Getting into Your Head(ache): Advertising Content for OTC Analgesics*

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Marketing Science Institute Working Paper

February 2008

Abstract

The over-the-counter analgesics market is characterized by substantial advertising expenditures by the top brands. Advertising-to-sales ratios in this industry range from 20-50%, and are more than 7 times higher than the average for all industrial sectors.

We use a novel dataset where we code the product characteristics featured in advertisements. For comparative advertisements, we record the rival products mentioned as well as the characteristics used for comparisons. We provide a comprehensive, five-year description of the number and types of characteristics mentioned in ads as well as the ad expenditures spent on emphasizing particular characteristics. The content analysis highlights the role of different types of advertising in enhancing product differentiation.

We then consider some theoretical hypotheses and test them with our data. First, we find that leading brands will be targeted most. Second, the fraction of comparative advertising is highest for new brands, and those with low market shares. Third, comparative advertising targets rival brands rather than stablemates. Fourth, there is only limited support for the idea that each characteristic will be advertised by only one product. However, we find that nationally advertised brands tend to specialize in which characteristics they advertise the most. Fifth, comparative advertising claims are more likely for experience rather than credence attributes. Finally, we find that usually comparative advertising targets products with active ingredients different from that of the attacking product.

Keywords: comparative advertising, advertising, content analysis, OTC pharmaceuticals.

JEL Classification: D12 D43 L15 M37

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*We thank David Mick, Ross Rizley, Columbia Warren and Ken Wilbur for useful comments and gratefully acknowledge funding of the Marketing Science Institute under MSI Research Grant #4-1364.

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1 Introduction

Approximately 84% of the United States population regularly uses over-the-counter (OTC) analgesics for headache, backache or other minor pain relief (Simmons Market Research, 2000). Drug stores, supermarkets and mass merchandisers sold more than $2 billion worth of such medicine in 2005. Selling pain relief is a huge business in the United States and around the world. What makes this market especially interesting to study is the significant discrepancy between true differentiation of almost homogeneous medical products and the perceived differentiation among different brands. The gap is arguably generated by advertising: the OTC analgesics market is characterized by substantial advertising expenditures by the top brands. Advertising-to-sales ratios in the OTC analgesics industry range anywhere from 20-50% and are more than 7 times higher than the average value for all industrial sectors.[1] According to OTC analgesics industry practice, substantial media budgets are built to reach around 80% of the target audience over 4 times for an average 4 week period (The OTC Drug Seminar Series (2004)). Moreover, this market is characterized by a high prevalence of comparative advertising, where one brand explicitly mentions a competitor while making comparative claims about competing product features. Some brands spend as much as 30% of their revenue on comparative advertising.

Most of the previous empirical studies on comparative advertising have focused on cross-industry analysis, bundling together comparative advertising across different industries with diverse market structures (Chou et al (1987) and Harmon et al (1983)). To our knowledge no research has been done to analyze what television ads claim within an industry, and, more specifically, what product characteristics firms tend to highlight and how much they spend on emphasizing particular attributes. This study also is the first to systematically examine the nature of comparative advertising claims within a specific industry.

In this paper we only code the objective content of advertisements as quantified through their mentioning of specific characteristics and competitors. We recognize indeed that advertising may persuade through other channels than pure information, and act on emotional factors. However, we have not attempted to code such effects, for several reasons. First, the primary content of this advertising appears to be informative. Second, we want to first address (what is arguably) the purely informational content, along the lines of traditional content analysis: adding the subjective side is a very interesting topic for further extensions. Third, given the subjective nature of the coding and the large sample size of ads, coding

[1] The OTC analgesics products fall within the "Pharmaceutical Preparations" sector (SIC 2834), which has a 4.8% advertising-to-sales ratio. The average advertising-to-sales ratio of all industrial sectors is only 3.2% (Schonfeld and Associates, 2005).

would also involve some noise, and necessitate frequent consistency checks.

There are a number of important managerial issues to which this research is relevant. What methods are used to differentiate seemingly quite homogeneous products? Do market leaders use comparative advertising and why? What types of ads and what types of claims do firms make about their rival products? Can aggressive advertising be used to restore brand name value and market share following a negative exogenous news shock? These are some of the issues we try to address in this paper.

