Determining Theme Park Attraction Attributes:

An Analysis of Factors that Impact Theme Park Attraction Popularity and Success

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A Senior Thesis submitted in partial fulfillment
of the requirements for graduation
in the Honors Program
Liberty University
Spring 2018

Acceptance of Senior Honors Thesis

This Senior Honors Thesis is accepted in partial fulfillment of the requirements for graduation from the Honors Program of Liberty University.

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Abstract

Theme parks have some attractions that are more popular than others, referred to as main ticket attractions (MTA). The purpose of this thesis is to create a model which can successfully predict whether or not theme park attractions are considered MTA. Data from leading USA theme park attractions has been recorded and analyzed for this thesis. A neural network model has been created using Matlab that categorizes attractions with up to 85% accuracy. However, some of the inputs are considered unstable once run through SAS JMP. To create a comparative study, a decision tree has been created in Matlab with the same 15 inputs. Five attractions were withheld from the models to compare their results. In the end, the decision tree categorized 90% of the attractions correctly, while the neural network categorized 80% appropriately.

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Introduction

Theme parks, like any business, are constantly seeking methods to improve their revenues and attract more customers. One of the most common ways to increase theme park attendance is by building new theme park attractions or implementing new versions of current ones. Theme park investments are expensive, though, so it is crucial that these businesses understand in which attractions to invest. By analyzing features that make these theme park attractions so popular to theme park visitors, better models can be created so that these companies can gain better insights.

Literature Review

Many journal articles have investigated methods of quantifying the satisfaction of the theme park customer (Boshoff, 2006; Geissler & Rucks, 2011), and many more have inspected techniques to optimize the efficiency and profitability of the theme park environment (Kim & Kim, 2016; Lee, Ting, & Chen, 2011; Liu, 2008; Rajaram & Ahmadi, 2003; Zhang, Li, & Su, 2017). Others have broadly evaluated theme park trends and strategies (Formica & Olsen, 1998; Lillestol, Timothy, & Goodman, 2015; Milman, 2001; Milman, 2010) and their impact on local tourism (Lau & McKercher, 2006; Lee, 2015; Milman, Okumus, & Dickson, 2010; Xia et al., 2010). Closer to the topic of this thesis include articles regarding the impact of new attractions (Cornelis, 2010), attributes of popular attractions in Hong Kong (McKercher, Ho, du Cros, 2004), and a model of investments in theme parks (van Oest, van Heerde, Dekimpe, 2010).

The article written in 2011 by Geissler and Rucks discusses the impact of new attractions in a theme park setting. It acknowledges the fact that theme park business continues to rise globally, but the available knowledge regarding the effects of new attractions is slim. Thus, the article's purpose is to further the discussion of these effects from the perspective of general theme park managers across Europe. These managers responded to a written survey, and then answered detailed questions by email, telephone, or interview. Investing in new attractions is considered the most important factor for increasing the number of annual theme park visitors by managers. Based on the article's analysis of historical data, the results indicated that theme parks who make a major investment into some new attraction every three years seem to have the highest effect in increasing their visitor numbers.

In the 2004 article by McKercher et al., five attribute categories are identified as potentially significant to the popularity of cultural attractions in Hong Kong. These include product, experiential, marketing, cultural, and leadership. Here, the authors hope to distinguish which among the five categories influence the popularity of cultural attractions in the Hong Kong region. The product category explains how popular the surrounding area is, examining the site, setting, and access of the attraction. The experiential category defines the attraction's uniqueness and relevance to the tourist, while the marketing category identifies the viable market segments and life cycle of the attraction. The cultural category judges the local and international social values related to the attraction, and the leadership category defines the vision and ability of the location to adopt an attitude toward tourism. Out of the five, the product category seemed to be the

most influential, though the article noted that to be popular, an attraction "must function first as a tourism attraction, and second as a site of cultural significance" (p. 405).

The purpose of the article by van Oest, et al. in 2010 is to create a marketing model to guide theme park investment decisions. Despite the high economic significance of the theme park industry and the massive investments that are required to complete new attraction projects, the article noted that no current marketing models exist to guide these investment decisions. The model proposed by the article determines the contribution of each attraction to attendance within and across years. The article categorizes attractions as either thrill or theme. Generally, with all else equal, thrill attractions are more effective for increasing theme park attendance than investing in themed ones. Under certain conditions, however, theme attractions can become more effective than thrill ones. This is true if a certain area of a park has become too saturated with thrill type rides, or a recent theme is especially popular amongst the general public. Another conclusion of the article is that it is more efficient to invest in multiple smaller attractions than in one large attraction.

The most related and useful article to this thesis was written in 2010 by Cornelis. The author echoes the claim of other articles that theme park research is young, and there is much more to be discovered and researched. Further, there is a specific need for theme parks to have the ability to consistently predict the success of its attractions. While the Walt Disney Company has been described as being "beyond excess – four or five standard deviations away from the mean" (Fjellman, 1992, p. 16), even it is "not capable

of consistently and correctly predicting the success of their new attractions" (Cornelis, 2010, p. 265).

To determine the significance of attractions to theme park attendance, Cornelis (2010) created a model with the addition of new attractions as only one of the inputs. The other inputs include: weekend days, national holidays, vacation periods, average temperature, total precipitation, opening hours, entrance fees, retheming of an existing attraction, addition of a new show, and special events. With this model, the author can predict theme park attendance with 98 to 99 percent accuracy. The R^2 value for the model is 0.646, indicating that about two-thirds of the variance in attendance can be explained by the model. The results also indicate the opening of a new theme park attraction can increase theme park attendance by 23 percent. The effect lasts, on average, about two years. While uncontrollable factors (such as if the day is a weekend, holiday, during a vacation period, the average temperature, and amount of precipitation) have a very strong effect on theme park attendance, the addition of a new attraction can have the highest impact on attendance amongst controllable factors.

From these four articles, it can be gathered that while an initial assumption might be that the ride type is the most influential factor in attraction popularity, this is not necessarily true. The timing of when the attraction opened, the availability and entertainment factor of the attraction, and the attraction theme can also highly impact the attraction's popularity. The articles also indicate the value that theme parks can gain from having accurate predictions for its new attractions. This thesis, then, brings a model for attraction popularity and success by analyzing features not mentioned in previous articles.

Additionally, previous models focused on an output of increased theme park attendance (Cornelis, 2010), while this thesis aims to successfully categorize attractions on whether or not they are main ticket attractions.

Main Ticket Attractions

Main ticket attractions (MTA) are defined as those attractions which are the most popular amongst theme park guests. Theme parks often describe these attractions as those that are the reason visitors buy tickets and visit the theme park at all. Since this definition is quite subjective and ill-defined, for the purpose of this thesis, MTA will be determined by the wait time for the attraction at the opening hour of the theme park.

Attractions have different load rates and speeds. By identifying which attractions have significant wait times at the theme park opening each day, these considerations can be factored out. The majority of theme park attractions in the United States have wait times between five and fifteen minutes when their theme parks open their gates. Approximately 19 percent of sampled theme park attractions have wait times over 25 minutes. This, then, is the determination for whether a theme park attraction is considered an MTA or not.

Theme Park Attraction Inputs

Determining how to measure the features of theme park attractions can be a precarious process. Many of these features require qualitative (also known as categorical) inputs. On the other hand, other features can be easily measured in numerical form. This requires a mixed method for the research. For this thesis, the population refers to all United States theme park attractions. The sample includes attractions from Walt Disney

World in Orlando, Florida, Disneyland in Anaheim, California, and Universal Studios in Orlando, Florida. In total, data has been collected on 128 sample theme park attractions. Both quantitative and qualitative features of these attractions have been collected in order to predict the whether or not these attractions are MTAs.

Quantitative

Quantitative inputs are those that can be numerically measured and recorded (Mertens, 2014). In previous studies, these have included average temperature for a specific day of the year, total precipitation, theme park hours, entrance fees, and opening date of the attraction. This model utilizes quantitative data about the theme park attraction, specifically.

Opening date. This thesis uses the opening date of the attraction as that was indicated to be significant in other studies. Technically, it is not the opening date that is being utilized, but rather, the age of the attraction, measured in years. The age of the attraction is seen as valuable for two reasons. First, it shows which attractions are new. Even if an attraction is not particularly successful in the long-term, it usually has an impact on park attendance for two years (Cornelis, 2010). Second, it may indicate the advancement of the attraction's technology. Older attractions cannot utilize recent technology (unless it has been refurbished), which may have an impact on popularity.

The opening date data was collected directly from each attraction's corresponding theme park web page. If the attraction has been refurbished with significant changes (updated technology, different vehicle types, retheming), the refurbish date has been

used. If, however, the refurbishment was minor (repainting, maintenance, single feature updates), the original attraction opening date was recorded.

Attraction length. The length of the attraction, measured in minutes, may have an impact on the perceived worth of the attraction itself. For example, if a theme park guest knows that an attraction has a relatively short duration, but the queue line is considered long, s/he may not believe the attraction is worth the wait.

Measured in minutes, this attraction input was collected from each theme park web page as applicable. *The Unofficial Guide: Walt Disney World 2018* (Sehlinger & Testa, 2018) and the *Unofficial Guide: Disneyland 2018* (Kubersky, Sehlinger, Testa, & Selga, 2018) were used to verify web page information.

Height requirement. For some theme park attractions, there exists a height requirement for passengers. On Disneyland's help center web page, under frequently asked questions, "safety" is listed as a general justification for these height requirements. Similarly, Universal Orlando Resort explains on its rider safety web page that "your safety is our top priority". To detail what may fall under the broad spectrum of safety, Saferparks lists two reasons for height requirements. First, and most likely, it may be connected to the physical size of the rider. There are many types of restraint systems used for attractions, and some are better suited to certain body sizes than others. The second reason is a correlation to age. If an attraction designer or manufacturer believes an attraction may be too intense for young children, a height requirement may be put in place based on a height percentile for the appropriate age group (Saferparks, 2018).

