贡献颇丰。

抗战胜利后，他站在国家和全民族立场，一再告诫国民党最高领导人不能再开内战，并为国内和平与国共合作奔走呼号。经过以他为代表的和平力量的不懈努力，成功地缓和了当时的国内紧张形势，也使得美国政府更加了解共产党在当时国家中的地位和作用，客观上对中国共产党日后成功帮助甚大。

张治中是国民党内具有重要影响力的领袖人物，长期居于决策层。他的政治主张一贯从国家利益和全民族利益出发，是当时统治阶级内部持久的进步能量。对于瓦解旧势力和腐朽政治，为民族和解与国家和平，他都能不惧风险、不畏艰难、不计得失，并做出巨大贡献。在复杂国际形势之下的海峡两岸长时间处于久分不合的历史时期，国家和民族更需要张治中这样具有高瞻远瞩、坦荡胸怀、敢于实践、不计个人得失的政治家。

对待整个民族和国家长远发展战略问题上，他是倡导和实施民族和睦政策，积极主张全方位外交的战略家。

在处理北疆暴乱和主政新疆期间，他制定若干项符合时代的民族和睦、和解、民生政策，有力地维护了国家统一完整和民族团结。之前，军阀盛世才以殖民和暴力政策统治新疆多年。盛世才的暴政和暴敛政策，使得少数民族经济困顿，民族间仇恨有增无减。1944年9月，新疆伊宁发生武装暴动。至1945年8月，北疆的伊犁、塔城、阿山三区另立政府。分裂势力参杂期间，试图建立“东土耳其斯坦共和国”，彻底分裂新疆。国际方面，1945年8月14日，斯大林主导的外蒙古独立成为事实。继而，斯大林又想支持北疆独立，意欲使其成为苏联加盟共和国。面对国内外复杂而严峻的形势，张治中坚定主张必须以政治手段解决新疆问题。他敏锐地指出：“新疆问题症结，从历史观察固然存在民族问题，但主要是政治问题。”(3)

他几度进疆，和三区领导层展开艰苦谈判，最终在1946年1月2日达成《新疆和平协议》(4)，并在1946年7月1日成立新疆联合政府，圆满的解决了新疆事件。

张治中治疆，是在内忧外患的险恶环境之下进行的。张治中以高超的政治智慧和胆识谋略，积极化解矛盾，坚决打击分裂势力，积极团结进步势力，维护并加强民族团结，致力发展经济，革除暴政。使得中国最大的边疆安全形势得到空前的巩固，维护了祖国的统一和完整，维护了中央政府的权威，也为全国各民族和睦做出了表率和引导作用。他的战略家胸怀和深邃思维，对于当今国家的民族和睦与自治政策都具有现实和长远意义。

张治中作为战略家，一生重视教育。他在主政湖南和新疆时，都制定政策兴办和扶持教育，善于保护和使用人才。1927-1937年，他担任国民党中央陆军军官学校教育长，他的学生是北伐和抗日的骨干力量。在1937-1938年湖南主政期间，他主导4000名学生培训参政，“六个月后，在这些青年教育培训下，具备现代国民的基础知识与精神的民众已有70万人，组成了卫国卫乡的武装力量”。(5)

从1929年起，张治中筹集资金，在家乡——安徽省巢县建立黄麓师范学校和两所小学，并亲自担任师范学校名誉校长。张治中十分重视少数民族教育，在1946年成立的新疆联合政府中，专门设立一个教育厅，并任命赛福鼎为厅长。他说：“要想新疆不变颜色，必须从经济建设和文化建设两方面着手。他亲自写一份名单，准备邀请一些名人到新疆讲学，有陶行知、卢致德、田汉、晏阳初、梁漱溟等。可惜这个计划因当时时局影响没有实现”(6)。作为国民党决策层人士，唯有张治中能抛开政治噬利心态，排除干扰，重视并积极实施惠及民族与子孙后代的教育政策。

中华人民共和国成立后，针对国情和错综复杂的国际形势，张治中向最高领袖直言建议：亲苏也亲美。他分析道“一，现在的世界是美苏两国争长，中国在中间举足轻重，是两雄争取的对象，中国投向哪一方，哪一方就占优势。二，中国统一以后，就要从事和平建设，国家百年积弱，百废待举，又是一个人口众多，幅员广阔的国家，光靠苏联帮助不够，还要利用美英法等发达国家才行。三，现在交通日益发达，各国人民贸易往来，互通有无，是正常的事，是任何国家也无法避免的。从长远看我们不但要和苏联做生意，还要和美英法等发达国家做生意，而不能像清朝那样闭关自守，夜郎自大，画地为牢，固步自封。”(7)

