An Exploratory Analysis of Motorcyclist Apparel Using Naturalistic Riding Data

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ABSTRACT

Many studies have investigated protective clothing in terms of injury prevention and mitigation, conspicuity, and comfort. However, most studies have involved accident data review, literature review, simulation studies, or self-reported data. All of these clothing-related issues are very complex subjects that warrant additional study, particularly under actual riding situations. The current paper will contain a descriptive summary of clothing worn in a sample of trips, and results will provide support for more detailed future analyses of clothing-related safety issues as the MSF 100 Motorcyclists Naturalistic Study comes to an end.

The MSF 100 Motorcyclists Naturalistic Study is being conducted to collect real-world riding data from riders in their natural day-to-day experiences. Data collection for the study is ongoing. Some participants have completed their involvement, while others are still on the road. This paper will report a sample of the clothing riders are wearing, based on review of video data collected in the study so far. Data analysis of a naturalistic study often involves descriptive statistics rather than inferential statistics because of the inability to control or measure many confounding factors. For these reasons, descriptive statistics are used to convey the results of this preliminary dataset, but additional analyses will be completed when the full data collection process is completed.

Video trips of riders were randomly sampled across participants (and thus location, including California, Florida, and Virginia) and were also stratified to investigate differences across the month and time of day of the sampled trips for each participant. The video reduction includes descriptions of clothing type (e.g., full jacket, short-sleeved shirt, and armor), color and reflectivity of clothing, the type and color of helmet and gloves, and eyewear type. Video reductionists also recorded the weather conditions in the trip in order to evaluate changes in clothing habits as related to weather.

Results of this work provide a description of the types of clothing and protective gear riders are using in their day-to-day riding, including whether and under what circumstances riders tend to vary their clothing and gear choices. The information is useful in providing an unbiased understanding of what riders actually wear, and can be used to guide messages used in training and other materials. The information regarding color and reflectivity provides data related to one element in the understanding of rider conspicuity. This initial database of riders' clothing habits across various conditions will provide guidance into the variation in rider clothing choices and the effect that these choices have on motorcycle safety.

INTRODUCTION

Over the last decade the number of motorcycle fatalities has steadily risen, with one out of seven road fatalities involving a motorcyclist (NHTSA, 2002). With this in mind, NHTSA published an agenda to look into motorcycle safety. The article, "National Agenda for Motorcycle Safety" (published in 2000), intended to provide a current snapshot of motorcycle safety and to map out a method for improving road safety, including a large push for a comprehensive motorcycle safety research (National Highway Traffic Safety Administration, 2000). Six years later, a follow up report for implementation of guidelines was released (NHTSA, 2006a). This guide placed heavy emphasis on the need for motorcycle-related crash research, focusing on roadway, vehicle, drivers, riders, and rider-related factors (NHTSA, 2006b).

The Motorcycle Safety Foundation (MSF) commissioned a study with the help of the Virginia Tech Transportation Institute (VTTI) to launch a naturalistic research project to study motorcycle riders operating within the surrounding transportation system. The MSF 100 Motorcyclists Naturalistic Study is being conducted to collect data from riders in their natural day-to-day experiences. Data collection for the study is ongoing. Some participants have completed their involvement, while others are still on the road. The following report describes the sample of riders included to date, specifically the description of the types of clothing (categorized largely by the level of protection against elements and injury) and protective gear riders are using in their day-to-day riding. The data are current as of this writing, but will be updated as data collection is completed.

METHODS

Methods Overview

One hundred motorcycle riders were used as participants in the study. These owners were at least 21 years of age and held a valid motorcycle license. Letters and phone calls to solicit participation were targeted to a two-hour radius around each installation site (Irvine, California; Orlando, Florida; and Blacksburg, Virginia), providing a phone number and an e-mail address for response if the recipient was interested in participating. Additional recruiting was done at bike shows, known riding areas, and on the Internet. Participants were required to read and understand English, and to be eligible for employment in the United States.

To obtain a broad sample of the riding population, seven motorcycle models were chosen from a variety of manufacturers. Demographics were established by rider age and motorcycle model, representing different styles of rider and background. The desired goal was to represent as broad a swath of the rider population as possible (young/old, male/female, experienced/inexperienced, etc.). In addition, various geographic sites were chosen in order to provide diversity in riding conditions.

Before participating in the study, riders were required to complete approximately an hour's worth of surveys and questionnaires to capture data such as riding history, training experience, risk adversity, and personality. In addition, riders also completed a basic balance and coordination exercise, an eye test, and recorded grip strength. Compensation for participating was $300.00 for the year per participant, and ten of the one hundred participants will receive a $750.00 gift certificate through a random drawing at the completion of the study.

