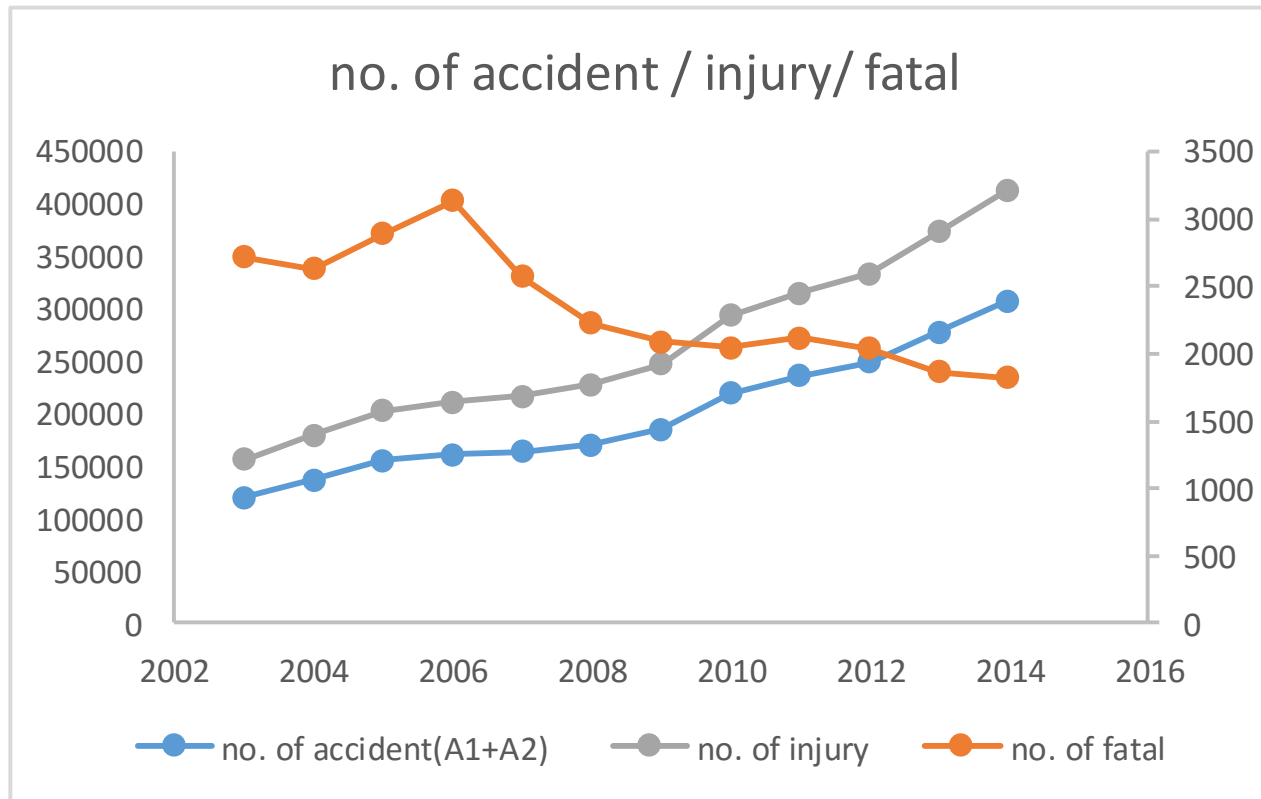# Comparative analysis of safety features of motorcycle and bicycle

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National Taiwan University

Velo-City 2016

1. Accident occurrence of Taiwan 2003-2014

no. of accident / injury/ fatal

Fatality no. decreasing, Injury no. increasing, during last ten years

	no. of accident (A1+A2)	no. of fatal	no. of injury
2003	120165	2717	156227
2004	137,221	2,634	179108
2005	155,814	2,894	203087
2006	160,897	3,140	211176
2007	163,971	2,573	216927
2008	170,127	2,224	227423
2009	184,749	2,092	246994
2010	219,651	2,047	293764
2011	235,776	2,117	315201
2012	249,465	2,040	334082
2013	278,388	1,867	373568
2014	307,842	1819	413229