历史实践证明，他的论断是正确的，长远的，是具有战略家眼光的。如果为当时最高领导层采纳，无疑会对中国建设与发展以及国家环境产生重大影响。

在执政一方的时候，他是能迅速改变不良局面、匡扶正气、除恶去毒、化腐朽为奇迹的杰出领导者。

1937 年 11 月，张治中主政湖南。在国民党政府为抗战迁都重庆以后，湖南由大后方变成了大西南的门户，同时地处连接中南地区枢纽之位置，战略地位非常重要。但此时的湖南在何建长期统治之下，百弊纵生，社会动乱，遗患甚多。重点表现在官员贪腐，财政亏空，伤兵为患、土匪横行，整个社会处于极为动荡和混乱之下。张治中上任后，即昭告全省军民：“我是为了做事到湖南来的，我只知道为国家服务，为人民服务。我绝对不是来做官的，我绝对不是来这里苟且偷安过因循的日子的。”(8)

他到任后，立即制定有效政策，采取有力措施，实施以整肃官吏社风，整治兵患、匪患，整顿财政、改善民生，改革、改进教育为主要内容的新政。

张治中上任后，只用一个多月时间，就有效解决了严重困扰湖南的伤兵问题，恢复了社会安定。同时，撤销了 80 余个各部队自行设立的招兵机构，实施中央统一兵额，省统一征兵的方法，彻底解决了军民严重不和的社会问题，也使役政走向正轨。此方法被中央政府采纳，并依此制定“战时募兵统制办法”在全国范围内实行，有力的支援了抗战。面对匪祸长期为患的实际情况，张治中一面着力恢复经济，改善民生，改善社会环境和风气。另一方面采取剿抚结合，民众自卫方针，并成立湘西绥靖处，初步解决了匪患困扰。

更为重要的是，张治中深知官场风气对社会风气的引导和形成具有至关重要的作用。因此他上任后，集中精力整肃官场、整顿官风。通过严禁公职人员赌博，严惩贪污腐败官员，严查官僚和渎职行为，培养和任用人才等措施。在短时间内使得湖南官场风清气正，为良好社会风气的恢复起到决定作用，湖南也因此成为民主人士和进步青年聚集的地方之一。在财政方面，通过开源节流，废除苛捐杂税，严禁非法摊派，确立新的预算制度，改革省县两级财政和金库，实施新的会计和审计制度等措施，有力的促进了湖南经济和财政健康发展，为湖南经济建设和民生持续改善起到重大而长远的作用。针对湖南教育的长期积弊和不平衡状况，他两次专门出巡，调查湖南教育状况。在 1938 年 8 月 8 日至 8 月 13 日召开了湖南全省教育会议，通过一系列决议，使湖南教育走上全面、均衡、持续发展的轨道，其深刻影响一直延续到现在。同时，他张开怀抱欢迎并妥善安置包括安徽省等全国其他省份因战乱迁移的学生，湖南成为学生避难和继续学业的大本营。

在湖南一年多的时间里，张治中以其全局意识、开阔眼界以及非凡能力，严厉整肃腐败官场，打击地方恶势力，清除兵患匪患，安定社会秩序，转化社会风气，有力推广和执行利国利民的教育与民生政策。同时，团结和帮助共产党抗日武装，积极支持了全国抗战事业。他的卓越政绩在全国起到表率作用，也为全国抗战产生了非常积极而重要的影响。他的执政理念和方略，尤其是整肃吏治，打击腐败，改善民生，重视教育等方面，在当今中国都具有重大的现实意义。

他接管新疆事务以后，面对军阀长期殖民时统治所遗留下来的诸多严重社会问题，面对当时苏联大国沙文主义主导之下企图分解并掌控新疆的国际环境，面对地区落后的经济基础和民生条件，面对伊宁三区混乱的分裂势力和分割局面，面对整个新疆民族矛盾抬升和不稳定社会乱局。他牢牢抓住主要矛盾，以维护国家主权和领土完整，维护中央统一领

导和权威，维护民族平等和团结为核心思想。以增加民族自治、扩大民主权利、尊重宗教信仰、促进民族特色生产、推进经济建设、加强文化教育等实践措施为主要内容。在很短时间内，就以其高超智慧和领导艺术，促使《新疆和平协议》成功签订，平息了武装暴动，建立了新疆联合政府，并发布了新的施政纲领。他的政策和措施，很快地提升了新疆的经济和民生，也使得新疆文化和教育得到了空前的改善。短期内就化解了民族矛盾，粉碎民族分裂势力，有效解决了新疆很多遗留问题，为新疆在其后很长一段时间内稳定和发展，包括后来的新疆和平解放，都起到了至关重要的作用。

从历史史实和贡献来看，张治中的治疆政策和效果以及后来长远影响，都远远超过了清朝左宗棠以武力和剥削为主的封建王朝式治疆理念和成果。他的很多治疆思想理念和实践效果，都对当今和以后新疆政策和工作有着长远和深刻的影响。

