

A SURVEY OF MOTORCYCLISTS' BRAKING TECHNIQUES

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ABSTRACT

A survey was made of 180 motorcyclists of the order in which they used the front and rear brakes in various braking conditions. About 40% of the riders had taken the motorcycle rider course for novices or experienced riders. Overall, up to 75% of riders reported using both brakes in hard braking on dry pavement and up to 47% on wet pavement. In less demanding braking there was a tendency to use the rear brake first or exclusively. Those who had taken a rider training course used both brakes simultaneously more in all conditions than those who had not taken a course.

INTRODUCTION

Motorcycles are generally designed with separate brake controls for the front and rear wheel brakes. The brake on the front wheel is usually operated by a lever on the right side of the handlebar and the brake on the rear wheel by a foot pedal located on the right side, ahead of the footrest and under the shift lever. This configuration provides a very convenient operation of the rear brake by the riders right foot, as it is resting just above the brake lever for comfortable and quick operation. The front brake requires that the rider move the fingers of the right hand from around the handlebar grip and extend them to enclose the front brake lever and then apply force on the lever. That action is less comfortable and requires that the grip on the handlebar is loosened, which reduces the stability of the riders body and the ability to have a firm grip on the machine and its controllability, and which takes more time than the simple action needed to depress the rear brake pedal. Not surprisingly, it would be expected that riders would be expected to have a preference in operation of the rear brake over the front.

If there is indeed such a preference, it can be expected to have an effect on the ability of riders to exert good braking control and especially to achieve the maximum braking deceleration when that is needed. This is because the rear brake alone can provide not more than 30%-40% of the braking effectiveness of the motorcycle, while the front brake provides the greater part (Obenski, 1994). It appears that there is such a preference, at least in the events leading up to crashes (Hurt et al, 1981). According to the findings of in-depth accident investigations of Hurt and his team, motorcyclists frequently failed to use the front brake to slow even when there was adequate distance to stop if the front brake had been used (Hough, 2000), because they only used the rear brake.

The present study was done in order to obtain a better understanding of how motorcyclists use the front and rear brakes and how pavement conditions, the degree of deceleration required, speed and the effect of having had a motorcycle rider training course affected their use of the brakes.

METHOD

Survey.

A survey was designed to elicit responses from which the braking techniques used by riders could be discerned. The survey asked respondents to indicate which brake they used (rear, front, both simultaneously, rear first then front, front first then rear, or other means of slowing) in stops from 30 mph, slowing from 30-20 mph and 55-30 mph and stops from 55 mph, when using gentle braking and hard braking, on dry and wet pavements, for a total of 16 conditions. They also indicated their years of riding experience, engine size of their motorcycle, miles ridden and whether they had completed a MSF course for novice or experienced riders.

Subjects.

The survey was completed by 190 motorcyclists who were attending experienced rider courses or instructor refresher courses in Illinois. Only 10 surveys were not used in the analyses because some were not fully completed and others were completed by riders who rode motorcycles that had front-rear integrated (unified) brake systems. The results are based on the remaining 180 respondents.

RESULTS

The respondents had median riding experience of about 8 years, rode about 4000 miles per year on motorcycles of 750cc median engine size and 41% had taken a training course. Those who had not taken a training course had ridden longer (median 9.5 v 6.0 years), more miles (median 4300 v 3500 miles) and had motorcycles with larger engines (median 800 v 670 cc).

Brake Operation

The order in which the brakes were applied and which brakes were used varied with the speed, degree of braking and the pavement condition and also was dependent on whether the respondents had taken a motorcycle rider course.

Stopping from 30 mph. Table 1 shows the percent of riders who indicated which brakes and in which order they usually the used the brakes in decelerating from 30 mph to a stop. In all pavement conditions (dry, wet) and braking levels (gentle, hard) the rear and front brakes were used simultaneously most frequently, but only on dry pavement and hard braking was simultaneous use of both brakes used substantially more often. In gentle braking to a stop from 30 mph the rear and front brakes were used alone 17% and 13%, respectively, and the

rear followed by front (21%) more often than the front followed by the rear (6%). About 1% or less of riders indicated that they would use the throttle and/or shift through the gears.

Table 1. Stopping from 30 mph: Brakes Used by Percent *of Riders.