The paper is organized as follows. In the next section we review the literature on content analysis and comparative advertising. Section 3 provides useful U.S. OTC analgesics market background. In sections 4 and 5 we contrast the "true" and perceived product differentiation existing in this market. The data and coding methodology are described in Section 6. Results of the advertising content analysis are presented in Section 7. In Section 8 we construct several hypotheses and test them against our data. Section 9 concludes. Finally, medical terminology relevant to our research is explained in the Appendix.

2 Literature Review

The theoretical economics literature on comparative advertising is very limited, although marketing research documents the phenomenon and analyzes its effectiveness thoroughly. Much of this literature (see Bagwell (2007) for a recent survey) has concentrated on normative economic questions (e.g., do firms reach the socially optimal number of consumers?). The first paper to address the issue of product heterogeneity by modeling consumer imperfect information about product characteristics was Anderson and Renault (2007). There are several theoretical attempts to model why comparative advertising arises in equilibrium and how it affects consumer and firm behavior. Barigozzi, Garella, and Peitz (2003) show that comparative advertising has a different signaling potential than generic advertising, since the comparative claim will be perceived by rational consumers to be more credible. Aluf and Shy (2001) model comparative advertising using a Hotelling-type model of product differentiation as shifting the transport cost to the rival's product. Anderson and Renault (2007) show that if the product is low quality, the firm will advertise detailed product information that enables consumers to determine their matches, while the firm with the high quality product will not. Shy (1995) argues that in the case of differentiated products, comparative advertising informs consumers about the difference between the brand they have purchased in the past and their ideal brand. In this case, it is likely that comparative advertising is meaningless for the inexperienced consumer because she would not comprehend an ad involving a comparison of the brands' attributes.

The marketing literature indicates that consumers in behavioral studies pay more attention to, and are generally more aware of, products after viewing comparative advertising relative to generic advertising (Grewal et al (1997)). Pechmann and Stewart (1990) suggest that 60% of all ads are indirectly comparative and 20% contain direct comparative claims. Whether this implies more competition is not clear. Rose et al (1993) point out that it is difficult to differentiate between whether consumers are making better informed decisions or are simply more persuaded by comparative advertising.

In the marketing literature, "content analysis" compares content across cultures (e.g., Madden, Caballero, and Matsukubo, 1986), over time (e.g., Bruce L. Stern and Alan Resnik, 1991), across media (e.g., Avery M. Abernethy and George R. Franke, 1996), and across different regulatory regimes (e.g., Abernethy and Franke, 1998). The seminal paper by Resnik and Stern (1977) postulated 14 categories of "information cues". The information cues include price, quality, performance, availability, nutrition, warranties, etc. In a survey of other papers, Abernethy and Franke (1996) present the results for an average over 4 studies of U.S. television advertising and show that the mean number of cues was 1.06, with only 27.7% having two or more cues, and 37.5% having no cues.

The marketing studies mentioned above, however, do not address any comparative advertising content, which is a significant component in some advertisements. Our paper aims to use the methodology of content analysis extended to comparative advertising. In addition, our research isolates a single industry, enabling us to consistently set product attribute categories and test which ones are most advertised in a comparative way.

3 Overview of the OTC Analgesics Industry

The OTC analgesics market covers pain-relief medications with four major active chemical ingredients. These are aspirin, acetaminophen, ibuprofen and naproxen sodium. The nationally advertised brands for each of these segments are such familiar brand names as Tylenol (acetaminophen), Advil and Motrin (ibuprofen), Aleve (naproxen sodium), Bayer (aspirin or combination), Excedrin (acetaminophen or combination), Midol and Pamprin (varying formulas for menstrual pain relief).

The industry is highly concentrated - the top 6 brands account for approximately 71% of the dollar market share. Generic store brands account for another 26%. The main brands (with national advertising), their market shares (calculated from our data), their ingredients, and ownership are given in Table 1 below.