In either case, height requirements may indicate an intended age group or thrill level for a particular attraction. Height requirements for each attraction were found and recorded from the corresponding theme park web pages. In some cases, there are two height requirements listed. One is for a child to ride the attraction with an adult, and the other is for the child to ride by him/herself. (For example, the Silly Symphony Swings in Disney's California Adventure park.) In these scenarios, the height requirement for the child to ride with an adult was recorded and used in the dataset.

Load rate. The load rate for an attraction refers to how quickly an attraction can load passengers. This is determined by how quickly the attraction moves, how many vehicles the attraction utilizes, the number of passengers per vehicle, and time it takes for passengers to enter the vehicle. Similar to attraction length, this quantitative input may impact its attraction's popularity because of perceived value. Two attractions, A and B, may have the same number of guests in their queue lines, but because attraction A's load rate is slower, it will take longer for guests to board attraction A. Thus, the average time in queue for attraction A will be greater. If attractions A and B are similar in all other features, it can be assumed guests will be more attracted to attraction B, making it more successful.

In the Unofficial Guide books (Kubersky, Sehlinger, Testa, & Selga, 2018; Sehlinger, & Testa, 2018), the approximate time it will take an individual to board each attraction given that one-hundred people are in front of him/her in the queue is listed. From this information, the load rate for each attraction was determined and recorded.

Qualitative

Qualitative data focuses on words, pictures, or artifacts and uses this information to categorize items (Mertens, 2014). It is not measured in a numerical fashion, but this does not indicate that it is less valuable than quantitative data.

Vehicle type. Attractions are often categorized into similar types. Some of these categories are widely used across theme park companies, and theme park visitors recognize these labels. Often, though, these categorizations are more dependent on the attraction environment (dark ride, water ride) than the vehicle type. This can indicate to visitors the intensity and thrill level of the attraction. For this thesis, attractions have been categorized by their vehicles or tracks, rather than by the environment. This has been done intentionally, in an attempt to remove the intensity and thrill level from the category. Intensity and thrill level of the attractions will be addressed by the sensory scale and thrill scale inputs, respectively.

Within the 128 theme park attractions originally sampled, there emerged 15 vehicle types. These are: boat, drop tower, fast guided track, merry-go-round, midway, omnimover, raft, roller coaster, show, simulator, spinner, train, truck, variable track, and water flume. The differences between these vehicle types will be discussed below. It should be noted, of these 15 types; one (truck) contains less than three sample attractions (Figure 1). This vehicle type was kept in the data due to one or more of the attractions being considered MTA.

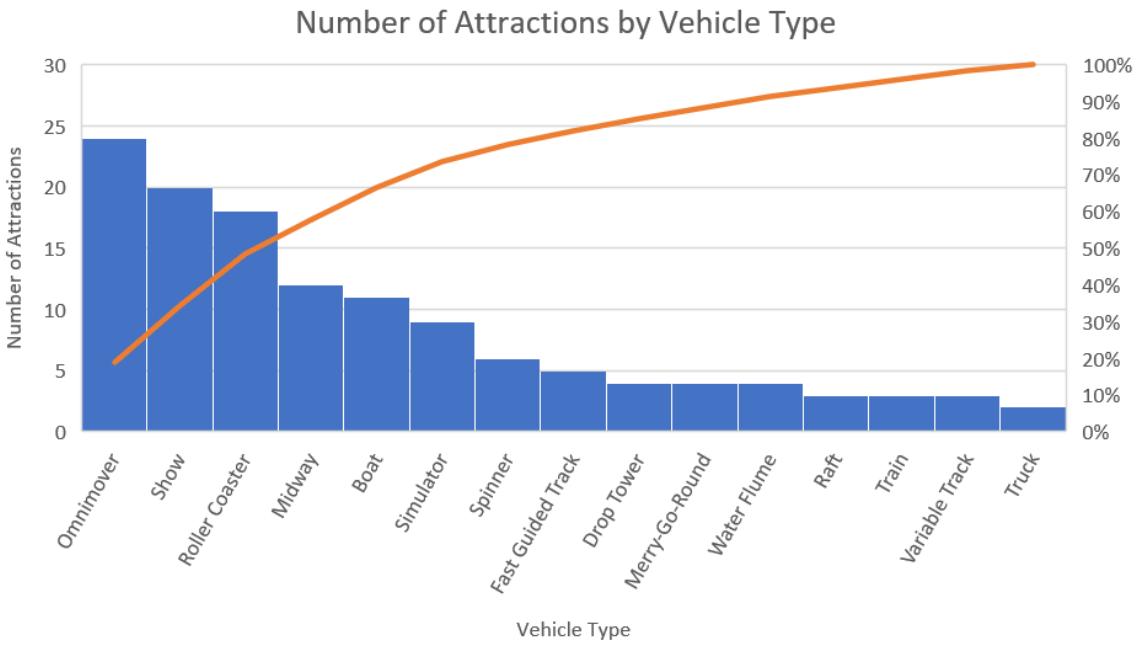

Figure 1. Sample attraction counts by vehicle types.

Water. There are three vehicle types that all travel in water: boat, raft, and water flume. Boat rides are defined as attractions with boat vehicles. These boats have defined forward and backward-facing ends, and multiple passengers can be transported in each vehicle. During the duration of the attraction, the boats are solely propelled by water. They often inhibit slow-moving water journeys, with little-to-no rough waters. A notable example of a boat ride is “it’s a small world” in both Disney theme parks.

Raft ride vehicles are circular in shape and large in size, often holding ten to twelve passengers at a time. Due to their shape, these vehicles rotate or spin as they move along. Thus, a passenger may travel facing forwards, side-ways, or backwards depending on the vehicle position in that moment. Generally, they are fast-moving rides, often simulating rapids. At Universal Studios, Popeye & Bluto’s Bilge-Rat Barges fall into this category.

Water flumes, sometimes referred to as log flumes, are notable for their long drops that drench their passengers. They are defined by their log-shaped vehicles. Like boat vehicles, water flume vehicles have defined forward and rear-facing ends. These vehicles, however, usually seat fewer passengers across their widths. They are propelled by water but are also lifted uphill by a belt or conveyor. Most famous in this category is Splash Mountain, located in the Disney theme parks.

Spin. Another larger category that has been broken down into three vehicle types is that of the spinning attractions. Midway attractions are defined as vehicles which rotate around the central object to which they are attached. Both Ferris wheels and aerial cycle rides (such as Dumbo the Flying Elephant) would fall into this vehicle category. Merry-go-rounds, also known as carousels, are considered a different type of vehicle because their vehicles usually only hold one passenger at a time, and usually do not incorporate an aerial component. Finally, spinners are the third spinning vehicle type. These vehicles are unique because each vehicle spins independently, and rather than simply rotating around a central object, spinner vehicles spin on their own axis. A famous spinner example is the Mad Tea Cups in both USA Disney parks.

Drop Tower. Drop tower vehicles are characterized by their vertical movement. They are lifted vertically, to great heights, and then released (or even pulled down), rapidly plummeting back to earth. These vehicles may seat only one rider or entire groups at a time. If the vehicles seat individual passengers, over-the-shoulder restraints are typically utilized for safety purposes. The Twilight Zone Tower of Terror in Walt Disney World is an excellent example of a drop tower attraction.

Omnimover. Omnimover vehicles are attached to conveyor tracks, slowly moving around the attraction. There is even and consistent spacing between omnimover vehicles, and they usually seat between two and three passengers. The speed of the vehicles is simultaneously controlled by an operator. The shape of the vehicles can vary, often being utilized to further the theming of the attraction. For example, in The Little Mermaid ~ Ariel's Undersea Adventure attraction, the omnimover vehicles are shaped like clamshells.

Roller Coaster. Easily distinguishable, roller coaster vehicles seat many passengers at a time and are attached to elevated railroad-tracks. These tracks utilize tight turns, steep drops, loops, and corkscrews to entertain guests. Brake runs are used to stop the roller coaster vehicles at the end of the attraction. Safety restraints may be lap bars, seatbelts, or over-the-shoulder depending on the intensity of the roller coaster. Most notable in this category is The Incredible Hulk coaster at Universal Studios.

Fast Guided Track. Fast guided tracks are not omnimovers, nor are they roller coasters, but they incorporate elements of both. These vehicles are guided by a track, but the can be individually moved. There is not necessarily even spacing between the vehicles. As in the name, these vehicles travel fast, sometimes spinning or even going backwards. Both Test Track, in Epcot, and Transformers: The Ride 3D, in Universal Studios, would be considered fast guided tracks.

Show. Show vehicles are always the same: seats. These may be theater-style seats or wood benches, but the purpose is to house as many people as possible. While

individuals are seated, entertainment plays out before them. This could be live-entertainment, theater, or film.

Simulator. Simulator vehicles seat passengers in a single room and use all sorts of movements and visual effects in an attempt to simulate another type of vehicle. Many of these attractions want the passengers to believe that they are flying (such as Soarin', Flight of Passage, and Star Tours). There are often jarring movements and simulated drops, causing many passengers to experience motion sickness.

Train. As with the roller coaster, train rides are easy to identify. These are slow-moving vehicles that seat many passengers at a time. They are attached to railroad tracks, but do not utilize any drops, loops, or corkscrews like roller coasters. These attractions often tell a story or give a tour of the theme park in which the visitors are traveling.