Participants had a small data acquisition system installed on their personally-owned motorcycles. The equipment installation time varied by the model of motorcycle, but ranged from 5 to 8 hours. Riders were instructed to ride as they normally would. At the completion of the study for that rider, the equipment will be removed and the motorcycle returned to its original state. The data acquisition system consisted of 5 cameras, a radar/GPS unit, and a data collection unit housing a hard drive and several other sensors (accelerometers, gyro, etc.). In addition, the participant's front brake lever and rear brake hardware were exchanged replacements that were instrumented with strain gauges to track brake use. In total, the system weighed approximately 7.5 lbs. The equipment was designed to be installed by trained technicians to facilitate the motorcycle being returned to its initial condition at the completion of the study.

Trip Sampling Methodology

The goal of trip selection in this study was to obtain a sample stratified to investigate differences between months and times of day of the sampled trips for each participant. A trip was defined as the period between when a rider started his or her bike and when he or she turned it off, with riding occurring between these two times. At the time of video reduction, 46 riders were chosen because videos were available for a substantial number of their completed trips. At the time of this analysis, participation for these riders ranged from 5 to 16 months.

All available trips were categorized into time-of-day categories using Global Positioning System (GPS) time in Coordinated Universal Time (UTC) and the Nautical Almanac Office - United States Naval Observatory definitions of morning civil twilight and evening civil twilight. The GPS time at the start of the trip was used to assign these time-of-day category for initial trip sampling. Selected categorizations were "Day," "Night," "Twilight PM," and "Twilight AM." Twilight PM was defined as the time after sunset when the sun was less than six degrees past the horizon. Twilight AM was defined as the time before sunrise when the sun was less than six degrees below the horizon.

The ideal sampling strategy was to select a valid trip for each of these four time-of-day categories, for each month of riding, for each of the 46 riders. A set of 372 trips were reduced during data exploration and protocol development, prior to finalizing the sampling strategy. Trips for this set were selected

randomly for each rider. These trips were placed into the appropriate month/time-of-day conditions based on the ideal sampling strategy, and then additional trips for the open conditions in the ideal strategy were randomly selected. Since these 372 trips were analyzed before the sampling plan was finalized, the number of trips per rider was not even. Some conditions included multiple trips for the same rider.

The sampling method was designed to obtain a sample of trip conditions (time of day and month) across riders, but due to the fact that some riders do not ride at certain times of the day or month of the year, was not intended to result in a perfectly balanced set of conditions. For a given rider, some categories would be populated, while others were not. Thus the final sample of 1460 trips was more indicative of riders' habits than being a sample of riders balanced across date and time of day. In addition, video reduction was to be performed on the entire trip, and so could span a transition from one time-of-day category to another. Therefore for some longer trips, because the trip start time was used to assign initial time-of-day categories but video reduction assigned a final time-of-day based on the majority of the trip, the final categorization differed from the initial categorization, creating further imbalance in the sampled trips across time-of-day.

Following video reduction of the 1460 trips for 46 participants (described in the following section), trips collected on the same day and in the same time frame were randomly down sampled to just one trip for the purpose of supporting description of riders' clothing habits across trips in this report. In this way, one trip was chosen that would be indicative of a distinct date/time of day combination. For instance, if four trips were reviewed for participant 1 during the Twilight PM period of January 1, 2012, one trip from these four was randomly chosen to be the representative case used in final analysis of that rider's clothing habits. Repetitive sampling on the same day for an individual rider would not be indicative of the overall rider clothing and gear choice because it would skew the results toward this particular day. After elimination of 249 duplicate date/time-of-day trips in this manner, the resulting dataset included 1211 trips.

Video Reduction Methodology

The method used to collect information about participants' clothing was video reduction. This method utilized a VTTI video viewing tool called Hawkeye, which allowed the analyst to view a trip video (all five camera views: face, front, left, right, and rear), while simultaneously entering data related to that trip into a computerized database, including clothing and environmental conditions.

A senior researcher developed a protocol for review of the final sample of trip videos. Data reductionists trained in video analysis followed this protocol to obtain information for each of the selected trips for the following descriptors ("unknown" was an option in every category, as well as "none" where applicable).