他始终是一个具有国际视野，强烈爱国情怀的国家栋梁之才，是伟大的爱国者。

在新中国国旗、国名制定中，张治中真知灼见是具有政治远见的、正确的，起到了非常重要的作用。现在的“中华人民共和国”国号，当初定名为“中华人民民主共和国”。张治中力排众议，他认为：共和本来就具有民主涵义，没必要重复，不如直接叫中华人民共和国。此建议被国家采纳。国旗确定过程也是如此，当时很多人倾向于五星红旗中间设三道横杠，意欲代表黄河、长江、珠江这三条主要河流。张治中认为：横杠从来不代表河流，况且国旗中间设横杠，有分裂之意。毛泽东听取了他的这些建议，向政协会议推荐“五星红旗”作为国旗最终方案。国名和国旗沿用至今。(9)

从 1949 年底到 1954 年 4 月，他任西北军政委员会副主席，和彭德怀、习仲勋一起工作。为稳定和建设大西北，贡献居伟。新疆和平解放以后，由于敌对势力不断捣乱破坏，散布谣言，同时面临一系列改编和重整，使得十余万起义部队一度思想混乱，消沉情绪蔓延，不稳定因素发酵。张治中到新疆以后，在起义部队干部大会上，以自己的经历、心路和感悟，连续做了两次推心置腹的长篇演讲。这两次名为《怎样改造》、《再谈怎样改造》(10)的讲话，在整个起义部队引起强烈反响，对起义部队思想转变和情绪稳定起到了决定性作用，对整个新疆的社会稳定和后续发展也起到至关重要的作用。

其后，他的足迹遍布大西北 5 个省区，在大西北地区起义部队改编，促进各民族团结，发展包括铁路建设在内的经济建设，提高西北地区的文化教育，领导土地改革和农业生产等领域勤奋工作，做出重大贡献。可以说这五年是张治中最为充实的岁月。他思想开明，勤政不倦，善于调查研究，对发现的问题开诚布公，直陈己见。西北五省区留下他大量足迹，他为大西北的建设和发展付出了智慧和心血。习仲勋给予他非常高的评价：“文白先生一生为人正派，襟怀坦荡…，在同文白先生几十年的交往中，我深深感到，他态度明朗，意志坚强，不断追求真理，从不固步自封。”(11)

张治中始终关心祖国统一大业，终生为祖国统一，民族团结而努力。由于他长期从事军校教育和长期处在国民党决策层，他的许多学生、故旧、部下都在 1949 年大陆解放以后居于台湾。张治中配合毛泽东、周恩来，先后发表过多次广播讲话，也给在港、在台国民党高层写过很多信函，热忱希望能促进国共第三次合作，以和平方式解决台湾问题。他的真诚用心和艰苦努力，对台湾国民党高层人员产生了积极影响。国民党最高当局也在 1957 年 4 月曾一度派密使来大陆沟通、考察。在张治中的影响之下，很多被特赦的原国

民党高官和将领都为两岸沟通与和平解放而积极工作，他们的努力也为后来海峡两岸的和平做出了巨大贡献。张治中在生命最后岁月里也坚信台湾终将回归祖国，他在遗嘱中说到：“解放后十七八年来，我所日夕念念不忘的是解放台湾这一祖国神圣领土…。台湾是一定迟早要解放的，是任何反动力量所不能阻挡的。”⑿

张治中为人宽厚重情，前后三次探望被软禁的张学良，并为之重获自由而多方努力。他多次探望、宴请被俘后特赦的原国民党高级将领和海外归来的前国民党高官，对他们的工作和生活给予许多帮助，也给予了他们很多的精神安慰和鼓励。即使在法制尽遭破坏的文革时期，他依然能刚直不阿，多次向最高领导人直言献策，为一些落难高官鸣冤叫屈，是当时难得的敢言政治家。

张治中秉承民族大义和高超智慧，在第一次国内战争时期、抗日战争时期、第二次国内战争时期，他始终是国民党内主和派的灵魂和主要代表人物。在他的感召和影响之下，国民党主流社会形成了一股强大的和平势力，为制止战争和减轻内战浩劫做出了杰出贡献。他为了国家和民族整体利益，不停地为休战与和平奔走呼号，成为和平理念的先驱，为民族复兴，新中国成立，建立了不朽功勋。

从辛亥革命到今日的中国，已经走过沧桑巨变的一百余年。当时积贫积弱、任人宰割的“东亚病夫”，现在已经完全屹立于世界最强之列。海峡两岸终将统一，中华民族也一定能够实现伟大的复兴。

在此历史时刻，我们深切纪念和缅怀张治中先生以及他的光辉业绩，历史将永远铭记他对国家和民族的巨大贡献。正如邓颖超所说的那样：“文白先生为中国民主革命和社会主义建设事业做出的重要贡献，将世世代代为中国人民所纪念。”⒀