2. Accident fatal and injury of motorcycle, Car and Bicycle 2003-2014
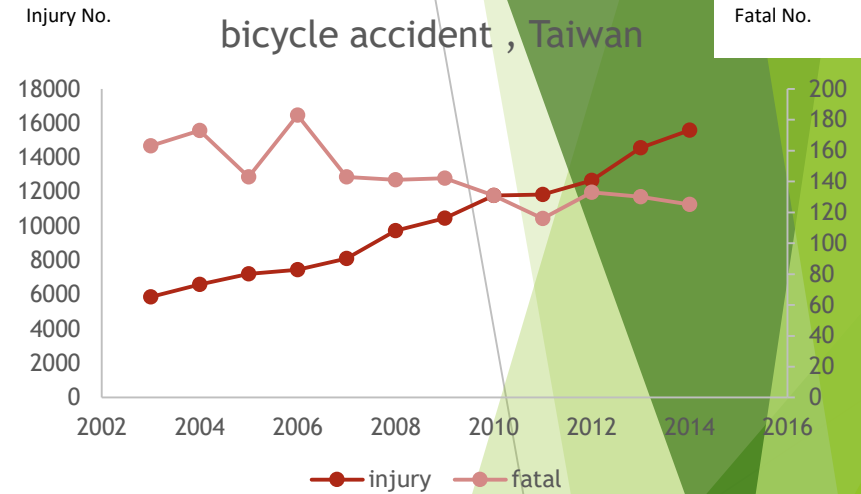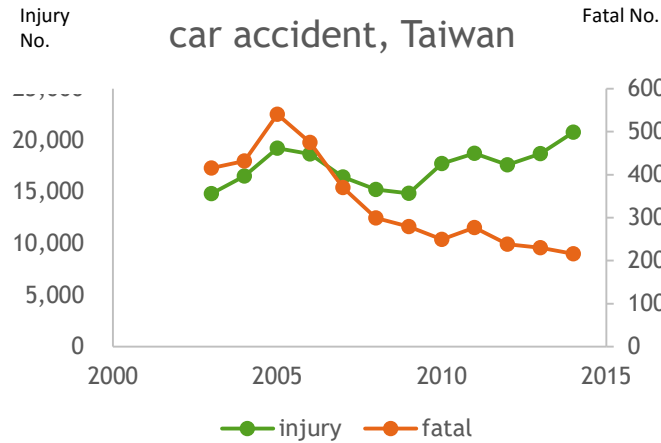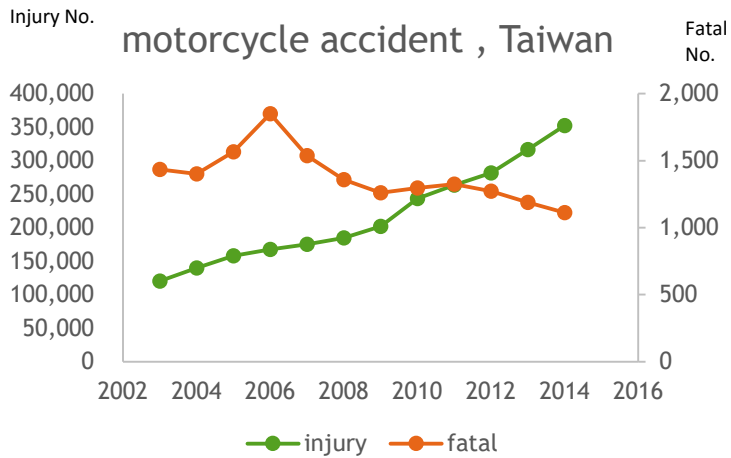
	motorcycle		Car		Bicycle	
year	injury	fatal	injury	fatal	injury	fatal
2005	158,117	1,565	19,234	540	7213	143
2014	352,138	1,111	20,789	216	15,582	125
Annual growth rate	+9.3%	- 3.8%	+0.87%	- 10.7%	+8.9%	- 1.5%