- Clothing (Torso)
    - Type (based on material/coverage)
        - Full Jacket Zipped, Leather
        - Full Jacket Zipped, Non-leather
        - Partial Jacket/Vest Zipped, Leather

        - Partial Jacket/Vest Zipped, Non-leather
        - Full Jacket Unzipped, Leather
        - Full Jacket Unzipped, Non-leather
        - Partial Jacket/Vest Unzipped, Leather
        - Partial Jacket/Vest Unzipped, Non-leather
        - Shirt, Long-sleeved
        - Shirt, Short-sleeved or Tank
        - Nothing
    - Armor (definitely armor, probably armor, probably no armor, definitely no armor)
    - Color (dark, light, bright, some light/bright)
    - Reflectivity (yes, no, partial)
- Helmet
    - Usage
    - Type (full, three-quarter, half, modular)
    - Color (dark, light, bright, some light/bright)
- Gloves
    - Usage
    - Type (full, open-fingered)
    - Color (dark, light, bright, some light/bright)
- Eyewear
    - Usage
    - Type (face shield, glasses)

Video reductionists also recorded the time-of-day category that applied to the greatest amount of riding time and most severe weather conditions during each trip. The reductionist first watched the entire video at high speed. If any clothing characteristic changed throughout a trip, the reductionist coded conditions that existed for most of the trip. If there was no clear most common clothing condition, the clothing characteristic at the point where the speed first exceeded 20 mph (or at the point of highest speed if the trip speed remained less than 20 mph) was recorded.

A range of clothing type options were included as part of the video reduction protocol, along with guidelines for consistency in making the determination. Variability, however, in making judgments as to whether a jacket is leather or not (e.g., at night) are inherent. The final goal of categorizing torso clothing was to provide some indication of selected protection from the elements as well as from injury if an accident occurs.

Note the inclusion of degrees of surety for reductionists in the clothing armor category ("definitely" and "probably"). The armor could be external (pads) or integral to the rider's jacket. Degrees of certainty in this determination ("definitely" and "probably") were allowed because judgment regarding the presence of armor proved to be difficult in many instances (for example, if it was internal armor and/or removable). This range was provided to reduce entries of "unknown" if the analyst had an inclination but was unsure.

A part of the overall reduction included reviewing clothing color. Reductionists were provided with a color chart along with general guidelines to aid in the distinction between Light, Bright, and Some Light/Bright (the Some Light/Bright category was used if less than the majority of the surface was light

or bright). Evaluation of clothing color as related to rider visibility is dependent upon multiple factors, including the time of the day and general surrounding conditions. The effect of clothing color is especially difficult to evaluate at night. Therefore for the scope of this study, a general evaluation of color categorization (dark versus light or bright) was conducted, but no overall analysis of rider conspicuity was performed.

Reductionists performed analysis of torso clothing reflectivity with guidance from the protocol. Similarly to the other clothing variables, this evaluation involved a good deal of subjectivity, and the effect of reflectivity on clothing visibility depends largely on the surroundings (including the time of the day and lighting). Although reflectivity characteristics were collected on all trips, the value and application of such information for day trips would not be the same as that for night trips.

Regarding evaluation of helmet type, if the modular helmet was worn for the majority of the trip with the chin bar down, it was coded as a full helmet. If a rider wearing a modular helmet wore it open for the majority of a trip, the helmet classification was marked as three-quarter because the level of protection was most similar to that of the three-quarter (open-face) helmet.

Helmet color evaluations were categorized and defined identically to the clothing color evaluations as described earlier (dark versus light or bright). The same problems also existed for the helmet color analyses that were described for the torso clothing color evaluation.

Since all clothing conditions were coded according to the criteria discussed above (code if conditions existed for the majority of the trip), an estimation of time with face shield down or glasses on was required in many cases. The fact that a condition was coded does not necessarily mean that the condition existed throughout the entire trip.

Note that, although eyewear was treated as a protective entity in this analysis, there was no distinction made between regular prescription glasses and protective glasses or goggles. Thus the implied level of protection in the use of eyewear was somewhat overestimated.

Following the video reduction of the dataset, a quality check was completed to assure consistency in judgment of subjective categories such as whether the clothing included armor. The most necessary quality control checks were performed for cases in which conclusions about a rider's choice in clothing would indicate change from one extreme to another (e.g., definitely wearing armor versus definitely not wearing armor). Quality review was conducted to minimize the likelihood that such extreme choice differences were not misrepresented.

RESULTS

The following results provide a description of the clothing worn by riders based on a partial sample of data and purely descriptive statistics. Although factors such as rider age and gender, bike type, weather, and date/time could affect clothing habits, investigation of such effects is not included here. The results are expected to be useful in establishing the range of clothing types and the frequency with which different clothing types are found in the data. The frequency table for each clothing category contains

not only the total number of trips with the observed condition, but also the number of individual participants that were observed wearing a certain type of clothing in any of the sampled trips. Because the sampling procedure restricted the data (e.g., not all months were available), total number of trips should not be the only indicator of clothing item popularity; the number of individual participants per category should also be considered as a measure of the popularity of the item.

Overall Data Description

A summary of clothing-related characteristics was obtained from the original 1460-trip, 46-participant dataset to develop a descriptive picture of the group of riders. The goal of this analysis was to produce a picture of the level of protection (from the elements as well as from injury severity) this sample of riders tended to create through clothing choices.