Brand	Ownership	Active Ingredient	Average Price*	Market share	Advert. share	TA/Sales	CA/Sales	CA/TA
Advil	Wyeth	IB	3.75	16.49%	20.88%	23.54%	14.17%	60.21%
Aleve	Bayer	NS	3.77	7.91%	13.88%	32.60%	20.08%	61.60%
Bayer	Bayer	ASP	2.75	5.45%	9.22%	31.43%	5.65%	17.98%
Excedrin	Novartis	ACT	3.63	8.39%	12.75%	28.24%	2.90%	10.28%
Midol	Bayer	ACT/NS/IB	5.60	1.67%	2.29%	25.55%	22.37%	87.55%
Motrin	McNeil	IB	3.65	5.58%	8.71%	28.99%	8.53%	29.41%
Pamprin	Chattem	ACT/NS/IB	4.29	0.56%	0.62%	20.38%	5.02%	24.65%
Tylenol	McNeil	ACT	3.29	27.88%	31.65%	21.10%	1.78%	8.42%
Generic					0%	0%	0%	0%
		ACT	2.03	8.40%				
		IB	2.74	9.02%	26.06%			
		NS	2.83	1.61%				
		ASP	1.32	6.44%				

*average price of a representative 24 pill bottle of regular strength tablets.

ACT-Acetaminophen; IB-Ibuprofen; NS-Naproxen Sodium; ASP-Aspirin

TA-Total Advertising; CA-Comparative Advertising

Table 1. OTC Analgesic Brands and Market Shares, 2001-2005 data.

Although each of the drugs generally treat pain, fevers and headaches (hence implying that they are close substitutes), there are some differences between analgesic types. While aspirin, naproxen sodium and ibuprofen are non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen is not. In general, ibuprofen and naproxen are more potent pain relievers, i.e., they reduce more pain than the same dose of acetaminophen or aspirin. On the other hand, acetaminophen is considered to be the safest pain reliever because it does not block prostaglandins, and therefore does not cause any gastrointestinal (GI) bleeding. However, even though acetaminophen reduces pain and fever, it does nothing for inflammation. Additionally, high doses of acetaminophen may damage the liver. Aspirin is the only pain reliever shown to reduce the risk of heart attack.

As we discuss in more detail below, all active ingredients deliver pain relief, but their effectiveness and safety profiles differ greatly. Choosing an OTC pain reliever involves balancing effectiveness for a particular ailment with its side effects, but these are not necessarily known to the buying public.

4 "True" Differentiation

From a consumer's perspective, finding simple relief for a headache or aching back is troublesome. The myriad of choices in the drug store aisle is enough to exacerbate the headache.

The product shelf is a maze of confusing labels, diverse pill forms and claims of body-part specific relief.

As noted above, almost all pain relief products are based on four active ingredients but packaged and advertised in numerous ways to appeal to different consumer needs. This observation leads us to emphasize the role of advertising in this industry, and hypothesize about perceived product (and quality) differentiation in consumers' eyes.

Clinically, all four main active ingredients have varying degrees of side effects – including gastrointestinal, cardiovascular, kidney and liver problems – which can become dangerous if the products are taken at more than the advised dosage. Because people react to each ingredient differently, clinical pain researchers are hesitant to assign superiority to any single drug. Active ingredients differ in potential medical risks that they entail and in the efficiency of pain relief. The analysis of inherent drug characteristics is important for our research, because we will use these measures in evaluating the credibility of comparative advertising claims.

4.1 Quantitative Measures of OTC Analgesic Characteristics

The medical literature provides objective risk and efficiency measures for each product, based on its active ingredient (or combination of ingredients), strength and recommended dosage.[2]

There are definitive maximum doses and durations of therapy for each active ingredient. Differences exist across different active ingredients in terms of the important safety issue of the potential for gastrointestinal (GI) toxicity and cardiovascular (CV) risk.

We attempt to quantify or rank all the true characteristics that were used in advertising associated with each active ingredient. First, we interpret claims concerning strength (e.g., "strong," "stronger," "tougher on pain") as the maximum level of pain relief achieved. Second, we interpret "fast" as the time taken to achieve a perceptible or meaningful pain relief (in medical literature terminology: onset to perceptible pain relief). Third, such claims as "long lasting" are interpreted as a duration of meaningful pain relief. Fourth, we use NNT (Number Needed to Treat) measure to approximate analgesic efficiency claims[3].