Variable Track. These are also referred to as simulated tracks. These utilize the same movements as simulator-type attractions, but while moving on a track. These vehicles are often simulating going over rough terrain, despite the track being flat. Like fast guided tracks, the vehicles do not necessarily have a uniform distance between them. Unlike fast guided tracks, though, the goal of a variable track vehicle is not to travel quickly. Attractions such as Indiana Jones in Disneyland fall into this category.

Truck. Easily defined, trucks are safari-type vehicles, used for rough terrain and long distances.

Based on well-known story. This is a binary, yes or no, category that records whether the attraction is based on a well-known story. Quite subjective, this category is tricky because some attractions may be based on a story, but it is not a well-known one.

Additionally, the story may have been well-known at one point in time but is not popular with today's audiences. An example of this scenario can be found in Splash Mountain. The attraction is based on the 1946 Disney film *Song of the South* and features characters such as Br'er Rabbit and Br'er Fox. While older generations may recognize the story-line and characters from the film, most of today's passengers are unaware of the attraction's beginnings.

Environment. This input categorizes attractions as outdoor, indoor, or both. Generally speaking, this is a straight-forward categorization. It should be noted, though, that covered, outdoor rides are still classified as outdoor. Attractions categorized as indoor may have queues that are partially or fully outdoor. Attractions that travel through tunnels are categorized as both if the tunnel is twice as long (or longer) than the full-length of the vehicle.

Age interest. Data has been collected from the Unofficial Guides (Kubersky, Sehlinger, Testa, & Selga, 2018; Sehlinger, & Testa, 2018) and their corresponding webpage, TouringPlans.com. This organization has been collecting theme park data for more than a decade, combining experts' opinions and survey results from its readers and users (TouringPlans, 2018). From these survey results, a rating has been given for each attraction by each age group on a scale from one to five. In this case, a five would indicate that the noted age group has demonstrated high interest in the attraction, while a one would show low, almost non-existent interest. This input may be valuable to the model because, in theory, a higher interest across a variety of age-groups would imply higher popularity for the attraction.

The data is broken-down into six age groups: preschool, grade school, teen, young adult, over 30, and senior. Preschool encompasses ages 0 to 5, and grade school from 5 to 12. Teen includes ages 12 to 18, and young adult umbrellas ages 18 to 30. The over 30 age group includes persons 30 to 55, and senior is anyone older than 55 years-old.

Thrill scale. In many attraction reviews, the thrill level or intensity of the ride is rated. However, these are often arbitrary and based on one author's opinion. To establish a more measurable and agreeable rating, the following scale has been produced (Table 1).

Table 1

Thrill Scale for Sample Attraction Data

Rating	Description
0	Smooth; no drops or spins
1	Small drops or spins
2	Big drops or spins
3	Extreme twists and turns; upside-down

This does not take into account any sensory components of the attraction; simply, the thrill of the track. Seven individuals were asked to rate each of the sample attractions based on the table above. The data used in the later discussed models is an average of the individuals' responses. (See Appendix B for the individuals' responses.) An example for each of the ratings: "it's a small world" would be categorized as a zero because it is smooth and has no change in elevation. Mad Tea Cups are considered about a one because of their spinning element. In the category of a two would be Splash Mountain

because of its big flume drop. Finally, the Incredible Hulk Coaster would be filed under a three with its seven inversions and 67 miles-per-hour speed (Universal Orlando Resort, 2018).

Sensory scale. To manage the sensory component of each attraction, a sensory scale was created. Similar to the previous input, seven individuals were asked to rate each of the sample attractions based on the criteria explained below. The data used in the later discussed models is an average of the individuals' responses. (See Appendix C for the individuals' responses.) The scale ranges from zero to four, counting the number of human senses that are manipulated to enhance the intensity or creativity of the attraction. To date, no attraction utilizes the human sense of taste; thus, a maximum of four senses can be engaged.

Visual. A visual stimulant for an attraction may include vision impairment, such as darkness or a blinding flash of light. It may control the lighting or colors to create a dazzling effect. 3D attractions manipulate the visual sense by using glasses to force the perspective of the passengers.

Auditory. An audio trigger is often characterized by its loudness. Intense noise, sudden explosions, or dramatic music may be used to manipulate the sense of hearing to intensify the attraction. It should be noted that most attractions utilize some form of background music, and this does not count towards the sensory scale.

Olfactory. The sense of smell is referred to as olfaction. Attractions that use a visitor's sense of smell to enhance the ride are often newer. If done correctly, the smell is

released in time with a corresponding visual, bringing the attraction to a new height of realism.

Tactile. Attractions that engage the sense of touch either encourage the passenger to interact with the ride (touch screens) or surprise the visitor, often with sprays of water or drastic temperature changes. It should be clarified that the movement of the vehicle is not inherently considered a tactile manipulation. A drop on a roller coaster is not a tactile engagement; this attraction component is captured in the thrill scale. Tactile triggers are more common than olfactory manipulations, but less than auditory or visual ones.

Examples. To make use of the sensory scale, three attractions will be examined. An attraction with a sensory score of zero is King Triton's Carousel in Disney's California Adventure. This attraction has no sensory manipulations. It does have lights and background music, but these are not classified as sensory engagements. There are no interactive components, loud noises, flashes, or smells.

DINOSAUR in Walt Disney World's Animal Kingdom Park rates as a two on the sensory scale by engaging both the visual and auditory senses of its visitors. The majority of the ride is in the dark, therefore, using the audience's lack of vision to enhance the intensity of the attraction. Additionally, there are flashes of light and smoke effects. As the vehicle journeys through the attraction, guests come upon different dinosaurs. Certain dinosaurs appear quickly, coinciding with loud, sudden screeches and noises. Thus, auditory engagement occurs.

It's Tough to Be a Bug! is a show attraction, also located in Disney's Animal Kingdom. As a show, it has no thrill components; no drops or spins. However, many

consider this attraction too “intense” for young children. Some blame the theming; after all, insects are at the top of many people’s fear list. Perhaps, though, it has less to do with the theming for the attraction, and more with the amount of special effects and utilized senses. It’s Tough to Be a Bug! rates as a four on the sensory scale. It is a dark attraction, going pitch-black at times. It is also a 3D show. It is loud and often described as scary. The audience is sprayed with water, and at one point, can feel the mice exiting the theater under their seats. Smells are wafted in the air, especially during the stink bug scene. Thus, it is possible that the reason this attraction is too intense or scary for young children is because of the stimulation overload they receive during the show.

Data Analysis

To analyze the collected data with all 15 inputs, Matlab’s neural network functionality was utilized. Neural networks assist the user in creating, training, and visualizing datasets (Mathworks, 2018). There are multiple different types of neural networks that can be performed, including classification, regression, or clustering. For this thesis, classification is the best fit. In Matlab software, this is also referred to as pattern recognition.

In order to use the classification neural network, though, qualitative pieces of data must be transformed into a numerical value. This simply means that instead of categorizing vehicle types by “Boat” or “Midway”, a one or two is used, where ones consistently represent the boat vehicle type and twos consistently represent the midway vehicle type. Once this recategorization is accomplished for all the inputs, each attraction must be categorized as an MTA or not. This is determined by the original definition of an

MTA: excessive wait time at the opening of the theme park each day. For this data, if an attraction has a queue wait time of 25 minutes or greater, it is categorized as an MTA. The original data may be viewed in Appendix A.

At this point in the data analysis process, Matlab requires two matrices for its neural network. The first contains the inputs for each attraction and the second is a corresponding matrix with their target outputs. It should be noted, five random attractions were withheld from the testing data so that this model may be compared to others. Since there are 15 inputs for each of the 123 sample attractions, the first matrix is a 123 x 15 matrix imported in Matlab as a cell array. To compliment the dimensions of the first matrix, the second matrix is imported into Matlab as a 123 x 2 cell array. Both columns are binary, with only ones and zeros. A one represents that the attraction does belong in that category. The first column is for the MTAs, so an attraction listed as a one in this column are considered an MTA. The second column is for non-MTAs; thus, attractions listed as a one in this column are not considered MTAs. If an attraction is listed as a one in the first column, it must be represented as a zero in the second column, and vice-versa.

Neural Pattern Recognition

In these types of neural networks, the user desires the network to classify the data inputs into the correct target categories (Mathworks, 2018). In this case, the desired outcome is for the neural network to classify a theme park attraction as an MTA or not, based on the inputs of vehicle type, thrill scale, sensory scale, attraction age, height requirements, etc. To achieve this, the network is set up with 10 hidden neurons to create the network architecture seen in Figure 2.

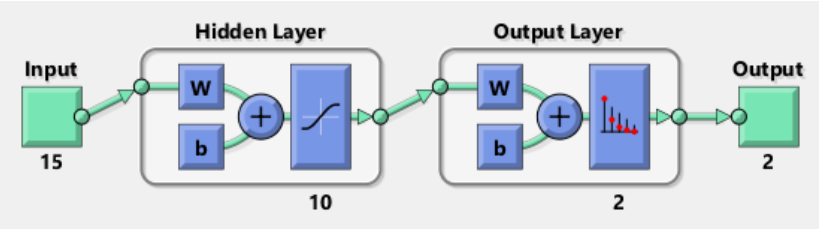

Figure 2. Neural network architecture.

Next, the network is trained using a percentage of the data. For the purpose of this thesis, 70 percent of the data was used for training the network. This is equivalent to 87 sample attractions. During the training phase, the network is adjusted based on the mean-squared error.

Then, the validation phase is used to measure the generalization of the network and stop the system once it stops improving upon itself (Mathworks, 2018). For this process, 15 percent of the data, or 18 sample attractions, is used. Next, the testing phase begins. This has no impact on any of the previous training; it simply tests the goodness of it. It measures the network performance using the last 15 percent of the data (again, about 18 samples). Finally, the neural network sends the results to the user.