3. Accident no. involved by motorcycle, car and bicycle
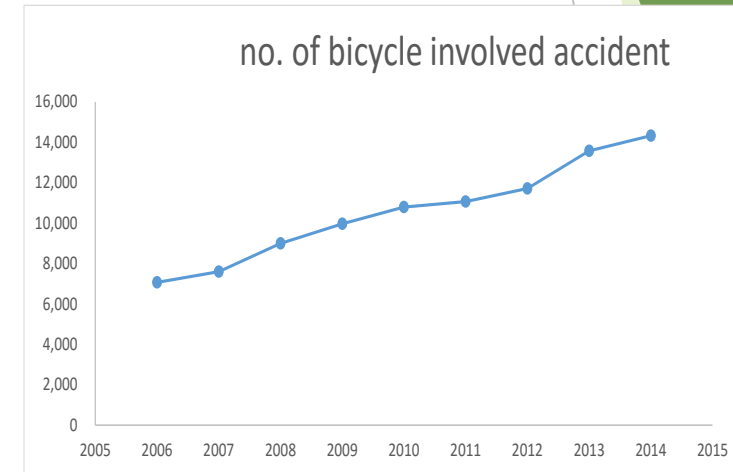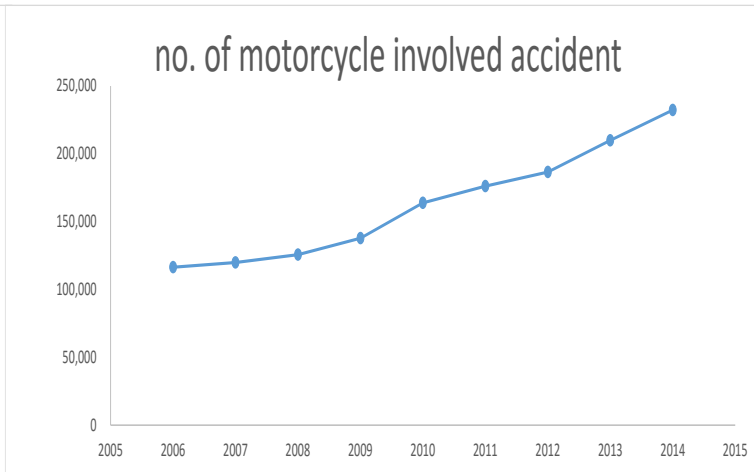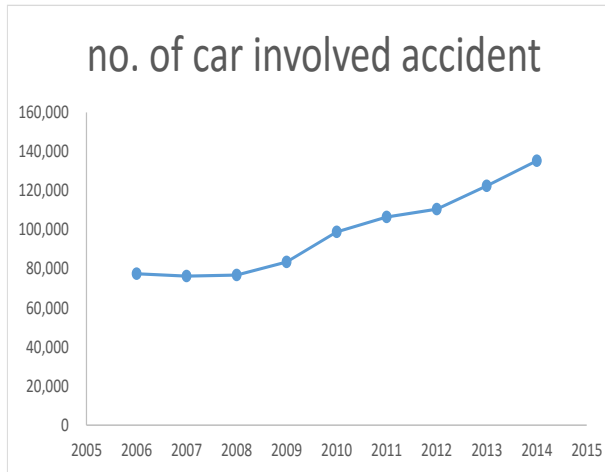
no. of car involved accident

no. of motorcycle involved accident

no. of bicycle involved accident

year	no. of motorcycle involved accident	no. of car involved accident	no. of bicycle involved accident
2006	116,439	77,525	7,061
2014	232,289	135,239	14,327
Average growth rate	9.01%	7.2%	9.2%

4.Interaction between car and motorcycle

year	motorcycle		Car		Bicycle	
	injury	fatal	injury	fatal	injury	fatal
2005	158,117	1,565	19,234	540	7213	143
2014	352,138	1,111	20,789	216	15,582	125
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year	no. of motorcycle involved accident	no. of car involved accident	no. of bicycle involved accident
2006	116,439	77,525	7,061
2014	232,289	135,239	14,327
Average growth rate	9.01%	7.2%	9.2%

	Casualty no. of motorcycle/ accident no. of motorcycle	Casualty no. of car/ accident no. of car
2008	89.3%	10.9%
2009	89.0%	10.1%
2010	89.3%	10.0%
2011	89.2%	9.8%

Every 10 motorcycle involved accidents cause 9 motorcyclists injury themselves.
Every 10 car involved accidents cause 9 other road users injury.

5. Comparative Analysis of Bicycle Accident - Taipei and Taiwan

Increase rate of bicycle accident in whole Taiwan is higher than in Taipei

Taiwan is 9.21%

Taipei is 9.19%

year	no. of accident, Taiwan	no. of accident, Taipei
2008	10,268	754
2009	11,516	829
2010	12,427	982
2011	12,838	1,013
2012	13,759	1,042
2013	15,830	1,177
2014	16,565	1,211

year	Taipei	Taiwan
2009	9.9%	12.2%
2010	30.2%	21.0%
2011	34.4%	25.0%
2012	38.2%	34.0%
2013	56.1%	54.2%
2014	60.6%	61.3%