The relative risk[4] and efficiency (as expressed by NNT) differences are summarized in Table 2.

[2]The material in this section is based on Hersh, Moore and Ross (2000), Circulation (2006), and Oxford League Table of Analgesic Efficacy (http://www.jr2.ox.ac.uk/bandolier)

[3]NNT is a standard efficiency measure used in the pain relief evaluation literature. See Appendix B for an explanation of how NNT is calculated.

[4]See Appendix B for an explanation of how RR is calculated.

Active Ingredient	Dosage, mg. (maximum daily, mg)	GI RR Measure	CV RR Measure	NNT Measure
Aspirin	325-1000, every 4-6h (4000)	3.1	1.07	4.0
Acetaminophen	325-1000, every 4-6h (4000)	1.0	1.35	3.8
Ibuprofen	200-400, every 4-6h (1200)	2.0	1.44	2.4
Naproxen Sodium	220-440, every 8-12h (660)	9.1	1.44	2.3

Table 2. Clinical Characteristics of OTC Analgesics (Hersh, Moore and Ross (2000); Oxford League Table of Analgesic Efficacy).

The locations of the main active ingredients in the space of characteristic (data from Table 2) which are most frequently used in comparative advertising claims are plotted in Figure 1.

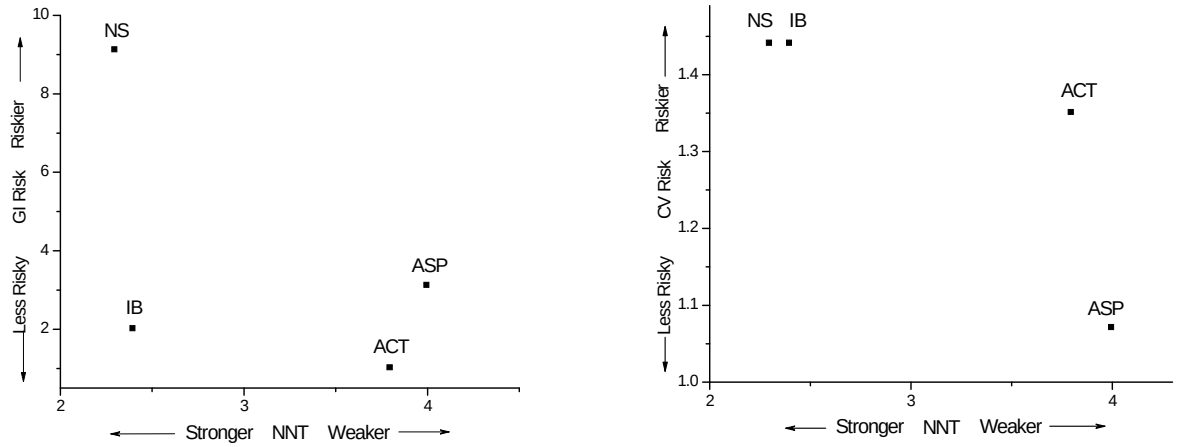

Figure 1. Location of Active Ingredients in the Characteristics Space.

After extensive review of the medical literature we were able to assign each active ingredient with a relative efficiency rank in one of 3 categories discussed above.[5] Note that this ranking is sufficient for us to verify comparative claims and establish relative advantage of specific agents. These rankings were created based on maximum recommended dosage (single dose): Ibuprofen – 400mg; Naproxen Sodium– 440 mg; Aspirin – 1000mg; Acetaminophen –

[5] We reviewed a number of medical journal articles trying to come up with the unique quantitative measures for the other three efficiency characteristics (maximum level of pain relief achieved, onset to perceptable pain relief and duration of meaningful pain relief). The most common occurence in medical articles was a comparison of only two or three active ingredients. We could not aggregate information from multiple articles due to the fact that different studies were based on different AI dosages or type of pain cured. See Appendix C for a list of references that we used to rank analyzed active ingredients.