Results

Matlab's neural pattern recognition app displays many charts and results for the user. One of these shows the number of samples allocated to each phase, along with the cross-entropy (CE) and percent errors (%E) (Table 2).

Table 2

Neural Pattern Recognition Results Based on Sample Attraction Data

	Samples	CE	%E
Training:	87	1.14596e-0	5.74712e-0
Validation:	18	3.19653e-0	5.55555e-0
Testing:	18	3.39518e-0	22.22222e-0

Ideally, cross-entropy will be minimized, indicating good classifications. A perfect zero would indicate no error whatsoever. The percent error indicates the fraction of samples that are not categorized correctly. A value of zero means none of the samples are misclassified and is considered ideal.

In Figure 3, the test confusion matrix (bottom, left matrix) is the most meaningful. In this figure, the first two diagonal cells (in green) show the number and percentage of correct classifications by the test network (Mathworks, 2018). In the first diagonal cell (top left), 12 samples are correctly classified as non-MTA, corresponding to 66.7 percent of the samples. In the second diagonal cell (center), 2 samples are correctly classified as MTA, corresponding to 11.1 percent of the 18 test sample attractions. Overall, 77.8 percent of the attractions are correctly identified during the test phase.

Figure 3. Confusion matrices for sample attraction data.

In the red squares of the same confusion matrix, three non-MTA attractions are incorrectly identified as MTA attractions. One MTA attraction was misclassified as a non-MTA. Overall, this demonstrates that using the identified inputs allows the neural network to correctly classify about 79 percent of theme park attractions. However, 15 inputs can seem an excessive and unrealistic amount of data for a business to collect.

SAS JMP

To understand the significance of the input variables, the model was run through SAS JMP. Thus, R^2 value of the model and the *p*-values for each variable was calculated

for the fit model. For the original model with all 15 inputs, the model received an R^2 value of 0.98. However, most of the inputs were considered "unstable", indicating that the input variables for the model may have perfect correlation to the output. For example, if an attraction is labeled as a 5 category within preschool interest, it would always be categorized as a non-MTA. Similarly, if an attraction was of vehicle type Merry-Go-Round, Show, or Midway, it would always be categorized as a non-MTA.

Decision Tree

Once the instability of the model was recognized, it was determined that a decision tree model would be beneficial. A decision tree model was then created in Matlab with the same 15 inputs from the previous model (Figure 4). The decision tree starts with the age of the attraction, or how long the attraction has been open to the public. From this decision, other inputs such as grade school interest, average wait time, thrill level, and teen interest level determine if the attraction should be categorized as an MTA or not. Following Figure 4, for example, if an attraction had been open for less than 6.5 years, had less than a 3.75 grade school interest rating, and an average wait time

assuming 100 people in front of you) less than 3.5 minutes, the attraction would probably be categorized as a non-MTA.

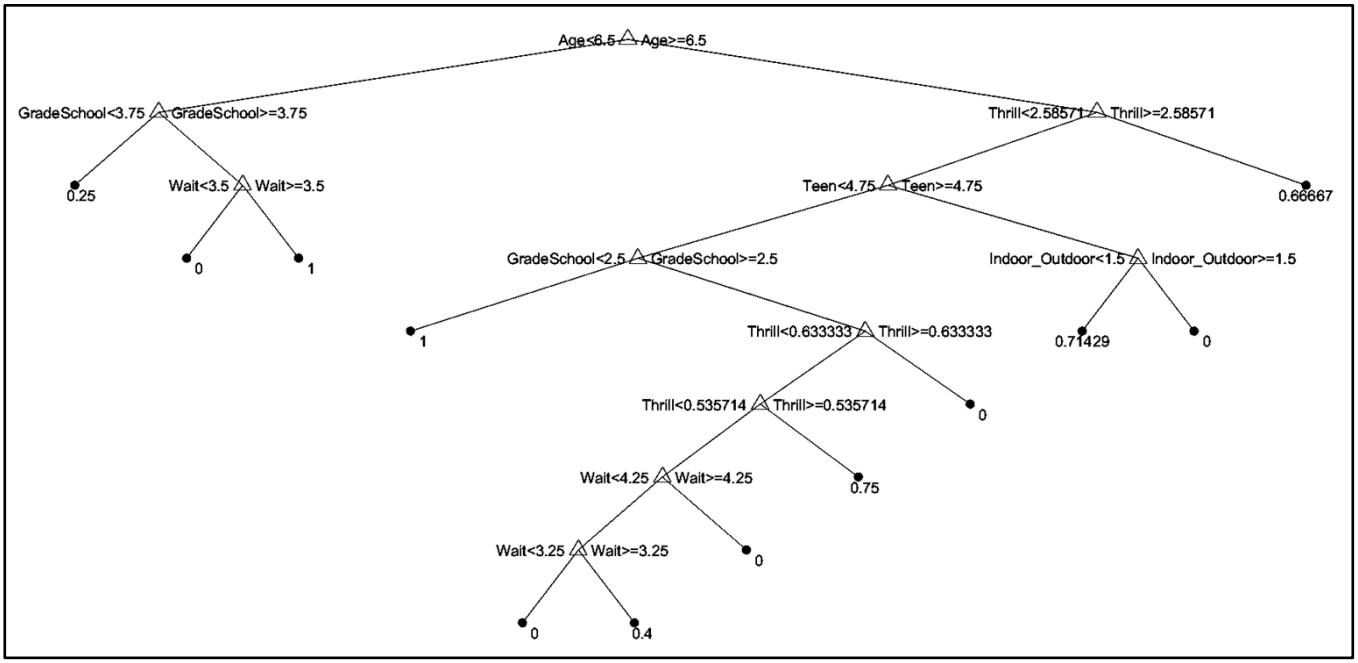

Figure 4. Decision tree.

Comparative Study

To compare the decision tree model with that of the previous neural network, Matlab was, once again, utilized to create a neural network. This time, however, the neural network only utilized those inputs mentioned in the decision tree. To create a fair comparative study, the same five random attractions were removed from the data before creating the neural network. These five attractions were Haunted Mansion in Magic Kingdom, Prince Charming Carrousel in Magic Kingdom, Triceratop Spin in Disney's Animal Kingdom, Jungle Cruise in Disneyland, and Transformers 3D in Universal Studios Florida. The results of these attractions in each model are captured in Table 3.

Table 3

Random Attraction Results for Comparative Study

Attraction Name	MTA (Yes/No)	Neural Network	Decision Tree
Haunted Mansion	No	0.0240	0
Prince Charming Carrousel	No	0.0507	0
Triceratop Spin	No	0.0189	0
Jungle Cruise	No	0.1131	0.4
Transformers 3D	No	0.1931	0

Both the neural network and decision tree correctly categorized all five random attractions. A zero indicates a non-MTA while a one represents an MTA. Some numbers in the table are not strictly zeros or ones. In these cases, we round accordingly. Unfortunately, all five of these random samples are non-MTAs. To see how the models compare when categorizing MTA attractions, the neural network and decision tree were rerun with two MTAs and three random non-MTAs withheld from the data. These five attractions were Revenge of the Mummy in Universal Studios, Soarin' in Epcot, Dumbo in Magic Kingdom, The Hall of Presidents in Magic Kingdom, and Flik's Flyers in California Adventure.

Table 4

MTA Results for Comparative Study

Attraction Name	MTA (Yes/No)	Neural Network	Decision Tree
Revenge of the Mummy	Yes	0.1896	0
Soarin'	Yes	0.1663	0.71429
Dumbo	No	0.2679	0
The Hall of Presidents	No	0.2635	0
Flik's Flyers	No	0.3266	0

In this scenario, the decision tree model performed better than the neural network. The neural network categorized both MTAs as non-MTAs. The decision tree, though, was able to categorize one of the MTAs correctly. Both models correctly categorized the three non-MTAs.

Future Analysis

For future attempts at modeling theme park attraction popularity, inputs might be added or retracted from this current dataset. Additional inputs may have more useful characteristics to apply, while current inputs may not be useful and simply slowing down the model.

Additional Inputs

Correlating merchandise sales. To quantify the current interest in a theme, story, or character, this model currently categorizes the sample attractions based on whether they are from a well-known story. A more accurate method for the same goal

would be to utilize merchandise sales from the past year that correlate to the theme park attraction. For example, Peter Pan's flight is based on the Peter Pan film. Similarly, Harry Potter and the Forbidden Journey is based on the Harry Potter books and films. However, Harry Potter was released more recently and may have more sales in its corresponding merchandise than Peter Pan. This would create a more quantifiable and accurate input.

Queue impact. While most theme park guests do not choose whether or not to visit an attraction based on its queue, this input may be one to consider. Some queues of today's attractions are interactive or play a part in telling the story of the attraction itself. The queue may even be an indication to the level of creativity and impact the attraction will have, as many queues are themed according to their respective attractions. Some parents may choose one attraction over another because of an interactive queue if all else is considered equal. While this input may be difficult to quantify, it may add an important creative input to the model.

Advancement of technology. Another input that would be difficult to quantify, but could significantly affect results, is the level or advancement of the technology utilized by the attraction. Newer attractions often use newer technology, which appeals to a broad category of theme park visitors. Theme park guests are always on the look-out for what is new and exciting, especially in regards to technology.

Removing Inputs

Environment. Whether an attraction is located inside or outside may not influence the attraction popularity. There are many examples of attractions outside,

inside, or both that have been popular amongst theme park visitors. There are other inputs that probably have more of an effect on the attraction's popularity than its environment.