注明：

⑴摘自《张治中回忆录》

⑵摘录《纪念父亲张治中将军》

⑶摘自《纪念父亲张治中将军》

⑷《中央政府代表与新疆暴动区域人民代表之间以和平方式解决武装冲突之条款》正文以及“附文一、附文二”统称。

⑸摘录《纪念父亲张治中将军》

⑹摘自《张治中治疆思想研究》中《陶天白漫忆张治中》

⑺摘自《纪念父亲张治中将军》

⑻摘自《和谈将军张治中》

⑼见《纪念父亲张治中将军》、《周恩来与张治中》、《和谈将军张治中》

⑽两篇讲话全文见《张治中治疆思想研究》

⑾习仲勋为《纪念父亲张治中将军》作序

⑿摘自《纪念父亲张治中将军》

⒀邓颖超为《张治中回忆录》作序

Mfsd2a 维持血-脑屏障功能的研究进展

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主要促进调解超家族蛋白2A（Major facilitator superfamily domain-containing protein 2a，Mfsd2a）是目前为止第一个确定的可以抑制脑微血管内皮细胞跨膜胞吞转运的分子，同时Mfsd2a亦被证实是DHA（二十二碳六烯酸）进入血-脑屏障的主要受体，DHA是一种omega-3长链多不饱和脂肪酸（LCPUFA）对大脑发育和认知功能正常至关重要，在大脑中的含量最为丰富，因为对大脑有益而被称为“脑黄金”，Mfsd2a被剔除的小鼠表现为脑中DHA水平降低、神经元数量减少、脑的大小和功能均降低。血-脑屏障是一个调节中枢神经系统内环境的细胞屏障，在为脑功能维持必要环境中起至关重要的作用，但却同时阻碍了以穿透血-脑屏障为方向的研究和治疗药物的研发。目前对Mfsd2a维持血-脑屏障功能的研究才刚刚起步，Mfsd2a在临床神经系统的疾病（包括感染、脑肿瘤、阿尔茨海默氏症等神经退行性疾病）的致病机制、实验室诊断、临床治疗和预后监测等方面还都是空白，国内亦无相关研究的报道，近期Nature发表了两篇论文报告了Mfsd2a在血-脑屏障功能的研究，本文将主要对Mfsd2a维持血-脑屏障功能的研究进展做一综述，以探讨Mfsd2a在神经系统疾病的研究和临床应用价值。

1 血-脑屏障的功能。

血-脑屏障(blood-brain barrier，BBB) 指脑毛细血管壁与神经胶质细胞形成的血浆与脑细胞之间的屏障和由脉络丛形成的血浆和脑脊液之间的屏障，这些屏障能够阻止某些物质（多半是有害的）由血液进入脑组织[xviii]。BBB是存在于脑和脊髓内的毛细血管与神经组织之间的一个调节中枢神经系统内环境的细胞屏障，能够维持脑内离子、激素和递质等的动态平衡，是机体最重要的内部屏障之一。BBB是由无窗孔的脑微血管内皮细胞(Brain Microvascular Endothelial Cell，BMEC)及其细胞间紧密连接(Tight junctions Tjs)、基膜(毛细血管基底膜)及嵌入其中的周细胞、胶质细胞（星形胶质细胞、小胶质细胞、少突胶质细胞)和极其狭小的细胞外的间隙结构共同组成的一个细胞复合体[xix]，其中BMEC及其Tjs是BBB的主要形态学基础。BMEC是BBB的基本骨架，是大分子物质通过内皮细胞间转运的屏障。基膜主要由纤维蛋白、IV型胶原组成能防止由于压力改变引起的血管变形[xx]。星形细胞（astrocyte）的足突组成坚韧的胶质膜，覆盖了毛细血管周围大部

分表面积，能维持BBB的完整性[xxi]。三者共同组成紧密连接的网状结构，控制血液与中枢神经系统的物质交换[1,2,xxii] 。机体内BBB这种特殊结构能阻挡病原生物和其他大分子物质由血液循环进入脑组织，可使脑组织少受甚至不受循环血液中有害物质的损害，BBB就像五星级酒店中的保镖一样，只允许一些选择性的分子从血液进入到脑液中，让一些重要的营养物质（如糖类）得以进入，将毒素和病原体阻断在外[xxiii]。这一屏障还确保了将一些废物过滤清除出大脑。BBB帮助维持了微妙的大脑环境，使人类大脑得以良好地发育，从而保持脑组织内环境的基本稳定，对维持中枢神经系统正常生理状态具有重要的生物学意义。BBB若受到破坏，其通透性随之增大，使本不能透过BBB大分子物质（内毒素，炎症因子）自由进出脑部，最终导致脑功能紊乱或丧失。这一屏障是如此的敏锐，同时也阻碍了某些药物通过BBB发挥作用。BBB就像一把双刃剑，一方面这有助于细胞界面保持恒定的环境,为神经元提供最佳的环境和选择性运输系统,调节想要和不想要的分子的通道。但另一方面,它对药物的研发和临床应用造成了巨大的挑战,因为它阻止大多数药物通过血液进入大脑[xxiv，xxv]。由于还不够了解BBB的形成和功能机制，研究人员一直无法诱导打开这一屏障。目前大量研究表明构成BBB的内皮细胞其屏障性质不是与生俱来的，而是在中枢神经系统的特殊环境下诱导产生的。大脑在发育过程中，脑的微血管分化、发育成熟形成BBB[xxvi]。为什么新生儿的BBB不完全，那些分子在BBB的成熟过程中起着重要的作用，作为大脑中的含量最为丰富“脑黄金”--DHA是通过何种途径进入大脑发挥作用的也一直是个未解的谜[xxvii]。