<u>Brake</u>	<u>Pavement Conditions and Level of Braking</u>			
	<u>Dry, Gentle</u>	<u>Wet, Gentle</u>	<u>Dry, Hard</u>	<u>Wet, Hard</u>
Rear only	17	18	3	9
Front only	13	3	0	0
R & F simultaneously	42	40	72	46
Rear then front	21	32	17	38
Front then Rear	6	4	8	7
Other	1	1	0	0

* All values rounded to nearest whole number.

Gentle braking to a stop from 30 mph on wet pavement was similar as on dry pavement, but Table 1 shows that the front brake alone was hardly ever used and that there was an increase in use of the rear brake first followed by the front. Hard braking on wet pavement showed a similar technique as for gentle braking

Slowing from 30-20 mph. In slowing from 30-20 mph (Table 2) using gentle braking on dry pavement the rear brakes were used alone by 38% and front brakes alone by 24%. On wet pavement there was less use of the front brake alone (8%) and more use of both brakes at the same time (34%) as well as more use of the rear first followed by the front (13%), than on dry pavement. Hard braking on dry and on wet pavements was similar to that in stopping from 30 mph (Table 1).

Table 2. Slowing from 30 - 20 mph: Brakes Used by Percent* of Riders.

<u>Brake</u>	<u>Pavement Conditions and Level of Braking</u>			
	<u>Dry, Gentle</u>	<u>Wet, Gentle</u>	<u>Dry, Hard</u>	<u>Wet, Hard</u>
Rear only	38	38	6	12
Front only	24	8	4	1
R & F simultaneously	26	34	65	44
Rear then front	5	13	16	37
Front then Rear	2	2	7	5
Other	4	4	1	1

* All values rounded to nearest whole number.

Slowing from 55-30 mph. In slowing from 55-30 mph (Table 3) using gentle braking, the trends in brake usage were similar to those found in slowing from 30-20 mph shown in Table 2, except that both brakes were applied at the same time more often. In hard braking from 55-30 mph the distributions of brakes used were quite similar to those in slowing from 30-20 mph (Table 2).

Table 3. Slowing from 55 - 30 mph: Brakes Used by Percent* of Riders.

<u>Brake</u>	<u>Pavement Conditions and Level of Braking</u>			
	<u>Dry, Gentle</u>	<u>Wet, Gentle</u>	<u>Dry, Hard</u>	<u>Wet, Hard</u>
Rear only	18	19	2	8
Front only	13	4	2	0
R & F simultaneously	42	41	68	46
Rear then front	19	28	20	39
Front then Rear	4	5	7	6
Other	3	3	1	2

* All values rounded to nearest whole number.

Stopping from 55 mph. In stopping from 55 mph (Table 4) the distributions of brakes used are similar to those in stopping from 30 mph (Table 1), except that in gentle braking from 55 mph there was less use of either brake alone.

Table 4. Stopping from 55 mph: Brakes Used by Percent *of Riders.

<u>Brake</u>	<u>Pavement Conditions and Level of Braking</u>			
	<u>Dry, Gentle</u>	<u>Wet, Gentle</u>	<u>Dry, Hard</u>	<u>Wet, Hard</u>
Rear only	4	9	1	5
Front only	3	1	0	0
R & F simultaneously	48	42	75	47
Rear then front	31	38	16	40
Front then Rear	12	7	8	8
Other	2	3	0	1

* All values rounded to nearest whole number.

Training

There was a noticeable difference in brake usage by those who had taken a motorcycle rider training course and those who had not. This is largely demonstrated by the greater use made of both brakes simultaneously, in all conditions, by riders who had taken a training course (Figure 1).