Based on well-known story. Repeating the content in the correlating merchandise sales paragraph, there may be better methods to quantify this attraction input. A binary input such as this does not tell us to what extent the story or character is well-known. Utilizing correlating merchandise sales for the story or character on which the attraction is based, may be a more accurate and quantifiable method for this input.

Conclusion

In conclusion, the purpose of this thesis is to create a model which successfully categorizes whether or not theme park attractions are MTA. Data for 13 input variables were collected from theme park sources for 128 theme park attractions. Two more input variables, thrill and sensory scales, were introduced to the data as well. A neural network was created in Matlab using all 15 inputs that were thoroughly discussed in the thesis. However, using SAS JMP, it was determined that there may be bias in the model as many of the inputs were classified as "unstable".

To determine if a better model could be created, a decision tree was formed using the same 15 inputs. In order to conduct a comparative study later on, five random attractions were withheld from both the decision tree and neural network. The decision tree included the age of the attraction, interest level of grade school children, interest level of teenagers, average wait time, thrill level, and whether the attraction is indoor or outdoor. When comparing the results of the two models for the five random attractions, both models correctly categorized all five attractions as non-MTA.

Because all five of the random attractions were non-MTAs, the analysis was performed again with five different samples withheld from the models. Two of the attractions were MTAs. In this scenario, the decision tree model correctly categorized four of the five attractions. Meanwhile, the neural network categorized three of the samples accurately. Between these two models, the decision tree may be more accurate and stable.

If further analysis were to be continued, additional inputs such as merchandise sales, queue line theming, and attraction technology would be included. These inputs may create a different perspective than what is currently available. Additionally, comparing to other authors' analyses would be intriguing. Cornelis, as well as other theme park authors, use models to predict theme park attendance. In further research, it would be interesting to determine what ratio of MTAs to non-MTAs creates the highest average theme park attendance.

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Appendix A: Attraction Data

In this table, data is shown for all attractions used in this thesis. Data was collected from Walt Disney World, Disneyland, and Universal Studios. Because Walt Disney World and Disneyland have some attractions with the same name, these attractions have "WDW" or "DLR" behind their title to differentiate.

Column 1 is the title of the attraction.
Column 2 is whether the attraction is considered a Main Ticket Attraction.
Column 3 is the age of the attraction in years.
Column 4 is the length of the attraction in minutes.
Column 5 is the height requirement of the attraction in inches.
Column 6 is the interest level (1-5) of preschool age children.
Column 7 is the interest level (1-5) of grade school age children.
Column 8 is the interest level (1-5) of teenagers.
Column 9 is the interest level (1-5) of young adults.
Column 10 is the interest level (1-5) of adults over the age of 30.
Column 11 is the interest level (1-5) of senior age adults.
Column 12 is the vehicle type utilized by the attraction.
Column 13 is the average wait per 100 people ahead of you in queue in minutes.
Column 14 is whether the attraction is based on a popular story or character.
Column 15 is whether the attraction is indoor, outdoor, or both.
Column 16 is the average thrill level from participants' responses (Appendix B)
Column 17 is the average sense level from participants' responses (Appendix C)

Astro Orbiter - WDW	No	24	1.5	0	4	4	3.5	3.5	3	3	Midway	13.5	No	Outdoor	1.20	0.60
Avatar Flight of Passage	Yes	1	6	44	3	5	5	5	5	4.5	Simulator	5	Yes	Indoor	2.50	4.00
The Barnstormer	No	7	1	35	4.5	4	3	3	3	3	Roller Coaster	7	No	Outdoor	1.00	0.50
Big Thunder Mountain Railroad - WDW	No	38	3.5	40	4	4.5	4.5	4.5	4.5	4	Roller Coaster	2.5	No	Both	1.86	1.71
Buzz Lightyear's Space Ranger Spin	No	20	4.5	0	4.5	4.5	4	4	4	4	Omnimover	3	Yes	Indoor	0.80	2.60
Country Bear Jamboree	No	47	11	0	4	3.5	2.5	3	3.5	4	Show	11	No	Indoor	0.40	1.40
DINOSAUR	No	20	3.5	40	2.5	4	4.5	4.5	4	4	Variable Track	3	Yes	Indoor	1.50	2.00
Dumbo - WDW	No	47	1.5	0	4.5	4	3	3	3.5	3.5	Midway	10	Yes	Outdoor	1.00	0.50
Expedition Everest	No	12	3.5	44	2.5	4.5	5	5	5	4	Roller Coaster	4	No	Both	2.43	2.29
Festival of the Lion King	No	20	30	0	4.5	4.5	4.5	4.5	4.5	5	Show	25	Yes	Indoor	0.00	2.17
Finding Nemo: The Musical	No	11	35	0	4.5	4.5	4	4	4.5	4.5	Show	30	Yes	Indoor	0.00	2.00

Frozen Ever After	Yes	2	5	0	4.5	4.5	4	4	4	4	Boat	4	Yes	Indoor	1.00	2.00
Gran Fiesta Tour Starring the Three Caballeros	No	11	7	0	4	4	3.5	3.5	3.5	3.5	Boat	4.5	No	Indoor	0.00	1.20
The Hall of Presidents	No	47	23	0	2	3	3.5	3.5	4	4.5	Show	23	No	Indoor	0.00	1.50
Haunted Mansion - WDW	No	47	7	0	3	4	4.5	4.5	4.5	4.5	Omnimover	2.5	No	Indoor	0.43	2.29
Indiana Jones Epic Stunt Spectacular!	No	29	30	0	3.5	4.5	4.5	4	4	4	Show	25	Yes	Outdoor	0.33	2.33
it's a small world - WDW	No	47	11	0	4.5	4	3	3.5	3.5	4	Boat	3.5	No	Indoor	0.00	1.29
It's Tough to be a Bug! - WDW	No	20	8	0	3	4	4	4	4	4	Show	16	Yes	Indoor	0.00	3.50
Journey into Imagination with Figment	No	16	6	0	4	3.5	3	3	3	3	Omnimover	2	No	Indoor	0.00	3.00
Jungle Cruise - WDW	Yes	47	9	0	3.5	4	4	4	4	4	Boat	3.5	No	Both	0.14	2.00
Kilimanjaro Safaris	Yes	20	20	0	4.5	4.5	4.5	4.5	4.5	5	Truck	4	No	Outdoor	0.57	1.71
Living with the Land	No	36	14	0	3.5	4	3.5	4	4	4.5	Boat	3	No	Indoor	0.00	2.00
Mad Tea Party - WDW	No	47	1.5	0	4.5	4.5	4	4	3.5	3	Spinner	7.5	Yes	Outdoor	1.60	0.60
The Magic Carpets of Aladdin	No	17	1.5	0	4.5	4	3.5	3.5	3.5	3.5	Midway	16	Yes	Outdoor	1.00	0.50
The Many Adventures of Winnie the Pooh - WDW	Yes	19	5	0	4.5	4	3.5	3.5	3.5	4	Omnimover	4	Yes	Indoor	0.20	1.40
Mickey's PhilharMagic	No	15	12	0	4	4.5	4	4	4.5	4.5	Show	12	Yes	Indoor	0.00	3.40
Monsters, Inc. Laugh Floor	No	11	15	0	4	4.5	4	4	4	4	Show	15	Yes	Indoor	0.00	1.71
Muppet*Vision 3D	No	27	17	0	4	4	4	4	4	4	Show	12	Yes	Indoor	0.25	3.00
Na'vi River Journey	Yes	1	4.5	0	4.5	4.5	4	4	4	4.5	Boat	5	Yes	Indoor	0.25	1.50
Peter Pan's Flight - WDW	Yes	47	3	0	4.5	4	4	4	4	4	Omnimover	5.5	Yes	Indoor	0.60	1.80
Pirates of the Caribbean - WDW	No	45	7.5	0	3.5	4	4.5	4.5	4.5	4.5	Boat	3	Yes	Indoor	0.83	2.83
Primeval Whirl	No	16	2.5	48	3	4	4	3.5	3.5	3	Roller Coaster	4.5	No	Outdoor	1.75	1.00
Prince Charming Regal Carrousel	No	47	2	0	4.5	4	3.5	3.5	3.5	3.5	Merry-Go-Round	5	No	Outdoor	0.40	0.60
Mission: SPACE	No	15	5	44	2.5	4	4.5	4.5	4	4	Simulator	4	No	Indoor	2.17	2.33
Rock 'n' Roller Coaster	Yes	19	1.5	48	1.5	4.5	5	5	4.5	4	Roller Coaster	2.5	No	Indoor	2.83	2.33
The Seas with Nemo & Friends	No	11	4	0	4.5	4	3.5	3.5	3.5	3.5	Omnimover	3.5	Yes	Indoor	0.33	1.83
Seven Dwarfs Mine Train	Yes	4	2	38	4	4.5	4.5	4.5	4.5	4	Roller Coaster	4.5	Yes	Both	1.60	2.00