bicycle accident

The cumulative bicycle accident Increase Rate based on 2008
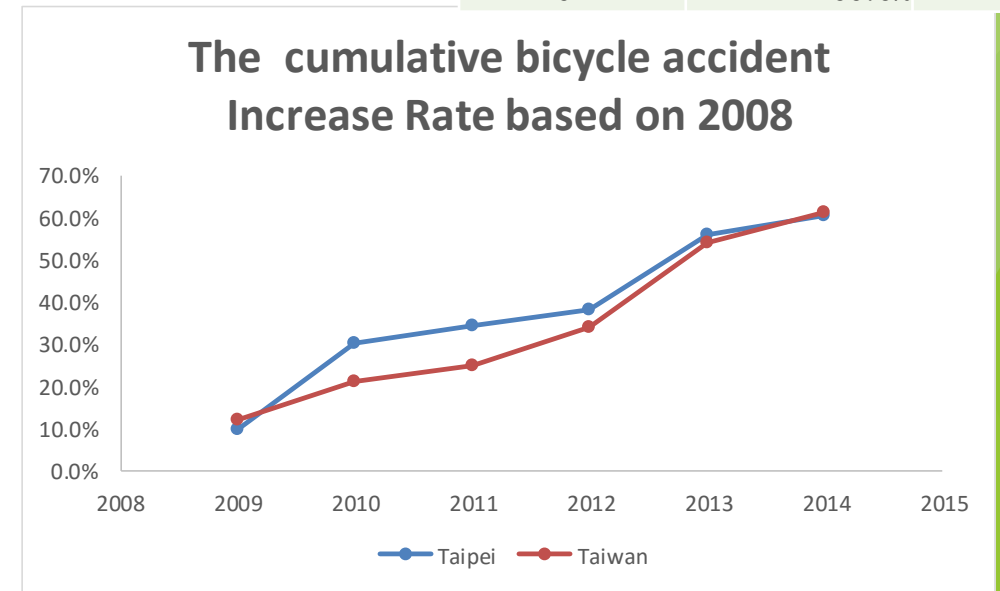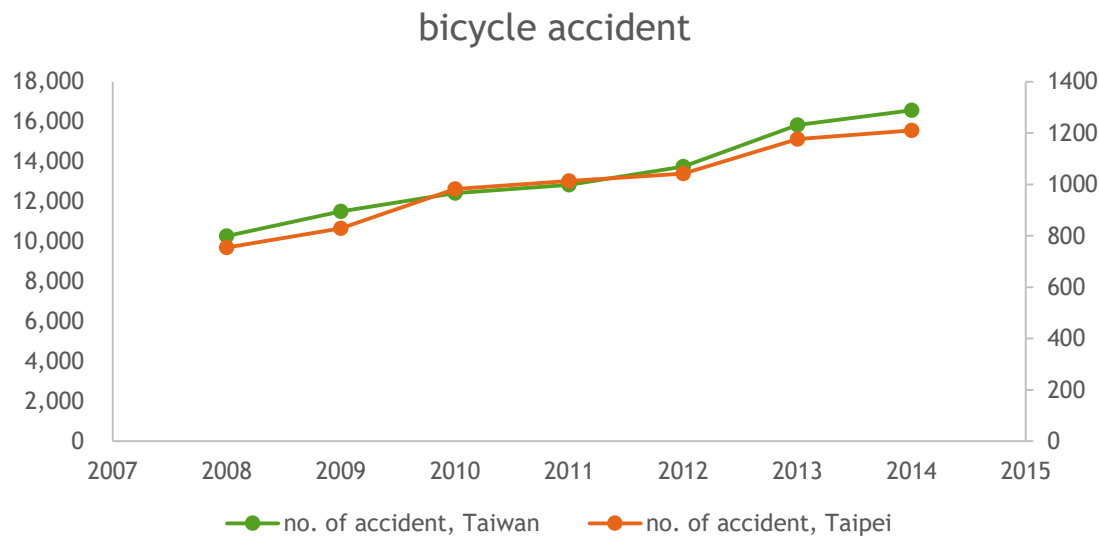
6. Comparative Analysis of motorcycle Accident - Taipei and Taiwan

Increase rate of motorcycle accident
in whole Taiwan is higher than in Taipei
Taiwan   is 9.81%
Taipei   is 9.12%

year	no. of accident, Taiwan	no. of accident, Taipei
2008	186,780	14882
2009	203,482	17,181
2010	245,201	21,318
2011	265,025	22,492
2012	282,740	21,379
2013	317,788	22,234
2014	353,249	23,468

year	Taiwan	Taipei
2009	8.9%	15.4%
2010	31.3%	43.2%
2011	41.9%	51.1%
2012	51.4%	43.7%
2013	70.1%	49.4%
2014	89.1%	57.7%