Table 1 indicates how many trips included participants riding during each time-of-day category. The riding habits varied for each participant, but as would be expected, the majority of trips occurred in daytime conditions. As mentioned, this was partially due to chance (based on the 372 preliminary reductions), but the distribution of trips across the four time categories generally represents the tendency of the rider sample to ride at these times. Total number of trips per participant varied, from 9 trips (1 participant) to 85 trips (1 participant); the mean number of trips was 32 trips (standard deviation 19). Table 1 also includes the number of participants whose data make up each row category, and the percentage of the total 46 participants that this number represents. All 46 participants experienced day riding, 78% of them rode some at night, and slightly more (85%) had trips during twilight before sunset, but only 35% of the participants ever rode in the morning before sunrise.

Table 1. Trip Distribution Across Time of Day (All Trips).

Time of Day	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Day	867	59.4%	46	100.0%
Night	316	21.6%	36	78.3%
Twilight PM	225	15.4%	39	84.8%
Twilight AM	52	3.6%	16	34.8%
	1460	100%		

Figure 1 depicts the distribution of trips across the time-of-day categories as well as months (1=January, etc.), indicating that the available trips were well-distributed across all months of the year. Although individual participants often tended to ride more during specific months, data across all months were available for the overall participant sample. Since these data were collected before all riders completed their full year, trips for all months of the year were not yet available for every rider.

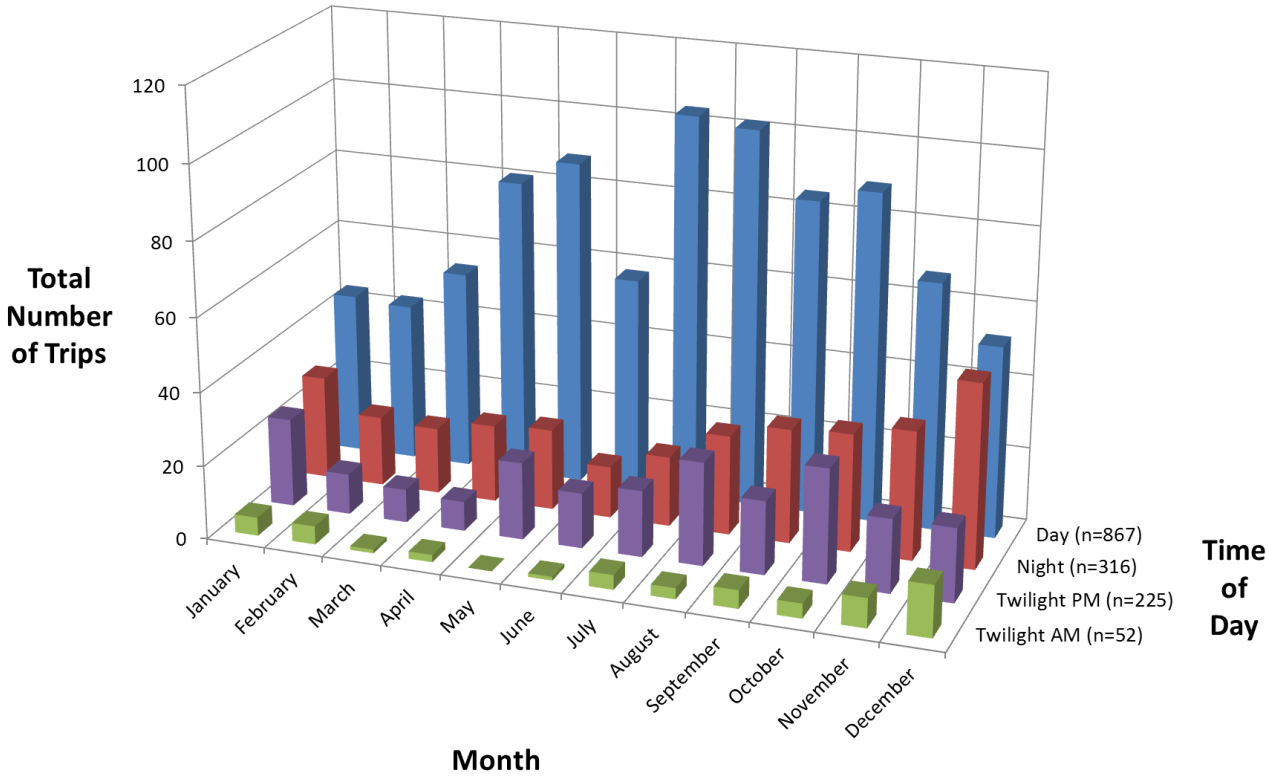

Figure 1. Trips by Month and Time of Day (all trips).