Soarin'	Yes	13	5.5	40	4	4.5	5	5	5	5	Simulator	4	No	Indoor	1.14	3.57
Space Mountain - WDW	Yes	43	3	44	2.5	4.5	5	4.5	4.5	3.5	Roller Coaster	3	No	Indoor	2.14	1.86
Spaceship Earth	No	36	16	0	3.5	4	4	4	4	4.5	Omnimover	3	No	Indoor	0.29	2.43
Splash Mountain - WDW	No	26	10	40	4	4.5	5	4.5	4.5	4.5	Water Flume	3.5	No	Both	2.00	3.00
Star Tours - WDW	No	7	7	40	4	4.5	4.5	4.5	4.5	4.5	Simulator	5	Yes	Indoor	1.83	2.00
Test Track	Yes	6	4	40	4	5	5	4.5	4.5	4.5	Fast Guided Track	4.5	No	Both	2.14	1.86
Tomorrowland Transit Authority PeopleMover	No	43	10	0	4	4	4	4	4	4.5	Train	1.5	No	Both	0.00	1.20
Toy Story Mania!	Yes	10	6.5	0	4.5	5	5	5	5	4.5	Omnimover	4.5	Yes	Indoor	1.17	2.33
TriceraTop Spin	No	17	1.5	0	4.5	4	3	3	3	3	Midway	10	No	Outdoor	1.50	1.00
Turtle Talk with Crush - WDW	No	14	17	0	4.5	4.5	3.5	4	4	4	Show	15	Yes	Indoor	0.00	1.80
The Twilight Zone Tower of Terror	No	24	4	40	2.5	4	4.5	5	4.5	4	Drop Tower	4	Yes	Indoor	2.57	2.00
Under the Sea ~ Journey of the Little Mermaid	No	6	5.5	0	4.5	4	3.5	4	4	4	Omnimover	3	Yes	Indoor	0.20	1.20
Voyage of the Little Mermaid	No	26	15	0	4	4	3.5	3.5	3.5	4	Show	30	Yes	Indoor	0.20	2.00
Walt Disney's Carousel of Progress	No	43	21	0	3	3.5	3.5	3.5	4	4.5	Show	10	No	Indoor	0.00	1.60
Walt Disney's Enchanted Tiki Room - WDW	No	47	15.5	0	3.5	3.5	3	3.5	3.5	4	Show	15	No	Indoor	0.00	2.00
Kali River Rapids	No	19	5	38	4	4.5	4.5	4	4	4	Raft	5	No	Outdoor	2.00	2.17
Alice in Wonderland	No	60	4	0	4	4	3.5	4	3.5	4	Omnimover	12	Yes	Both	0.20	1.40
Astro Orbiter - DLR	No	20	1.5	0	4	4	3	3.5	2.5	2.5	Midway	13	No	Outdoor	1.20	1.00
Big Thunder Mountain Railroad - DLR	No	39	3.5	40	3	4.5	5	5	4.5	4	Roller Coaster	3	No	Outdoor	2.20	2.00
Buzz Lightyear Astro Blasters	No	13	4.5	0	4.5	4.5	4.5	4	4	4	Omnimover	3	Yes	Indoor	0.80	2.60
Flik's Flyers	No	16	1.5	0	4.5	3.5	3	3	3	3	Midway	12	Yes	Outdoor	1.33	1.33
Francis' Ladybug Boogie	No	16	1	0	4.5	3.5	3	3	3	3	Spinner	16	Yes	Outdoor	1.00	1.00
Gadget's Go Coaster	No	25	0.83	35	4.5	3.5	3	3	3	3	Roller Coaster	10	No	Outdoor	1.00	1.00
Goofy's Sky School	No	7	1.5	42	3.5	4	4	3.5	3.5	2.5	Roller Coaster	6.25	No	Outdoor	1.75	1.25
Golden Zephyr	No	17	2	0	3.5	3.5	3.5	3	3	4	Midway	8.5	No	Outdoor	1.00	1.00
Grizzly River Run	No	17	5.5	42	3	4.5	5	4.5	4.5	4	Raft	5	No	Outdoor	2.00	2.25

Guardians of the Galaxy - Mission: BREAKOUT!	Yes	1	2	40	1	4	5	5	4.5	5	Drop Tower	4	Yes	Indoor	3.00	3.00
Haunted Mansion - DLR	No	49	5.5	0	2.5	4	4.5	4.5	4.5	4.5	Omnimover	2.5	No	Indoor	0.60	2.00
Heimlich's Chew Chew Train	No	16	2	0	4.5	3.5	3	3	3	3	Train	10	Yes	Outdoor	0.00	1.00
Indiana Jones Adventure	No	23	3.5	46	1.5	4	4.5	5	4.5	4	Variable Track	3	Yes	Indoor	2.40	3.00
it's a small world - DLR	No	52	14	0	4.5	3.5	3.5	3.5	4	4.5	Boat	2.5	No	Indoor	0.00	1.80
It's Tough to be a Bug! - DLR	No	17	8.5	0	4	4.5	4	4	4.5	4.5	Show	20	Yes	Indoor	0.00	3.80
Jumpin' Jellyfish	No	17	0.75	40	4	3.5	2.5	2.5	3	2	Drop Tower	20	No	Outdoor	1.00	1.00
Jungle Cruise - DLR	No	63	7.5	0	4	4	4	4	4	4	Boat	3.5	No	Outdoor	0.20	1.60
King Arthur Carrousel	No	63	2	0	4.5	4	3.5	3.5	3.5	4	Merry-Go-Round	8	No	Outdoor	0.50	0.75
King Triton's Carousel	No	17	2	0	5	4	3.5	3	3.5	3	Merry-Go-Round	8	No	Outdoor	0.50	0.75
The Little Mermaid ~ Ariel's Undersea Adventure	No	7	6.25	0	4.5	4	3.5	3.5	3.5	4	Omnimover	3	Yes	Indoor	0.40	1.60
Luigi's Rollickin' Roadsters	Yes	2	1.5	32	4	3.5	3.5	3.5	3.5	4	Spinner	10	Yes	Outdoor	1.00	1.50
Mad Tea Party - DLR	No	63	1.5	0	4.5	4	4	4	3.5	3.5	Spinner	8	Yes	Outdoor	1.67	0.33
The Many Adventures of Winnie the Pooh - DLR	No	15	3	0	4.5	3.5	3	3.5	3.5	4	Omnimover	5	Yes	Indoor	0.20	1.40
Mater's Junkyard Jamboree	Yes	6	1.5	32	4.5	4	3.5	4	4	3.5	Spinner	10	Yes	Outdoor	1.00	1.50
Matterhorn Bobsleds	No	59	2.5	42	2	4.5	4.5	4	4	3	Roller Coaster	7	No	Both	2.00	2.00
Monsters, Inc. Mike & Sulley to the Rescue!	No	12	3.75	0	4	3.5	3.5	3.5	3.5	4	Omnimover	4	Yes	Indoor	0.67	1.67
Mr. Toad's Wild Ride	No	63	2	0	3.5	4	3.5	3.5	3.5	4	Omnimover	9	No	Indoor	0.80	2.20
Peter Pan's Flight - DLR	Yes	63	2	0	4.5	4	4	4	4.5	4.5	Omnimover	11	Yes	Indoor	0.60	1.40
Pinocchio's Daring Journey	No	35	3	0	3.5	3.5	3	3.5	3.5	3.5	Omnimover	8	Yes	Indoor	0.25	1.50
Pirates of the Caribbean - DLR	No	51	14	0	3.5	4.5	4.5	4.5	4.5	5	Boat	3	Yes	Indoor	1.20	3.00
Radiator Springs Racers	Yes	6	4	40	3.5	5	5	5	5	5	Fast Guided Track	4	Yes	Both	2.20	2.40
Roger Rabbit's Car Toon Spin	No	24	3	0	3.5	4	3.5	4	3.5	4	Omnimover	7	No	Indoor	1.33	2.33
Silly Symphony Swings	No	8	1.5	40	3.5	4	4.5	4	4	3.5	Midway	6	No	Outdoor	1.67	0.67

Snow White's Scary Adventures	No	63	2	0	3	3.5	3.5	3.5	3	3.5	Omnimover	9	Yes	Indoor	0.50	1.75
Soarin' Around the World	No	17	4.5	40	4	4.5	5	5	5	5	Simulator	4	No	Indoor	1.40	3.60
Space Mountain - DLR	Yes	41	2.75	40	2.5	4.5	5	5	4.5	4	Roller Coaster	3.5	No	Indoor	2.40	2.00
Star Tours - DLR	No	7	7	40	3.5	4.5	4.5	4.5	4.5	4	Simulator	6	Yes	Indoor	1.80	2.40
Storybook Land Canal Boats	No	63	6.5	0	4	4	3.5	4	3.5	4.5	Boat	16	Yes	Outdoor	0.00	1.25
Toy Story Midway Mania!	Yes	10	6.5	0	4	4.5	5	5	4.5	4.5	Omnimover	9	Yes	Indoor	1.00	2.20
Turtle Talk with Crush - DLR	No	13	17	0	4.5	4	4	3.5	4	4.5	Show	15	Yes	Indoor	0.00	1.75
Walt Disney's Enchanted Tiki Room - DLR	No	55	14.5	0	4	3.5	3.5	4	3.5	4.5	Show	11	No	Indoor	0.00	2.00
California Screamin'	Yes	17	2.5	48	2	4.5	5	5	4.5	4	Roller Coaster	2.5	No	Outdoor	2.80	1.60
Dumbo - DLR	No	63	1.67	0	5	4	3.5	3.5	3.5	3.5	Midway	12	Yes	Outdoor	1.00	0.75
Mickey's Fun Wheel	No	17	9	0	3	4	4	3.5	3.5	3	Midway	6.25	No	Outdoor	1.00	1.00
Splash Mountain - DLR	No	29	10	40	3.5	4.5	5	4.5	4.5	4	Water Flume	3.5	No	Both	2.00	3.00
Caro-Seuss-el	No	19	2	0	5	4	2	4	3.5	4	Merry-Go-Round	9	Yes	Outdoor	0.33	0.67
Despicable Me Minion Mayhem	Yes	6	5	40	2	4.5	4	4.5	4	3	Simulator	7	Yes	Indoor	1.00	3.50
Doctor Doom's Fearfall	No	19	0.67	52	1	4	3.5	1	3.5	3	Drop Tower	18	No	Outdoor	2.50	1.00
Dudley Do-Right's Ripsaw Falls	No	19	5	44	1.5	4.5	4.5	4.5	4	4	Water Flume	9	No	Both	2.00	3.00
E.T. Adventure	No	28	4.5	34	4	4	3	3	3.5	4	Omnimover	5	Yes	Indoor	1.00	1.00
Flight of the Hippogriff	No	18	1	36	4	4.5	3.5	3.5	3.5	3.5	Roller Coaster	14	Yes	Outdoor	1.25	0.75
Harry Potter and the Escape from Gringotts	Yes	4	4.5	42	2	4	5	5	5	4	Fast Guided Track	4	Yes	Indoor	2.50	3.17
Harry Potter and the Forbidden Journey	Yes	8	4.5	48	1.5	4.5	4.5	4.5	4.5	3.5	Variable Track	4	Yes	Indoor	2.83	3.17
Hollywood Rip Ride Rockit	No	9	2.5	51	1	4	5	4.5	4.5	1.5	Roller Coaster	7	No	Outdoor	3.00	2.00
Jurassic Park River Adventure	No	19	6.5	42	2.5	4	4.5	4.5	4	3.5	Water Flume	5	Yes	Both	2.00	2.83
Kang & Kodos' Twirl 'n' Hurl	No	5	1.5	0	4	3	3	3	3	2	Midway	21	No	Outdoor	1.00	1.00
Men in Black: Alien Attack	No	18	4.5	42	2	5	5	4	4	3.5	Omnimover	5	Yes	Indoor	1.17	2.50