motorcycle accident

The cumulative motocycle accident Increase Rate based on 2008
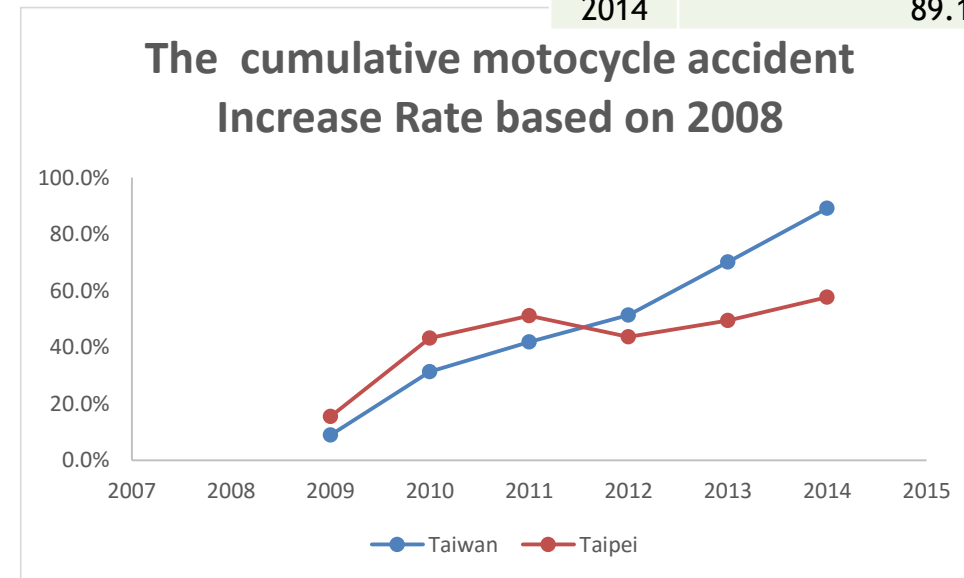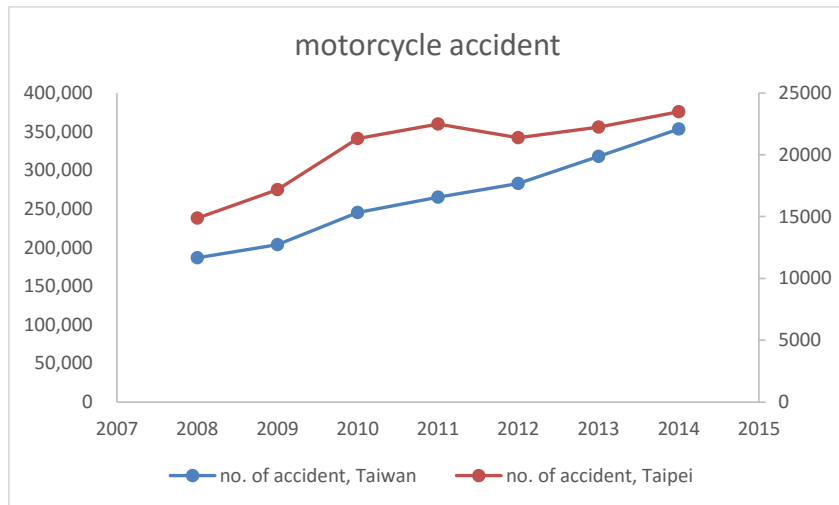
Age distribution of motorcycle accident

	<10	10~14	15~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60~64	65~69	70~74	75~79	80~84	>84
motorcycle accident people	1626	3118	56459	89252	45959	34909	27431	21674	20256	21348	20489	18246	11417	9195	5873	2409	1851
	0.0042	0.008	0.1442	0.228	0.1174	0.0892	0.0701	0.0554	0.0517	0.0545	0.0523	0.0466	0.0292	0.0235	0.015	0.0062	0.0047

age distribution of bicycle accident

	<10	10~14	15~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60~64	65~69	70~74	75~79	80~84	85~
No. of people	235	2110	2335	771	597	652	590	635	766	887	1135	1232	1135	1319	1164	790	509
%	1.4	12.4	13.7	4.5	3.5	3.8	3.5	3.7	4.5	5.2	6.7	7.2	6.7	7.8	6.8	4.6	3