1000mg. These measurements enable us to identify the relative locations of all the products in the characteristics space.

Time to Perceptible Pain relief (*Fast*)	Maximum pain relief achieved (*Strength*)	Duration of meaningful time relief (*Longevity*)
Soluble Ibuprofen	Naproxen	Naproxen Sodium
Ibuprofen	Ibuprofen	Ibuprofen/Soluble Ibuprofen
Acetaminophen	Acetaminophen	Acetaminophen
Naproxen Sodium	Aspirin	Aspirin
Aspirin		

Table 3. Relative Ranking of Efficiency Measures (starting from the most effective).

5 Perceived Differentiation

Competing brands, as directed by the FDA, contain the exact same dosage of active ingredient. Advil, for example, contains 200 milligrams of ibuprofen, as does competing brand Motrin IB. Extra Strength Tylenol contains 500 milligrams of acetaminophen, as does Extra Strength Excedrin, which also includes a small amount of caffeine. There are even different products with the same brand name that have identical medical formulas. In 2000, the FDA permitted drug companies to label pain products as "migraine relievers". Migraine products carry different instructions and labels, but that labeling does not guarantee any difference in actual pain medicine. A closer look at the fine print on the labels confirms that each "migraine" product is the same as the regular version. Each tablet or caplet of Motrin Migraine contains the same 200 milligrams of ibuprofen, the active ingredient, as regular Motrin. The same is true for the ibuprofen-based Advil and Advil Migraine.

The only difference between Excedrin Migraine and Excedrin Extra Strength or Tylenol 8 Hour and Tylenol Extra Strength is the box. The tablets in each contain the same amounts of aspirin, acetaminophen and caffeine– the pain reliever's active ingredients. During our analyzed period, Tylenol is the leader in creating product differentiation, offering its Extra Strength Tylenol in six different pill forms as well as a liquid. There are also Tylenol versions for menstrual pain, migraine, arthritis and pain relief with sleep aid. Advil and Aleve are packaged in three pill forms, and Bayer offers a safety-coated aspirin pill. (See Table 8 in the Appendix for the complete list of advertised products and their ingredients).

Building brand trust via the channel of advertising is also an essential part of building and restoring perceived product quality. In late 2004, the FDA publicly announced that clinical study evidence indicated that patients taking naproxen sodium (Aleve) may be at an increased risk of suffering heart attack or stroke. The public press widely and immediately reported negative news about Aleve, unleashing a media frenzy that caused one of the largest

crises in the OTC analgesics industry. Headlines like "Aleve – the latest drug to cause Heart attacks" were found in almost every news stand. By the end of January 2005, sales of Aleve plummeted by over 50% suffering the largest decline in brand history.[6] The aggressive "Good News" and personal testimonials advertising campaigns were designed to demonstrate Aleve's safety and efficacy in a way that would restore confidence in the brand. The shock was softened and eventually turned around by advertising.

Additionally, in this market we observe a lot of products of similar or identical quality, where cheaper generic products do not advertise and have lower market shares. There exists a lingering perception that generics are somehow inferior to their brand-name counterparts. However, all drugs are subject to the same regulatory scrutiny by the FDA. They must contain the same active ingredient as the brand-name product, and generic drug makers have to prove their product is just as safe and effective with the same quality, purity, and potency.[7]

Firms concede that there is little to differentiate the medicine in the pills, especially when there is a legal FDA restriction concerning strength and safety for over-the-counter use of certain analgesic agents. This confirms our suspicion that the market is saturated with products that from a true quality perspective are almost identical, yet there is perceived differentiation in this market.

In this section we underscore that advertising generates perceived product differentiation and quality in this market. If all of the characteristics of a good were readily measurable and verifiable, then their value would be known to the consumer and advertising should not affect demand for the good. In some cases, the product is so intricate that its characteristics and its worth are not fully understood by the average consumer. OTC analgesics products are indeed characterized by a quality aspect that is sufficiently complex and involves medical terminology. In this case, assuming that all consumers are aware of the existence of all available OTC analgesics in the market, advertising affects the consumer's perception of the quality of goods by supplying information about the product. Consumers derive from advertising an improved perception of the quality of the product, which heavily depends on the value of the attributes advertised and additional information transmitted by advertising.