One Fish, Two Fish, Red Fish, Blue Fish	No	19	2	0	4	4.5	3.5	2.5	3	3	Midway	9	Yes	Outdoor	1.00	0.50
Popeye & Bluto's Bilge-Rat Barges	No	19	4.5	42	1.5	4.5	4.5	5	4.5	4	Raft	5	No	Outdoor	2.00	2.00
Poseidon's Fury	No	19	17	0	2	3.5	2.5	3	3	3	Show	25	No	Indoor	0.50	2.25
Race Through New York Starring Jimmy Fallon	No	1	4	40	1	3.5	3.5	3.5	3.5	3.5	Simulator	5	Yes	Indoor	1.00	2.00
Revenge of the Mummy	Yes	14	3	48	1	3	4.5	4.5	4.5	4	Roller Coaster	7	Yes	Indoor	2.60	2.60
Shrek 4-D	No	15	20	0	3	4	3.5	3.5	3.5	3.5	Show	16	Yes	Indoor	0.25	3.00
Skull Island: Reign of Kong	No	2	6	36	2.5	3.5	4.5	3.5	4	5	Truck	3	Yes	Both	1.50	2.50
Storm Force Accelatron	No	18	1.5	48	5	4	4	3.5	3	3	Spinner	21	No	Outdoor	1.00	1.00
The Amazing Adventures of Spider-Man	No	19	4.5	40	1.5	4.5	4.5	4.5	4.5	4	Fast Guided Track	5	Yes	Indoor	1.33	2.67
The Cat in the Hat	No	19	3.5	36	5	4	3	3.5	3	4	Omnimover	5	Yes	Indoor	0.00	0.00
The High in the Sky Seuss Trolley Train Ride	No	19	3.5	40	5	4	3	3	3.5	4.5	Train	9	Yes	Both	0.00	1.00
The Incredible Hulk Coaster	No	19	2.25	54	1	3.5	5	5	4.5	3.5	Roller Coaster	9	Yes	Outdoor	3.00	2.25
Transformers: The Ride-3D	No	7	4.5	40	1	4	4.5	4.5	4	2.5	Fast Guided Track	5	Yes	Indoor	1.50	3.00
Woody Woodpecker's Nuthouse Coaster	No	19	1	36	4	4	2	2.5	2.5	2.5	Roller Coaster	8	No	Outdoor	1.00	1.00
The Simpsons Ride	No	10	4.5	40	1	4	4	3.5	3	2.5	Simulator	5	Yes	Indoor	1.75	2.75
The Eighth Voyage of Sindbad	No	19	17	0	2	3.5	3	3	2.5	2.5	Show	15	No	Outdoor	0.50	2.00
Fear Factor Live	No	13	30	0	1	2	4	3	3	2	Show	15	No	Outdoor	0.00	2.00

Appendix B: Thrill Data from Respondents

In this table, seven participants' responses for the thrill level of each attraction has been recorded. If a participant was not familiar with an attraction, s/he left that attraction blank.

Column 1 is the title of the attraction.
Column 2 is the responses of the first participant.
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Column 5 is the responses of the fourth participant.
Column 6 is the responses of the fifth participant.
Column 7 is the responses of the sixth participant.
Column 8 is the responses of the seventh participant.

Astro Orbiter - WDW	2	1	1	1			1
Avatar Flight of Passage			3				2
The Barnstormer			1				1
Big Thunder Mountain Railroad - WDW	2	2	2	2	2	1	2
Buzz Lightyear's Space Ranger Spin	1	1	1	1			0
Country Bear Jamboree	0	0	0	2			0
DINOSAUR	0	1	3	2		1	2
Dumbo - WDW	1	1	1				1
Expedition Everest	2	3	3	2	2	2	3
Festival of the Lion King	0	0	0	0	0		0
Finding Nemo: The Musical	0		0				0
Frozen Ever After	1	1	1	1			1
Gran Fiesta Tour Starring the Three Caballeros	0	0	0	0			0
The Hall of Presidents	0	0	0	0	0		0
Haunted Mansion - WDW	1	0	0	1	1	0	0
Indiana Jones Epic Stunt Spectacular!	2	0	0	0		0	0
it's a small world - WDW	0	0	0	0	0	0	0
It's Tough to be a Bug! - WDW	0	0	0	0	0		0
Journey into Imagination with Figment			0				0
Jungle Cruise - WDW	0	0	0	0	1	0	0
Kilimanjaro Safaris	0	1	1	0	1	1	0
Living with the Land	0	0	0	0	0		0
Mad Tea Party - WDW	2	2	1	2			1
The Magic Carpets of Aladdin		1	1	1			1
The Many Adventures of Winnie the Pooh - WDW	0	0	0	1			0
Mickey's PhilharMagic	0	0	0	0			0
Monsters, Inc. Laugh Floor	0	0	0	0	0	0	0
Muppet*Vision 3D	1		0	0			0
Na'vi River Journey	1		0			0	0
Peter Pan's Flight - WDW	1	0	1	1			0
Pirates of the Caribbean - WDW	1	1	1	1	0		1

Primeval Whirl	1		2			2	2
Prince Charming Regal Carrousel	1	0	0	1			0
Mission: SPACE	3		3	1	1	3	2
Rock 'n' Roller Coaster	3		3	3	2	3	3
The Seas with Nemo & Friends	1	0	0	0	1		0
Seven Dwarfs Mine Train	2	1	2	1			2
Soarin'	1	1	2	1	1	1	1
Space Mountain - WDW	2	3	3	2	1	2	2
Spaceship Earth	1	0	0	0	1	0	0
Splash Mountain - WDW	2	2	2	2	2		2
Star Tours - WDW	2	2	2	2		1	2
Test Track	2	2	3	2	2	2	2
Tomorrowland Transit Authority PeopleMover	0	0	0	0			0
Toy Story Mania!	1	1	1	1		2	1
TriceraTop Spin	2		1	2			1
Turtle Talk with Crush - WDW	0	0	0	0			0
The Twilight Zone Tower of Terror	3	2	3	2	2	3	3
Under the Sea ~ Journey of the Little Mermaid	0	1	0			0	0
Voyage of the Little Mermaid	0	0	0	1			0
Walt Disney's Carousel of Progress	0	0	0		0		0
Walt Disney's Enchanted Tiki Room - WDW	0	0	0	0			0
Kali River Rapids		2	3	2	2	1	2
Caro-Seuss-el			0	1			0
Despicable Me Minion Mayhem			1				1
Doctor Doom's Fearfall			3				2
Dudley Do-Right's Ripsaw Falls	2	2		2	2		2
E.T. Adventure							1
Flight of the Hippogriff		1		1	2		1
Harry Potter and the Escape from Gringotts	2	2	3	3	2		3
Harry Potter and the Forbidden Journey	3	3	3	3	2		3
Hollywood Rip Ride Rockit				3			3
Jurassic Park River Adventure	2	2	2	2	2		2
Kang & Kodos' Twirl 'n' Hurl							1
Men in Black: Alien Attack	2	1	1	1	1		1
One Fish, Two Fish, Red Fish, Blue Fish			1				1
Popeye & Bluto's Bilge-Rat Barges					2		2
Poseidon's Fury		0	0	2			0
Race Through New York Starring Jimmy Fallon			1				1
Revenge of the Mummy	3	2	3	2			3
Shrek 4-D	0		0	0			1
Skull Island: Reign of Kong			1				2
Storm Force Accelatron							1
The Amazing Adventures of Spider-Man			1		1		2
The Cat in the Hat			0				0
The High in the Sky Seuss Trolley Train Ride		0	0				0
The Incredible Hulk Coaster	3		3	3			3
Transformers: The Ride-3D			1				2