●**Highest in motorcycle accident :**
Between 15-24 has 35% of motorcycle accident injury
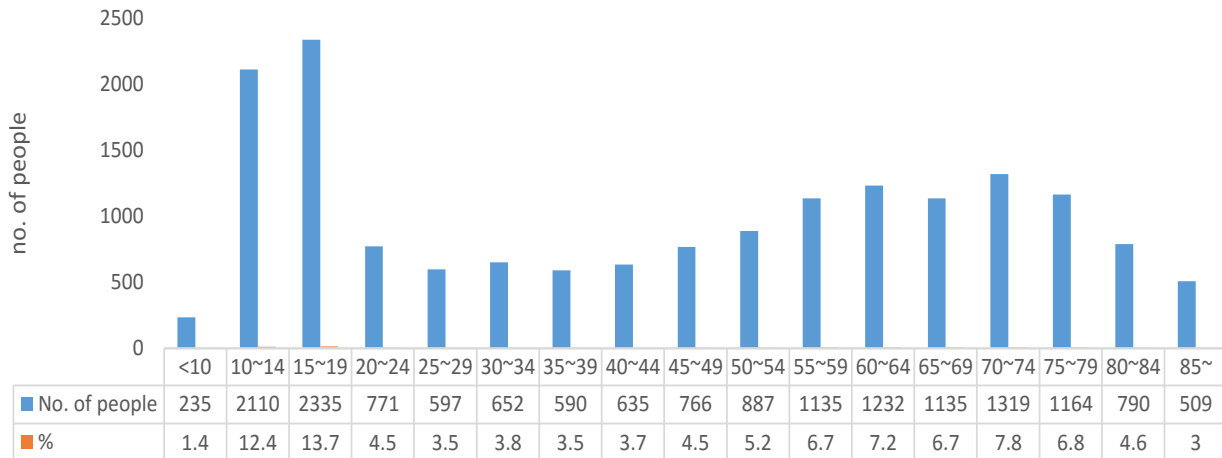
●**Highest in bicycle accident :**
Between 10-19 has 26.1% of bicycle accident injury

Source:2014全國車禍資料庫

8. Location of Accident of motorcycle and bicycle

- Motorcycle , at intersection and near intersection has 62.18%
- Bicycle, at intersection and near intersection has 48.5%
- Bicycle accident occurred more on the lane of road section

Location of accident	Bicycle		motorcycle	
	No.	Percent	No.	%
At intersection	6586	38.7%	195598	51.64%
Lane of road section	5023	29.5%	90607	23.92%
Near intersection	1666	9.8%	39910	10.54%
Slow traffic lane	1565	9.2%	27052	7.14%
Express lane	949	5.6%	23943	6.32%
other	1211	7.1%	1697	0.44%

location of motorcycle accident

	at intersection	lane	near section	slow traffic lane	express lane	other
Frequency	195598	90607	39910	27052	23943	1697
Percent	51.64%	23.92%	10.54%	7.14%	6.32%	0.44%
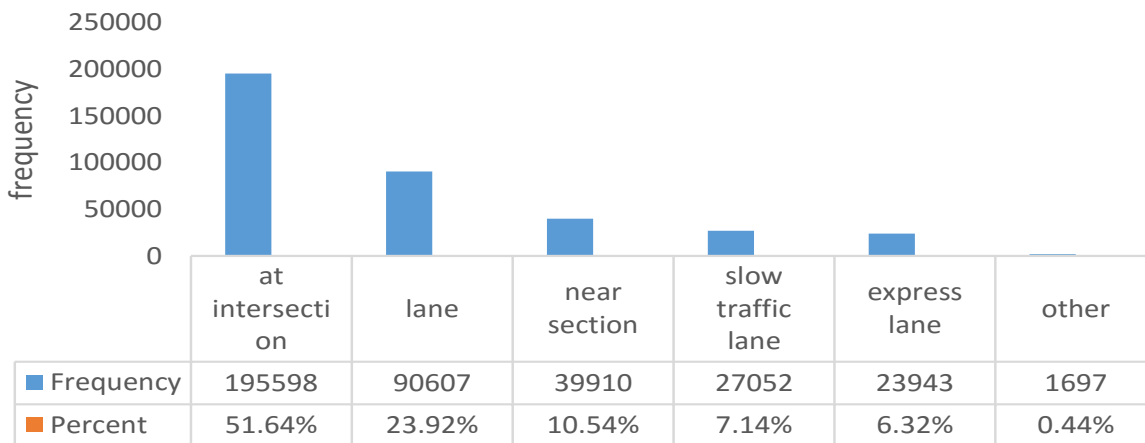
location of bike accident

	at intersection	lane	near intersection	slow traffic lane	express lane	other
Frequency	6586	5023	1666	1565	949	1211
Percent	38.7	29.5	9.8	9.2	5.6	7.1