2 主要促进调解超家族蛋白2A（Major facilitator superfamily domain containing 2A，Mfsd2a）

Mfsd2a是哺乳动物主要促进因子超级家族的一个成员，以前被认为是一个“孤儿运输因子”，含有12个α-螺旋的跨膜区结构(Transmembrane domains ,TMDs)的碳水化合物的运载体，每个α-螺旋至少含有17种氨基酸作为他们的TMDs[xxviii,xxix]，Mfsd2a位于人类染色体 1p34，老鼠Mfsd2a基因位于鼠类染色体4D2.2，其在演变过程中相对保守，Mfsd2a编码形成一个59 kDa的MFSD2A跨膜蛋白，并特异性的表达于大脑的血管内皮细胞中，其在大脑的内皮细胞表达量是肺内皮细胞的78.8倍[24]。目前证实有两个Mfsd2蛋白质：Mfsd2a和Mfsd2b,这两个蛋白的序列和结构与细菌渗透酶和同向转运蛋白及其相似，Mfsd2a基因长14.3 kb,由14个外显子和13个内含子,而Mfsd2b基因由13个外显子和12个内含子,Mfsd2a包含一个Mfsd2b没有的基因——内含子9。这种基因组结构上的相似性表明Mfsd2a和Mfsd2b源于一个共同的祖先基因。但通过对序列比较发现与之前报道和命名的Mfsd2b不同，拥有494个氨基酸的Mfsd2a的氨基酸仅仅有59%相似和42%的相同，但老鼠和人类Mfsd2a蛋白质有85%是相同的；通过对Mfsd2a / b和几个不同细菌（包括念珠藻属的藻青菌和大肠杆菌）的Na + /蜜二糖同向转运（melibiose symporter MelB）[xxx,xxxi,xxxii]的比对发现,其与念珠藻属的藻青菌和大肠杆菌分别有47%和43%的同源性。通过对Mfsd2a序列和结构域的分析表明,这种蛋白质参与了Na+/ MelB和其他相关细菌的碳水化合物转运蛋白/透性酶，这表明Mfsd2a亦是主要促进因子超级家族的一个成员，故命名为Mfsd2a，以区别于Mfsd2b [xxxiii]。

共聚焦显微镜证明 Mfsd2a 定位在内质网上，Mfsd2a 在许多组织和饥饿[xxxiv]诱导的肝脏和褐色脂肪组织（brown adipose tissue BAT）中高表达。Mfsd2a 在 BAT 和肝脏中以振荡表达方式存在,其在细胞中的表达量从 0am 开始稳步上升，12am 达到了顶峰,然后迅速周期性的下降，基本上成正态分布，表明 Mfsd2a 是一个昼夜节律的振荡的表达模式。Mfsd2a 大大调节在 BAT 的生热作用,其感应通过 βAR 信号途径控制。研究表明 Mfsd2a 在适应性产热（体温中枢）作用中发挥着重要作用，此外 Mfsd2a 是重要的营养调控的基因，在机体的生长，运动功能，脂质代谢等方面起着极其重要的作用[xxxv]，新生儿及儿童体温中枢发育未完善，体温调节能力差，Mfsd2a 与之是否有关联值得进一步研究。

研究证实 Mfsd2a 表达方式与饥饿[xxxvi重]因素引起的肝脏的变化有关,他同时与在抗生素运输 [xxxvii]以及人类胎盘细胞的融合有关[xxxviii,xxxix],Mfsd2a 在肝脏只有低水平表达，但它不同品系的老鼠中是整个大脑是高度表达的,老鼠缺乏 Mfsd2a 虽然表现为肝脏代谢正常,但却会发展为神经系统功能障碍[xl]。Nguyen 等证实 Mfsd2a 结合 LPC-DHA 并转移到内部脂质小叶,使得 DHA 绕过内皮细胞之间的 Tjs 达到大脑内皮细胞的另一面。DHA 在大脑中的目标仍是未知,也不清楚 DHA 是通过何种形式跨越完全覆盖大脑的周细胞。此外，Ben-Zvi 等还表明,Mfsd2a 抑制内皮细胞的跨膜转运,这种跨膜结构运输着血浆中蛋白质的转运[xli]。Nguyen 和 Ben-Zvi 等都证实 Mfsd2a 在大脑内皮细胞中表达升高的事实表明它在 BBB 中是个重要的角色[24，xlii]。