Woody Woodpecker's Nuthouse Coaster							1
The Simpsons Ride	3		1	2			1
The Eighth Voyage of Sindbad				1			0
Fear Factor Live							0
Alice in Wonderland	1	0	0	0			0
Astro Orbiter - DLR	2	1	1	1			1
Big Thunder Mountain Railroad - DLR	2	2	3	2			2
Buzz Lightyear Astro Blasters	1	1	1	1			0
Flik's Flyers	2			1			1
Francis' Ladybug Boogie							1
Gadget's Go Coaster		1					1
Goofy's Sky School	3	2		1			1
Golden Zephyr							1
Grizzly River Run	2	2		2			2
Guardians of the Galaxy - Mission: BREAKOUT!	3						3
Haunted Mansion - DLR	1	0	1	1			0
Heimlich's Chew Chew Train		0					0
Indiana Jones Adventure	3	2	3	2			2
it's a small world - DLR	0	0	0	0			0
It's Tough to be a Bug! - DLR	0	0	0	0			0
Jumpin' Jellyfish							1
Jungle Cruise - DLR	0	0	1	0			0
King Arthur Carrousel	1	0	1				0
King Triton's Carousel	1	0	1				0
The Little Mermaid ~ Ariel's Undersea Adventure	0	1	0	1			0
Luigi's Rollickin' Roadsters				1			1
Mad Tea Party - DLR		2	2				1
The Many Adventures of Winnie the Pooh - DLR	0	0	0	1			0
Mater's Junkyard Jamboree				1			1
Matterhorn Bobsleds	2	1	3	2			2
Monsters, Inc. Mike & Sulley to the Rescue!	2	0					0
Mr. Toad's Wild Ride	1	0	1	2			0
Peter Pan's Flight - DLR	1	0	1	1			0
Pinocchio's Daring Journey	1	0		0			0
Pirates of the Caribbean - DLR	2	1	1	1			1
Radiator Springs Racers	2	2	3	2			2
Roger Rabbit's Car Toon Spin	2	1					1
Silly Symphony Swings	2			2			1
Snow White's Scary Adventures	1	0		1			0
Soarin' Around the World	2	1	2	1			1
Space Mountain - DLR	2	3	3	2			2
Star Tours - DLR	2	2	1	2			2
Storybook Land Canal Boats	0	0		0			0
Toy Story Midway Mania!	1	1	1	1			1
Turtle Talk with Crush - DLR	0	0		0			0
Walt Disney's Enchanted Tiki Room - DLR	0	0	0	0			0
California Screamin'	3	3	3	2			3
Dumbo - DLR	1	1	1				1
Mickey's Fun Wheel			1				1
Splash Mountain - DLR	3	2	2	1			2

Appendix C: Sensory Data from Respondents

In this table, seven participants' responses for the sensory level of each attraction has been recorded. If a participant was not familiar with an attraction, s/he left that attraction blank.

Column 1 is the title of the attraction.
Column 2 is the responses of the first participant.
Column 3 is the responses of the second participant.
Column 4 is the responses of the third participant.
Column 5 is the responses of the fourth participant.
Column 6 is the responses of the fifth participant.
Column 7 is the responses of the sixth participant.
Column 8 is the responses of the seventh participant.

Astro Orbiter - WDW	0	1	1	0			1
Avatar Flight of Passage			4				4
The Barnstormer			1				0
Big Thunder Mountain Railroad - WDW	0	2	2	3	3	1	1
Buzz Lightyear's Space Ranger Spin	3	2	2	3			3
Country Bear Jamboree	1	2	1	2			1
DINOSAUR	1	2	2	3		2	2
Dumbo - WDW	1	0	0				1
Expedition Everest	2	2	2	2	3	2	3
Festival of the Lion King	2	2	2	3	2		2
Finding Nemo: The Musical	2		2				2
Frozen Ever After	2	3	1	2			2
Gran Fiesta Tour Starring the Three Caballeros	2	1	0	2			1
The Hall of Presidents	2	2	0	2	2		1
Haunted Mansion - WDW	3	2	1	3	3	2	2
Indiana Jones Epic Stunt Spectacular!	3	2	2	2		2	3
it's a small world - WDW	3	2	0	2	2	0	0
It's Tough to be a Bug! - WDW	3	4	4	2	4		4
Journey into Imagination with Figment			3				3
Jungle Cruise - WDW	3	2	1	3	3	0	2
Kilimanjaro Safaris	2	2	0	2	4	0	2
Living with the Land	2	2	0	2	4		2
Mad Tea Party - WDW	2	0	0	0			1
The Magic Carpets of Aladdin		1	0	0			1

The Many Adventures of Winnie the Pooh - WDW	2	2	0	2			1
Mickey's PhilharMagic	3	4	4	2			4
Monsters, Inc. Laugh Floor	3	2	1	2	2	1	1
Muppet*Vision 3D	4		3	2			3
Na'vi River Journey	2		1			1	2
Peter Pan's Flight - WDW	3	2	1	2			1
Pirates of the Caribbean - WDW	3	3	4	3	2		2
Primeval Whirl	2		0			1	1
Prince Charming Regal Carrousel	2	1	0	0			0
Mission: SPACE	2		2	3	2	2	3
Rock 'n' Roller Coaster	3		2	2	2	2	3
The Seas with Nemo & Friends	2	2	2	2	2		1
Seven Dwarfs Mine Train	2	2	2	2			2
Soarin'	4	4	3	3	4	3	4
Space Mountain - WDW	2	2	2	2	2	1	2
Spaceship Earth	3	3	3	3	2	0	3
Splash Mountain - WDW	4	3	2	3	3		3
Star Tours - WDW	3	2	1	3		1	2
Test Track	2	2	1	2	2	2	2
Tomorrowland Transit Authority PeopleMover	2	1	1	1			1
Toy Story Mania!	3	2	2	3		2	2
TriceraTop Spin	2		0	1			1
Turtle Talk with Crush - WDW	3	2	1	2			1
The Twilight Zone Tower of Terror	3	2	1	2	3	1	2
Under the Sea ~ Journey of the Little Mermaid	2	2	1			0	1
Voyage of the Little Mermaid	2	2	1	3			2
Walt Disney's Carousel of Progress	3	2	0		1		2
Walt Disney's Enchanted Tiki Room - WDW	2	2	2	2			2
Kali River Rapids		2	4	2	2	1	2
Caro-Seuss-el			1	1			0
Despicable Me Minion Mayhem			4				3
Doctor Doom's Fearfall			1				1
Dudley Do-Right's Ripsaw Falls	4	3		3	2		3
E.T. Adventure							1
Flight of the Hippogriff		0		1	1		1
Harry Potter and the Escape from Gringotts	4	3	3	3	3		3
Harry Potter and the Forbidden Journey	4	3	3	3	3		3
Hollywood Rip Ride Rockit				2			2

Jurassic Park River Adventure	3	3	3	2	3		3
Kang & Kodos' Twirl 'n' Hurl							1
Men in Black: Alien Attack	3	3	2	3	2		2
One Fish, Two Fish, Red Fish, Blue Fish			0				1
Popeye & Bluto's Bilge-Rat Barges					2		2
Poseidon's Fury		3	1	2			3
Race Through New York Starring Jimmy Fallon			2				2
Revenge of the Mummy	2	3	3	2			3
Shrek 4-D	2		4	3			3
Skull Island: Reign of Kong			3				2
Storm Force Accelatron							1
The Amazing Adventures of Spider-Man			3		2		3
The Cat in the Hat			0				0
The High in the Sky Seuss Trolley Train Ride		1	1				1
The Incredible Hulk Coaster	2		3	1			3
Transformers: The Ride-3D			3				3
Woody Woodpecker's Nuthouse Coaster							1
The Simpsons Ride	4		2	2			3
The Eighth Voyage of Sindbad				2			2
Fear Factor Live							2
Alice in Wonderland	2	2	0	2			1
Astro Orbiter - DLR	2	1	1	0			1
Big Thunder Mountain Railroad - DLR	2	2	2	3			1
Buzz Lightyear Astro Blasters	3	2	2	3			3
Flik's Flyers	2			1			1
Francis' Ladybug Boogie							1
Gadget's Go Coaster		1					1
Goofy's Sky School	2	1		1			1
Golden Zephyr							1
Grizzly River Run	3	2		2			2
Guardians of the Galaxy - Mission: BREAKOUT!	3						3
Haunted Mansion - DLR	2	2	1	3			2
Heimlich's Chew Chew Train		1					1
Indiana Jones Adventure	3	3	3	3			3
it's a small world - DLR	1	2	4	2			0
It's Tough to be a Bug! - DLR	4	4	4	3			4
Jumpin' Jellyfish							1
Jungle Cruise - DLR	2	2	1	2			1
King Arthur Carrousel	2	1	0				0

King Triton's Carousel	2	1	0				0
The Little Mermaid ~ Ariel's Undersea Adventure	2	2	1	2			1
Luigi's Rollickin' Roadsters				2			1
Mad Tea Party - DLR		0	0				1
The Many Adventures of Winnie the Pooh - DLR	2	2	0	2			1
Mater's Junkyard Jamboree				2			1
Matterhorn Bobsleds	2	2	2	2			2
Monsters, Inc. Mike & Sulley to the Rescue!	2	2					1
Mr. Toad's Wild Ride	3	3	1	2			2
Peter Pan's Flight - DLR	2	1	1	2			1
Pinocchio's Daring Journey	2	1		2			1
Pirates of the Caribbean - DLR	3	3	4	3			2
Radiator Springs Racers	2	2	3	3			2
Roger Rabbit's Car Toon Spin	3	2					2
Silly Symphony Swings	1			0			1
Snow White's Scary Adventures	2	1		3			1
Soarin' Around the World	4	4	3	3			4
Space Mountain - DLR	2	2	2	2			2
Star Tours - DLR	3	2	2	3			2
Storybook Land Canal Boats	2	1		2			0
Toy Story Midway Mania!	3	2	1	3			2
Turtle Talk with Crush - DLR	2	2		2			1
Walt Disney's Enchanted Tiki Room - DLR	2	2	2	2			2
California Screamin'	2	0	1	2			3
Dumbo - DLR	2	0	0				1
Mickey's Fun Wheel			1				1
Splash Mountain - DLR	3	3	3	3			3