9. Motorcycle and Bicycle accident collision type at intersection

Collision type	Motorcycle	Bicycle
Turn movement other angle collision	45.7%	31.5%
Sideswipe (same direction)	8.2%	15.2%
Rear end	4.8%	12.3%
Right angle	22.2%	8.2%
Rollover or fall	2.2%	4.8%
Sideswipe (opposite direction)	2.2	4.%
other	14.3	1.9%

motorcycle collision type at intersection

	turn collision	right-angle	sideswipe(same direction)	rear-end	rollover or fall	sideswipe(opposite direction)	other
no. of accident	80701	39841	14410	8549	3913	3905	25246
%	45.7	22.6	8.2	4.8	2.2	2.2	14.3

bicycle accident collision type

	Turn collision	Sideswipe(same direction)	Rear-end	Right-angle	rollover or fall	sideswipe(opposite direction)	Head-on
%	31.5	15.2	12.3	8.2	4.8	4	1.9

10. Modal share and accident casualty share of motorcycle and bicycle, 2014

Modal share	Bicycle(%)	Motorcycle(%)	accident no and share	No.	percent
Taipei City	3.94	24.35	**Motorcycle**	**23468**	**49.6**
			Bicycle	**1220**	**2.6**

Odd ratio motorcycle/bicycle = 2.037/0.66=3.086

The motorcycle has the risk triple than the bicycle in Taipei

11. Influence factor of bicycle safety at intersection (poison regression)

modelling

modet	R	R square	Adjusted R square	Est. Standard error
1	.974[a]	.949	.939	.27135

coefficient

variable	Non Normalized Coefficient		Normalized coefficient		
	B	Standard deviation	Beta	t	significance
(constant)	−1.051	.155		−6.768	.000
Pavement crack	−.008	.282	−.001	−.027	.979
Bicycle left turn volume	−.031	.006	−.283	−4.952	.000
Retail store at corner	−.003	.065	−.002	−.045	.965
Left turn exclusive lane	−.778	.098	−.262	−7.910	.000
Two Stage motorcycle zone	.288	.133	.132	2.170	.034
Medium island	.107	.114	.037	.942	.350
Raining or not	.076	.109	.023	.705	.484
Night time	−.082	.078	−.035	−1.050	.298
Right turn vehicle no.	.001	.000	.235	3.270	.002
Right turn rate	1.521	.709	.085	2.147	.036
Left turn rate	1.368	.658	.087	2.079	.042
Bicycle volume	−.008	.000	−.816	−23.691	.000

- ## accident increasing factor
  - motorcycle two-stage waiting zone
  - motorized vehicle flow
  - Motorized vehicles left turn ratio
  - Motorized vehicles right turn ratio
- ## accident decreasing factor
  - left turn lane

Summarized from project report of bicycle intersection design guidance 2011, Hsu, T.-P etc.

12.Safety improvement countermeasures for bicycle

▶ 1. differentiate between exclusive lane in road section and crossing lane at intersection

▶ 2. Setup bicycle stop line

▶ 3. Connecting bicycle space on road section and at intersection consistently

▶ 4. Combining cycling space, waiting zone, crossing lane and bicycle signal as a complete system

▶ 5. Integrating bicycle, pedestrian and motor vehicle facilities at intersection ,such as signal

▶ 6. Integrative consideration of bicycle movement of left turn, straight out and right

Summarized from project report of bicycle intersection design guidance 2011, Hsu, T.-P etc.

13.Bicycle stop line and waiting zone (Photo: Hsu, T.P)