Table 2 includes the time-of-day distribution of the 1211 distinct trips used for final clothing evaluation, as described in the Trip Sampling Methodology section earlier. There were still 46 participants' data in the dataset (and no participant was lost from any of the four time-of-day categories), but the total number of trips per participant now varied from 5 to 79 trips; the mean number of trips used in the analysis was 26 trips (standard deviation 17). The trip distribution (and percentage of participants making up each category) is similar to the one in Table 1, but in this case no date/time-of-day condition is overrepresented.

Table 2. Trip Distribution Across Time of Day (Distinct Trips).

Time of Day	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Day	653	53.9%	46	100.0%
Night	288	23.8%	36	78.3%

Time of Day	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Twilight PM	219	18.1%	39	84.8%
Twilight AM	51	4.2%	16	34.8%
	1211	100%		

Figure 2 presents the updated distribution of trips across the months for each of the four time-of-day categories, with the 1211-trip dataset.

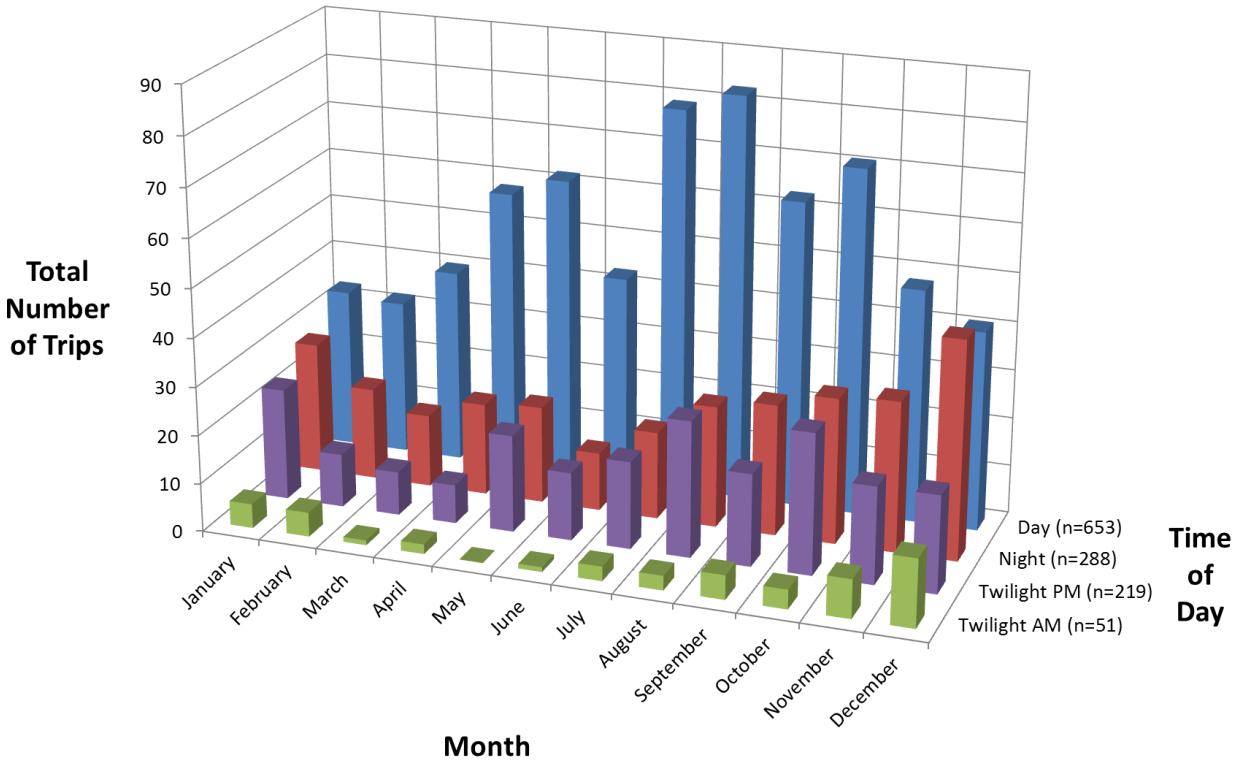

Figure 2. Trips by Month and Time of Day (distinct trips).

The distribution looks very similar to that in Figure 1. Note that the distribution of trips throughout the year is expected to change some as the final data is incorporated.

Clothing (Torso) Analysis

Clothing (Torso) Type

Table 3 includes an overall frequency count of clothing type observed for all trips. Since each participant did not have the same number of trips in the sample, more frequent riders added a larger number of trips to the final results. The Number of Participants and Percentage of Participants columns in Table 3 provide a feel for whether the more "common" articles of clothing are chosen by many of the participants, or just worn frequently by fewer participants. For example, there were fewer overall instances of riders with short-sleeved or tank shirts than the full leather zipped jacket, but there was a greater variety of participants who wore the short sleeves at one time or another. Further analysis showed that 93% of participants were observed in some of their trips with some type of full zipped jacket (either leather or non-leather).