2.1 Mfsd2a是BBB发育和功能的一个重要调控因子

BBB 在为脑功能维持中枢神经系统正常生理状态具有重要的生物学意义，这种精密的结构可以保护脑组织少受甚至不受循环血液中有害物质的损害，但对于以脑为方向的治疗药物却是一个不方便的障碍。现在约 98%的小分子药物和 100%的大分子药物及抗体都不能通过 BBB。仅有不到 1%的药物试图靶向这一屏障[7]，为了穿透 BBB，大多数试图了解及操控 BBB 的研究工作都将焦点放在 Tjs 上，其阻止了几乎所有的物质挤入屏障细胞之间。Ben-Zvi 等发现 Mfsd2a 似乎影响了不太受到关注的第二种屏障跨越机制：胞吞转运作用（transcytosis）[xliii]，在这一过程中一些物质借助囊泡转运通过屏障细胞。胞吞转运作用常发生在身体的其他部位，通常在 BBB 受到抑制[xliv]。来自哈佛医学院的这个研究小组在小鼠中鉴别出了一个叫做 Mfsd2a 的基因，其可能是限制 BBB 通透性的原因。Ben-Zvi 等发现 Mfsd2a 在 BBB 发育和功能形成中的一个重要的调控因子。该屏障在缺失 Mfsd2a-/-的小鼠中会变得有泄漏，这可能是跨细胞的小泡运输量增加所造成的一个后果[24]。Mfsd2a 或许就是其中的一个抑制因子。这是第一个确定可以抑制胞吞转运的分子，它开启了一种新的方式来思考如何设计出一些策略将药物传递到中枢神经系统。”Ben-Zvi 等通过在发育的不同阶段将少量的染料导入到胚胎小鼠的血液中，观察其是否漏过小鼠大脑微血管的血管壁，如果漏过则表明血液屏障尚未形成，若是停留在微血管内，则表明 BBB 已形成。这使得他们能够确定 BBB 构建的时间窗。研究成年生物 BBB“泄漏”的研究人员通常是将染料直接注入到血管中[xlv]，但胚胎微血管太小，太过精微,而将染料注入到了心脏中会导致血压升高，脑微血管爆裂，难以判断泄漏是由于 BBB 不成熟或是操作染料所引起[xlvi,xlvii]。为了鉴别出了可以避开这些假象，研究人员创新性的将染料注射于肝脏[xlviii]。Ben-Zvi 等创新的这种新的染料注射技术使得我们提供了明确的证据，证实在胚胎发育过程中 BBB 开始起作用，同时确

定了 BBB 在小鼠体内形成的时间胚胎 15.5 天，研究人员通过与来自外周血管和脑血管的内皮细胞对比，寻找基因表达差异蛋白，筛选出了 Mfsd2a 基因[24]。

由于人类也具有 Mfsd2a，在人体中阻断它的活性有可能使得医生能够短时间地开启 BBB，选择性地让一些药物进入来治疗如脑肿瘤和感染等危及生命的疾病。相反的，由于研究人员已将 BBB 退化与几种脑疾病联系到一起，提高 Mfsd2a 有可能使得医生能够增强 BBB，缓解阿尔茨海默氏症[xlix]、肌萎缩侧索硬化症（ALS）[l]和多发性硬化症一类的疾病。这一研究发现对于依赖于胞吞转运作用的身体其他区域，例如视网膜和肾脏或许也具有影响。同时为观察年轻生物 BBB 发育，揭示出对于其形成和功能极为重要的分子具有重要的意义。

除在证实 Mfsd2a 脑血管 BMEC 中的开启作用，Ben-Zvi 等还证实了 Mfsd2a 还在胎盘和睾丸中活化，这两个器官亦均具有屏障类功能。并且，在其他具有 BBB 的脊椎动物（包括人类）都共享这一基因。研究人员发现 Mfsd2a-/-的小鼠，BBB 会发生泄漏。为了了解原因她们将焦点放在两个基本特征上：细胞间的紧密连接阻止了水溶性的分子通过，总是发生于外周血管中的胞吞转运很少存在于皮质血管中。发现了 Mfsd2a 在不影响紧密连接的情况下调控了胞吞转运，同时她们还发现星形细胞调控了 Mfsd2a[24]。将来她们希望了解星形细胞确切告诉了内皮细胞做什么[li]。老鼠的 BBB 的脑内皮细胞与肺内皮细胞相比在胚胎的 E13.5 周高表达，而在 Mfsd2a 敲出的老鼠 BBB 的损伤是从胚胎 15.5 到成年，那么人的 BBB 形成是在多少周？周细胞在 Mfsd2a 调控 BBB 的机制也有待于进一步的研究。