Waiting zone and stop line of bicycle in Taipei

Waiting zone and stop line of bicycle, in Germany

14. Typical collision type of motorcycle accident at intersection

- 1. Sideswiped collision: change lane
- 2. Right Angel collision: change interval
- 3. Left turning other Angle collision by left turning movement : turning movement with straight movement
- 4. Right turning other Angle collision by right turning movement : turning movement with straight movement
- 5. Rear-end collision: change interval and width of intersection
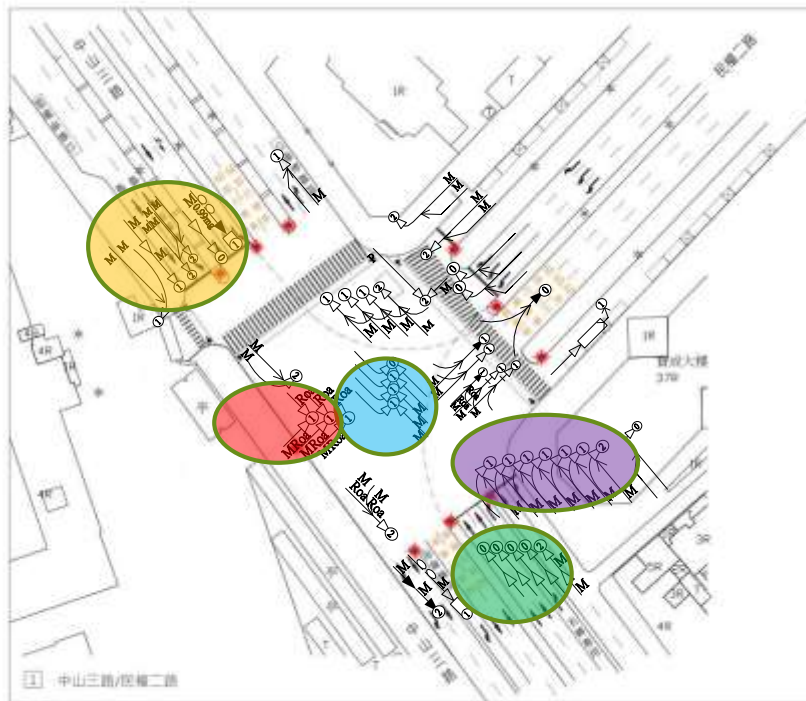
Summarized from project report of motorcycle safety at intersection design guidance 2014, Hsu, T.-P etc.

Safety improvement countermeasure for motorcycle, example

- Right turn other angle collision (same direction): **Separate signal phase from inside lane (fast lane) and curb lane (slow lane)**
- Left turn other angle collision (opposite direction): **Narrow the conflict area by shifting front the stop line and set up protected left turn phase and to longer all red time**
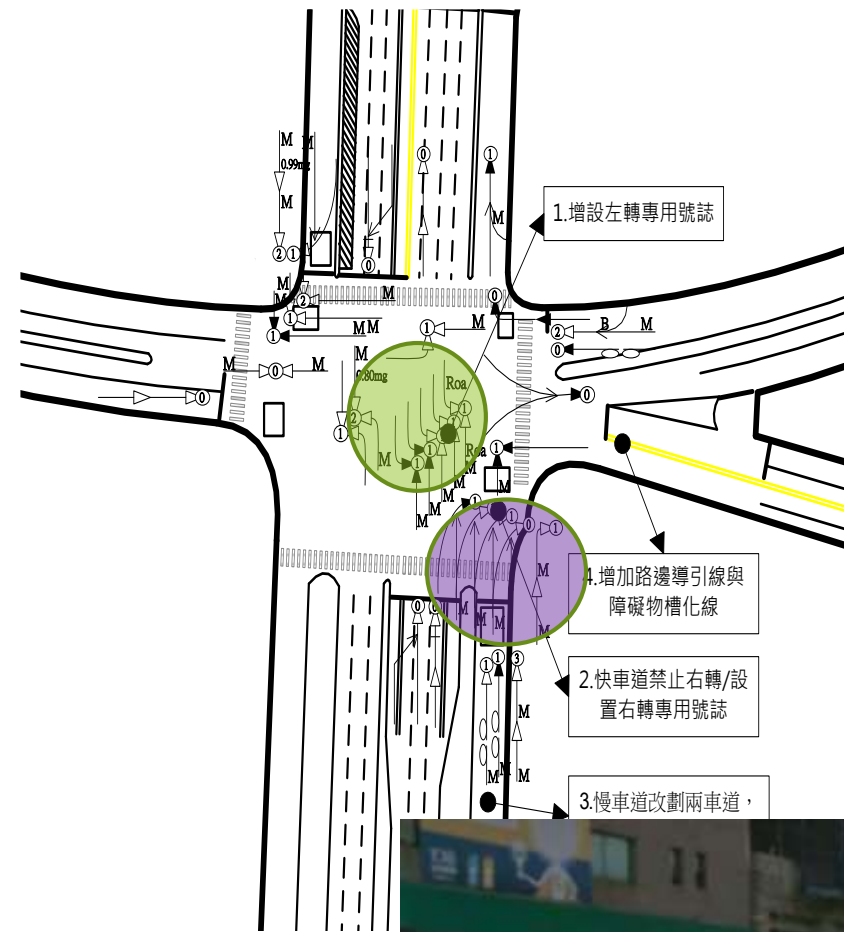
Summarized from project report of motorcycle safety at intersection design guidance 2014, Hsu, T.-P etc.

Closing remark

Motorcycle and bicycle have somehow different accident occurrence characteristics.

To enhance the traffic safety for motorcycle and for bicycle should take the different characteristics into consideration

Thank you for listening

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