Table 3. Clothing (Torso) Type Distribution (Number of Trips).

Clothing (Torso) Type	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Full Jacket Zipped, Non-leather	447	36.9%	34	73.9%
Full Jacket Zipped, Leather	340	28.1%	27	58.7%
Shirt, Short-sleeved or Tank	240	19.8%	31	67.4%
Shirt, Long-sleeved	91	7.5%	19	41.3%
Partial Jacket/Vest Zipped, Leather	37	3.1%	7	15.2%
Partial Jacket/Vest Zipped, Non-leather	18	1.5%	4	8.7%
Full Jacket Unzipped, Leather	16	1.3%	6	13.0%
Unknown	13	1.1%	6	13.0%
Full Jacket Unzipped, Non-leather	5	0.4%	4	8.7%
Partial Jacket/Vest Unzipped, Leather	2	0.2%	2	4.3%
Partial Jacket/Vest Unzipped, Non-leather	2	0.2%	2	4.3%
Nothing	0	0.0%	0	0.0%
	1211	100.0%		

Clothing (Torso) Armor

Table 4 includes the overall frequency of total trips for each armor category. As mentioned previously, the participant count per category is useful to consider. For example, only 18 participants made up the "Definitely Armor" category (18.7% of all 1211 trips), so definitely wearing armor was less widespread across participants than "Probably No Armor," with 26 participants making up 12.1% of all 1211 trips. Although the (definite or probable) use of torso armor was observed in only 38.4% of all trips (all participants), 72% of the participants were observed at some point wearing armor. In terms of full-time protection, 17% of the participants "definitely" or "probably" wore armor for 100% of their trips.

Table 4. Clothing (Torso) Armor Distribution (Number of Trips).

Clothing Armor	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Definitely No Armor	578	47.7%	36	78.3%
Probably Armor	239	19.7%	26	56.5%
Definitely Armor	226	18.7%	18	39.1%
Probably No Armor	147	12.1%	26	56.5%
Unknown	21	1.7%	8	17.4%
	1211	100.0%		

Clothing (Torso) Color

Table 5 presents the number of trips for each color of torso clothing. Although 60% of the trips included participants wearing all dark torso clothing, in another 39% of the trips the rider was wearing torso clothing with some form of light or bright color. Also, even though the majority of trips included a participant wearing dark, five of the participants were never observed wearing dark (41 participants' data made up the dark clothing category).

Table 5. Clothing (Torso) Color Distribution (Number of Trips).

Clothing Color	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Dark	727	60.0%	41	89.1%
Light	173	14.3%	32	69.6%
Some Light/Bright	164	13.5%	21	45.7%
Bright	134	11.1%	27	58.7%
Unknown	13	1.1%	6	13.0%
	1211	100.0%		

Clothing (Torso) Reflectivity

As shown in Table 6, video reduction of nearly every trip (97% of all trips) resulted in the conclusion that reflective clothing was not worn by the rider. In addition, the 15 trips with reflective clothing were spread between 11 different riders (further analysis showed that even when a participant chose to wear reflective clothing, it was never in more than 10% of their total trips). This indicates that there was no conscious effort for any rider to wear reflective clothing often.

Table 6. Clothing (Torso) Reflectivity Distribution (Number of Trips).

Clothing Reflectivity	Frequency	Percent	Number of Participants	Percentage of Participants
No	1175	97.0%	45	97.8%

Clothing Reflectivity	Frequency	Percent	Number of Participants	Percentage of Participants
Yes	15	1.2%	11	23.9%
Can't Tell	14	1.2%	6	13.0%
Partial	7	0.6%	1	2.2%
	1211	100.0%		

Helmet Analysis

Helmet Usage

The first item of interest related to helmets was whether a rider chose to wear one. Table 7 includes the number of trips per location in which the rider was wearing a helmet, not wearing a helmet, or the reductionist was not able to tell. The percentages of trips for each location under each category of helmet usage are also included. Locations were classified according to helmet laws at the time of data collection (Insurance Institute for Highway Safety, 2013), as applicable to each rider's associated age at the time. Because all of the riders were over 21, Florida's no helmet law applied across all trips in Florida. The 46 riders in this study were distributed between three home states as follows: California, 20 riders; Virginia, 16 riders; Florida, 10 riders. These state assignments were based upon where the rider lived at the time of installation, not on each individual trip location.

Table 7. Helmet Usage Distribution Across Location (Number of Trips).