2.2 Mfsd2a是DHA进入BBB的主要受体

DHA（二十二碳六烯酸）是一种 omega-3 长链多不饱和脂肪酸（LCPUFA），DHA 正常大脑的大脑发育和认知功能的重要性是众所周知的[lii]，在大脑中的含量最为丰富，因为对大脑有益而被称为“脑黄金”，然而人们一直不清楚 DHA 是如何被大脑吸收的。杜克-新加坡国大医学研究生院(Duke-NUS)的 David Silver 及同事鉴定出了转运蛋白 Mfsd2a，证实了 Mfsd2a 是 omega-3 脂肪酸 DHA 向脑中吸收的主要运输因子。Mfsd2a 只在 BBB 的内皮中表达，Mfsd2a 被剔除的小鼠脑中 DHA 水平降低、神经元数量减少、脑的大小和功能均降低。这一发现将有助于人们进一步理解 DHA 的作用机制。只有当 DHA 这种脂肪酸是附加到脂质溶血磷脂酰胆碱（lysophosphatidylcholine LPC），形成 LPC-DHA 的形式后，Mfsd2a 才能够跨膜传输 DHA[25]。

脑和神经组织是脂类数量与种类最多的组织。细胞膜由液态的双层脂质膜镶嵌着各种蛋白质构成，而 DHA 正是构成脑、神经系统和视网膜的结构脂。大脑的 60%是由结构脂质构成，其中含量最丰富的就是 AA 和 DHA，它们对大脑的生长发育、功能和完整性有着重要的作用[liii]。丹麦科学家 L. Lauritzen 等在关于长链多不饱和脂肪酸（LCPUFA）与脑和视网膜发育的研究综述指出，LCPUFA 占细胞膜中脂肪酸的 21%-36%。神经组织中，如脑和视网膜中 DHA 的含量尤其高。成人大脑干中的 50%—60%为脂类，而其中有 35%是 LCPUFA。科学家们指出，DHA 这样的组织特异性分布提示其在这些神经组织中发挥着重要的功能[liv,lv]。

英国科学家 Michael A Crawford 的研究显示，胚胎形成的初期，也即怀孕的最初几周是脑细胞分裂生长的活跃期，此时胚胎的发育完全依赖于妈妈的营养和健康状况。实验证实在脑部发育的早期，缺乏 DHA 对脑发育的影响是有害且永久的。尽管 DHA 对大

脑功能有益，但大脑吸收这种脂肪酸的机制一直是个谜[lvi,lvii]。David Silver 亦认为如果能够阐明 DHA 进入大脑的机制，我们就可以利用这一信息促进它的定向吸收效率，开发改良版的营养添加剂。并通过研究数据证实缺乏 Mfsd2a 转运子的小鼠大脑比对照组小 1/3，这些小鼠出现了记忆和学习缺陷，而且表现出高水平的焦虑。同时，研究人员发现这些小鼠的学习、记忆和行为缺陷，与膳食中缺乏 DHA 的小鼠非常类似，随后证实 Mfsd2a-/-小鼠的确缺乏 DHA。并意外地发现 Mfsd2a 转运的是 LPC 化学形态中的 DHA。这一发现非常重要，因为 LPC 是主要由肝脏生产的一种磷脂，高水平存在于人类的血液中。过去人们一直认为 LPC 对细胞有毒，不清楚它们在体内有何作用[lviii]。他们的研究首次为人们提供了一个研究 DHA 缺乏及其功能的遗传学模型。同时证实了 Mfsd2a 是胎儿大脑和成年人大脑摄取 DHA 的主要途径，而被转运的 DHA 存在于 LPC 的化学形态中[25]。他们的发现可以帮助人们更有效地将 DHA 整合在食物中，挖掘 DHA 促进大脑生长和功能的最大潜力。这对于胎儿发育时期没有获得足够 DHA 的婴儿来说特别有意义。

2.3 除了BBB，Mfsd2a还参与了其他屏障（如胎盘屏障和血-视网膜屏障）功能的形成。

Toufaily C等通过在滋养层融合及其表达在正常与子痫前期胎盘进行了研究，发现Mfsd2a是Syncytin-2的受体，MFSD2a蛋白存在于细胞质和细胞膜上,毛喉素诱导的BeWo细胞的融合的同时可以提高MFSD2a的表达,敲出MFSD2a将影响BeWo细胞的融合；严重子痫前期胎盘的MFSD2a表达量明显降低。这些数据均支持MFSD2a滋养层融合和胎盘发展的重要性[lix]。此外Liang 等证实GCM1是一个通过Syncytin2和其受体MFSD2A基因调控胎盘细胞融合表达关键蛋白,GCM1也可能在Syncytin2基因表达的表观遗传调控发挥重要作用[lx].在胎盘中MFSD2A充当一个受体ERVFRD-1 / syncytin-2和滋养层需要融合.MFSD2A在单核细胞滋养层中不断的通过融合增殖使细胞滋养层形成合胞体滋养层使MFSD2A在合胞体滋养层中高度表达[lxi]。与BBB的功能成熟相关的MFSD2A蛋白，通过在视网膜内的时空表达模式，像静脉输送AAV9一样抑制视网膜的转导，这表明AAV9也是通过跨膜的形式穿过血-视网膜屏障的[lxii]。