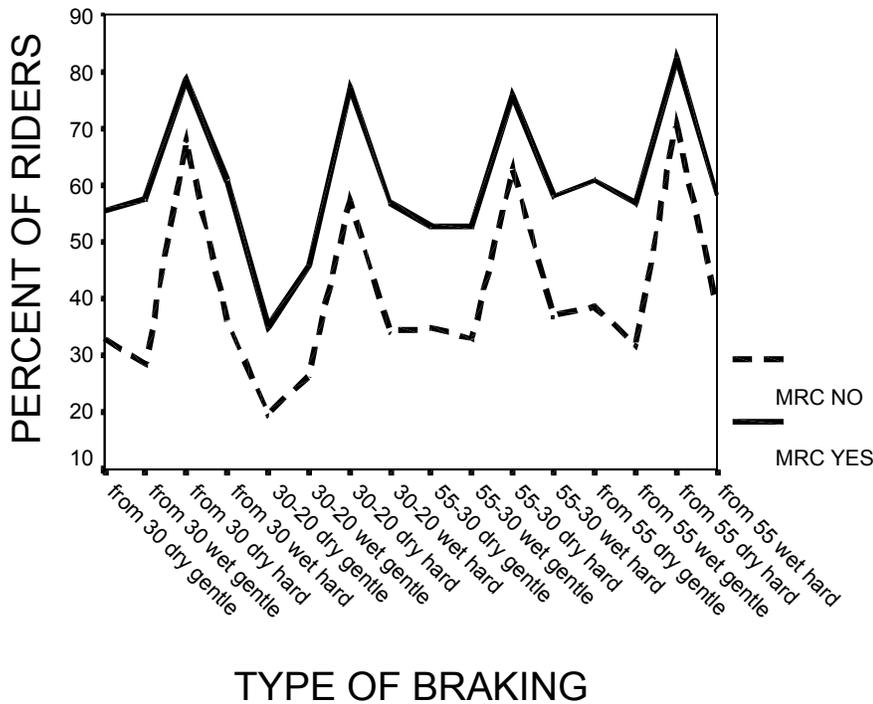


Figure 1. Percent of riders using rear and front brakes simultaneously in various braking conditions for those who had and had not taken a training course.

DISCUSSION

The results of the survey have shown that motorcyclists differ in the way that they apply the rear and front brakes and that the differences are affected by the level of deceleration that is required and also by the pavement conditions.

In low decelerations from 30-20 or 55-30 mph and stopping from 30 mph on dry and wet pavements the rear brake alone was frequently used, while the front brake alone was used fairly frequently on dry pavements, though much less than the rear brake alone, and rarely on wet pavements. In stopping at low deceleration from 55 mph the rear or front brakes alone were rarely used with most braking being done using both brakes together and slightly less frequently with the rear brake applied first followed by the front brake. Thus, the

motorcyclists interpreted the need to brake gently from 55 mph to a stop differently than slowing from 55 mph or from 30 mph or stopping from 30 mph, and relied much more on the use of both brakes. The reason for this is not clear other than that the riders may have perceived the need to brake for longer and wanted to share the braking load and wear between both brakes.

In hard braking on dry pavements there was a decided shift to the increased simultaneous use of both brakes. That is clearly shown in Figure 1. Those who did not use both brakes together mostly used the rear brake first followed by the front. In hard braking on wet pavement there was a reduction in simultaneous use of both brakes, compared with braking on dry pavement (Figure 1). and an increased frequency in the application of the rear brake first followed by the front, which more closely followed the pattern of gentle braking on wet pavement.

The riders clearly favored the rear wheel brake over the front. The mean percent frequency of rear brake use, either alone or when applied first and followed by the front brake, excluding those occasions when both were used at the same time, was 38%. By comparison, the front brake was used alone or first in 11% of the conditions, overall, again excluding those events when both brakes were used simultaneously.

There is no question that riders who have taken the motorcycle rider training courses make significantly more use of both brakes simultaneously in all braking conditions (Figure 1). This indicates another potential benefit of the courses and may be a reason for a finding (Mortimer, 1988) that graduates of the motorcycle rider course had less severe injuries and less damage to their motorcycles in their accidents than those who had not taken the course.

While up to 75% of the riders indicated that they use both brakes simultaneously in hard braking on dry pavement (Table 4), it is apparent that there is less tendency to use both brakes than is desirable and too much reliance on the rear brake especially on wet pavement. This may be due to the convenience afforded by the position of the foot brake control of the rear brake, the relative inconvenience of the front brake lever and the fear of overbraking and locking the front wheel.

Since those riders who had taken a novice or experienced rider course used both brakes simultaneously, more than those who had not taken formal training, it indicates that training to use both brakes at all times can be beneficial and should be encouraged. But, the findings of this survey and those of accident studies show that motorcyclists often do not use the front brake. Another approach is to design the brake system so that activation of either the foot or the hand brake engages the brakes on the front and rear wheels. Studies have shown that such “integrated” or “unified” brake systems can reduce stopping distances substantially compared with the action of the rear brake alone (Mortimer, 1986). Although some motorcyclists are averse to such brake systems, believing that they can modulate the individual brakes to better advantage, the facts are that they are not able to do so in emergency situations when the extra brake force of the front wheel brake is critical. To maximize the advantage of an “integrated” brake system it should be combined with anti-lock capability to enhance rider safety.

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