	Helmet Usage (Trips)					
	Yes		No		Unknown	
Location	Number of Trips	Percentage of Location Trips	Number of Trips	Percentage of Location Trips	Number of Trips	Percentage of Location Trips
CA (helmet law)	648	99.2%	0	0.0%	5	0.8%
VA (helmet law)	337	96.3%	*8	2.3%	5	1.4%
FL (no helmet law)	159	76.4%	47	22.6%	2	1.0%

*actual trips were not in Virginia, but Florida, Michigan, South Dakota, and Wyoming (no applicable helmet laws)

As expected, a smaller percentage of observed trips for Florida-based participants included riders who chose to wear helmets than in California or Virginia. Even so, helmet usage for riders based in Florida was fairly high, at 76.4% of the observed trips. Of the 159 trips for participants based in Florida who were wearing a helmet, only 10 trips were in states with helmet laws (Georgia, Tennessee, Virginia, and Vermont). The remainder of the trips were either in Florida (133 trips) or in other states with no applicable helmet law (12 trips in Kentucky or Pennsylvania), other than 4 trips where the specific location could not be determined.

Table 8 clarifies the breakdown of these percentages by rider, showing that 2/3 of the Florida riders wore helmets in 100% of their selected trips (only one Florida rider never wore a helmet in the observed trips). Of all 36 riders from states with a helmet law (California and Virginia), only 3 (in Virginia) were observed not wearing a helmet, each was for less than 13% of all observed trips, and as noted in Table 7, all of these trips occurred in states with no applicable helmet law.

Table 8. Helmet Usage Distribution Across Location (Number and Percentage of Participants in Each Location).

	Helmet Usage (Riders)					
	Helmet Usage=100%		100%>Helmet Usage>50%		Helmet Usage<50%	
Location	Number of Riders	Percentage of Location Riders	Number of Riders	Percentage of Location Riders	Number of Riders	Percentage of Location Riders
CA (helmet law)	18	90.0%	2	10.0%	0	0.0%
VA (helmet law)	12	75.0%	4	25.0%	0	0.0%
FL (no helmet law)	6	66.7%	2	22.2%	2	22.2%

Helmet Type

The number and percentage of trips in which riders were wearing the different types of helmets, as well as the number of participants with at least one trip for each helmet type, are shown in Table 9.

Table 9. Helmet Type Distribution (Number of Trips).

Helmet Type	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Full	528	43.6%	25	54.3%
Three-quarter	262	21.6%	11	23.9%
Half	245	20.2%	15	32.6%
Modular	109	9.0%	6	13.0%
None	55	4.5%	7	15.2%
Unknown	12	1.0%	5	10.9%
	1211	100.0%		

Because the helmet tends to be a more consistent clothing/gear item for motorcyclists than other clothing items, further analysis was performed on these results to get an idea about the level of this consistency. The following list represents variation in participants' dedication to helmet types.

- Riders who chose to always wear one type of helmet:
  - Fifteen riders wore the full helmet for all of their observed trips
  - Five riders wore the three-quarter helmet in all of their observed trips
  - Six of the riders wore the half helmet all of the time

    - Three riders wore the modular helmet throughout all of their observed trips
- Riders who wore one type of helmet in the large majority of their observed trips (but not 100%):
    - Four riders chose the full helmet
    - Four riders chose the half helmet
    - Three riders chose the three-quarter helmet
    - One rider chose the modular helmet
- Riders who split their preference fairly evenly between two types of helmets
    - Two riders chose the half helmet and the three-quarter helmet
    - One rider chose the half helmet and the modular helmet

Helmet Color

Table 10 presents the distribution of the observed helmet color across all trips, along with the number of participants with trips in each category.

Table 10. Helmet Color Distribution (Number of Trips).

Helmet Color	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Dark	683	56.4	30	65.2%
Light	293	24.2	14	30.4%
Bright	114	9.4	7	15.2%
N/A	55	4.5	7	15.2%
Some Light/Bright	53	4.4	7	15.2%
Unknown	13	1.1	6	13.0%
	1211	100.0		

Glove Analysis

Glove Usage

Table 11 includes the results of the glove usage analysis for all 1211 trips. In more than two-thirds of the trips (71.0%), the rider was wearing some type of glove. As evidenced by the Number of Participants column, five of the participants never wore gloves, and more than half went without gloves at some point while riding.

Table 11. Glove Usage Distribution (Number of Trips).

Glove Usage	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Yes	860	71.0%	41	89.1%
No	329	27.2%	28	60.9%
Unknown	22	1.8%	5	10.9%
	1211	100.0%		

Glove Type

The follow-up evaluation on Glove Usage was Glove Type (Full, Open-fingered, None, or Unknown). Results are in Table 12. The full glove was the most common type across all trips by far, but six of the participants never wore full gloves in their observed trips.

Table 12. Glove Type Distribution (Number of Trips).