3 Mfsd2a 在抑制药物通过血脑机制和肿瘤的机制

3.1 作为运输载体的衣霉素（tunicamycin TM）是一种天然的核苷抗生素，也是 N-糖链抑制剂，可通过抑制蛋白糖基化途径中十四糖二磷酸长萜醇的生成，进而抑制了糖链的加工，形成脱糖蛋白，阻碍了内质网内新生蛋白质糖基化修饰。用 TM 刺激细胞后可以引起内质网压力和激活的蛋白质的反应。MFSD2A 作为介导 TM 毒性的关键蛋白，细胞没有 MFSD2A 表现为 TM 耐药,而 MFSD2A 高表达的细胞则表现为高度敏感，同时可以增强内质网应激反应。MFSD2A 是公认的 TM 透过细胞膜进入机体的运输车，能够促进 TM 转运进入肿瘤细胞发挥作用[lxiii,lxiv]。MFSD2A 是否是其他抗生素的受体有待于进一步证实，针对通过星形细胞设计打开 BBB 的药物将不合逻辑的(因为这些细胞存在于血管内皮细胞的脑细胞一侧而不是血液一侧),但是针对存在于内皮细胞管腔一侧的 Mfsd2a(接触血液)设计药物可能是可行的。

3.2 通过连锁不平衡(Linkage disequilibrium LD)分析，研究人员限定一个地区与肺癌病情进展有关，这个区域位于 1 号染色体上 p34，确定一个 106 kb 的 LD 的区域,这其中包括 MYCL1 、TRIT1(tRNA-isopentenyl transferase 1)和 MFSD2A,现在已证实了 MFSD2A 是一种新型的肿瘤抑制基因可以调节细胞周期和基膜粘附[lxv,lxvi]，同时在该区域的这三个邻居基因 MYCL1 、TRIT1 和 MFSD2A 的多态性和单倍型也与胃癌患病风险和临床病理特点有关，这可能有助于胃癌风险评估和预后的预测[lxvii]。在小鼠中已经证实可以通过减少周细胞密度(细胞环绕的小血管内皮细胞)，可以增加血管内皮细胞的跨膜转运[lxviii,lxix],导致了 Ben-Zvi 等发现了大脑内皮细胞的表达 Mfsd2a 取决于星形细胞的存在[24]，跨膜转运对于药物的运输至关重要，现在没有证据表明跨膜转运对于分子质量和理化性能有任何限制[18]。MFSD2A 在脑肿瘤中的致病机制及预后监测的价值有待于进一步的深入研究。

4 展望

Nature 同期发表的两篇文章就像一石双鸟一样，阐明了 Mfsd2a 在 DHA 如何通过结合跨膜转运进入脑细胞和抑制跨膜转运中的双重作用机制。Mfsd2a 传输脂肪对大脑发育和功能至关重要,同时抑制传输路线穿越 BBB，但还几个细节有待探讨：Mfsd2a 如何调节内皮细胞的跨膜转运吗?是直接机制还是间接地通过缺陷的脂质运输? 像饮食缺乏 DHA 等其它因素造成的脂质缺乏可能可以揭示这一问题。现在已知 DHA 通过 Mfsd2a 受体进入 HBMEC,但 DHA 如何在大脑中发生的进一步运输目前还不清楚。在大脑中 DHA 虽然可能在膜或结构的形成和在调节细胞信号的具有重要的作用，进一步研究 Msfd2a 敲除的老鼠将有助于这些和其他问题解决。同时研究 Mfsd2a 分子运输将有必要了解 MFSD2A 的生理功能和机制，以及 MFSD2A 在神经系统的疾病（包括感染、脑肿瘤、阿尔茨海默氏症等神经退行性疾病）中的致病机制及预后监测的价值也有待于进一步的深入研究证实。

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作者及本文研究内容介绍和自评：王世富，主要从事神经系统感染和脑科学的研究，Mfsd2a 是目前为止第一个确定的可以抑制脑微血管内皮细胞跨膜胞吞转运的分子，同时亦被证实是 DHA（二十二碳六烯酸）进入血-脑屏障的主要受体。这必将引导 Mfsd2a 研究的热潮，同时有关 Mfsd2a 的综述和研究国内尚无研究，本文的综述将有助于我国在本领域紧跟国际前沿的研究进展。

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