Glove Type	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Full	770	63.6%	40	86.96%
None	329	27.2%	28	60.87%
Open-fingered	90	7.4%	11	23.91%
Unknown	22	1.8%	5	10.87%
	1211	100.0%		

This dataset was analyzed by participant, along with the dataset including the 15 riders who wore gloves in 100% of their observed trips, to discover that 11 of these 15 wore full gloves for every trip, while the remaining 4 wore full gloves for some trips and open-fingered gloves for the remainder.

Eyewear Analysis

Eyewear Usage

The final clothing-related item for evaluation was eyewear. This question involved whether the rider utilized any type of eyewear (including glasses or a face shield) during the majority of a trip. Table 13 presents the eyewear usage in the sample. All of the participants wore some type of eyewear at some point during their sampled trips, but about a third of them also experienced some instances of not wearing eyewear.

Table 13. Eyewear Usage Distribution (Number of Trips).

Eyewear Usage	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Yes	1113	91.9%	46	100.0%
No	81	6.7%	15	32.6%
Unknown	17	1.4%	9	19.6%
	1211	100.0%		

Further analysis showed that a majority of riders wore some type of eyewear during the majority of their observed trips. Of the 46 participants, 30 wore eyewear for 100% of all observed trips. No rider went without eyewear for all observed trips. The largest percentage of total trips that any rider went without eyewear was 35%.

Eyewear Type

Table 14 provides the number of trips including each type of eyewear. Riders wore some type of face shield in just over half (55.2%) of the sampled trips. For approximately one-third of the trips (36.7%), the rider was wearing glasses and either didn't have a face shield or the face shield was up. Nearly three-fourths of the participants rode at times with a face shield, and more than half (61%) rode some wearing glasses.

Table 14. Eyewear Type Distribution (Number of Trips).

Eyewear Type	Number of Trips	Percentage of Trips	Number of Participants	Percentage of Participants
Face Shield	669	55.2%	34	73.9%
Glasses	444	36.7%	28	60.9%
None	81	6.7%	15	32.6%
Unknown	17	1.4%	9	19.6%
	1211	100.0%		

CONCLUSION

The data from the MSF 100 Motorcyclists Naturalistic Study is still accumulating at the time of writing. These analyses and results were based on a sample of the data. This work introduces a method for reviewing rider clothing within naturalistic riding data and provides a detailed classification system for describing rider gear (including helmets and gloves). The analyses provide an objective description of the variation in clothing items both between riders and for individual riders.

This data set included 1211 trips, with riding examples for each month of the year, as well as each of the four time-of-day categories (Day, Night, Twilight PM, and Twilight PM). However, because all data are not yet available, the entire riding season or year may not yet be included in these data for each participant. The warmer months during the daytime appear to be the most common, however variation in these data (e.g., lower trip counts in June) indicate that it is likely prudent to wait for the entire data set before providing summary descriptions. Within participant variation indicates that the majority of participants (43 of 46) tend to ride more in the day.

Although habits varied within participant, overall clothing choices which afforded substantial protection from weather and injury were frequently in the data set when considered as frequency of trips and numbers of participants. These clothing choices included full jackets, leather clothing, helmet usage (specifically, full helmets), glove usage (especially full gloves), and eyewear usage (especially face shields). Reflective clothing was not a common observance in the sampled trips.

Within the data set, in terms of torso protection, everything from short sleeve shirts to armor was observed. Riders seemed to prefer wearing full zipped jackets (93% of participants were observed in some of their trips with some type of full zipped jacket, either leather or non-leather), but also spent a

large percentage of time wearing short-sleeved shirts or tank tops with no jacket. The use of armor was not prevalent in terms of total percentage of trips, but many riders (33) sometimes or always wore armor (13 riders went without armor all of the time).

Of the rest of the clothing items investigated, glove usage seemed to vary the most within individual participants, while helmet usage was the most constant. In terms of glove usage, 56% of the participants varied in terms of whether they wore gloves or not (33% of the participants always rode with gloves and 11% always rode without gloves). Comparatively, only 22% of the participants varied in terms of helmet usage (78% of the participants always wore a helmet, whereas no participant went without a helmet for all trips). When selecting specifically the 10 riders in no helmet states, only 4 of these riders were ever observed without a helmet at some point. Thus helmet usage, even in states with no helmet law, was observed to be common. Likewise, the use of eyewear (face shield or glasses) was very prevalent in the observed trips.

This study presents the groundwork to answer the question of what motorcyclists wear. Previous research into this area has been primarily based on self-reported data; this study presents actual observational data, rather than rider recollection of what they "normally" wear. Because these participants were volunteers, they might be expected to represent safer riders, who were observed wearing a range of clothing types. The choices that these riders made, as well as the variation in these choices, provide information for understanding the broad topic of motorcyclist clothing and protective gear. Subsequent analyses will be used to statistically compare inter- and intra-individual differences in what people wear and also relate those findings to demographic and environmental factors, personality types, and riding behavior.

REFERENCES

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