[6] Aleve Case History. Real People Campaign (2006)

[7] http://www.fda.gov/cder/consumerinfo/generics_q&a.htm

6 Data

6.1 Datasets

The data that we use for the analysis consist of (1) product level data and (2) advertising data. In addition to these 2 datasets we also use (3) consumer level data prepared by Simmons Market Research. The product level data were purchased from AC Nielsen and consist of 4 week observations[8] of average prices, dollar sales and dollar market shares of any OTC pain reliever sold in the U.S. national market during the 5 years from 2001 through 2005. Data is disaggregated down to the individual UPC (Universal Product Code) level.

The majority of products in the dataset fall under the category "headache medicine," but pain remedies in the arthritis and menstrual analgesics categories are included in the dataset as well. We have data on essential product attributes: active ingredient, strength (regular, extra strength, etc. as regulated by the FDA), pill type (caplet, tablet, gelcap, etc.), number of pills contained in the product, and purpose (menstrual, migraine, arthritis, general, children, etc.).

Advertising data were purchased from TNS-Media Intelligence. This novel dataset contains not only monthly advertising expenditures and units for 2001-2005 for each product advertised in the OTC analgesics category, but also video and image files of all advertisements. While the advertising numbers include expenditures on multiple media, almost all of the advertising budgets were spent on broadcast television advertising, including network, cable, and spot TV.

The availability of such a rich dataset enables us to include advertising content (focusing on comparative advertising) in the analysis of this market. The characteristics of each product revealed in the advertisements are coded and, in the case of comparative advertisements, the rival products mentioned are recorded as well as characteristics on which the comparative statements were based. Such coding generates matrices of advertised characteristics and the cross targeting of brands via comparative advertising.

Finally, consumer level data comes from the Survey of Media and Markets conducted by Simmons Market Research Bureau. Simmons collects data on individual media habits, product usage and demographics from about 20,000 households annually. This dataset has rich information on the brand choices of OTC analgesics, frequency and purpose of use, exposure to media and demographic characteristics (age, sex, income, etc.). An example of Simmons data is given in Table 4.

These data suggest that there are several consumer types in the market: those with

[8] Product level data was normalized to monthly frequency to match the advertising data frequency.

infrequent needs, (headache, muscle ache, etc.) those with moderate but not constant needs (backache, menstrual pain), and those with constant needs (arthritis). This trichotomy alerts us to expect price discrimination across groups with different valuations among groups, sorted by different pill bottle sizes.

Purpose of Use	Proportion Using
Headaches	54.58%
Other Muscle/Body Aches	26.34%
Colds, Flu and Fever	25.18%
Backaches	21.38%
Menstrual Pain	11.24%
Arthritis or Rheumatism	10.87%
Other Pain	16.25%

Table 4. Purpose of use of OTC Analgesics.

6.2 Coding of the Advertisements

There were 4503 individual commercials during 2001-2005. Out of 4503 commercials 346 had missing video files. We should note that usually each individual video was shown multiple times. The total number of commercials shown over the 5 year period in all types of media is a staggering 595,216. We watched all included ads, and recorded mentioned characteristics. We also decided whether the characteristic could be classified as an experience or as a credence characteristic.[9] We elaborate on the types of characteristics and the importance of their distinction in Section 8. The following characteristics were recorded:

(1) Whether the commercial had any comparative claims – explicitly comparing to any other products.

(2) If a commercial was comparative, what was the comparative claim:

a) Faster (experience)

b) Less drug interference/safer (credence)

c) Stronger, As strong (experience)

d) More Effective (experience)

e) Longer Lasting (experience)

f) More Popular (credence)

g) Fewer Pills (credence)

[9]The distinction follows that developed by Nelson (1970): Experience characteristics - consumers cannot determine them before they buy the product, but consumption allows consumers to assess them; Credence characteristics - consumers cannot check the presence or evaluate credence characteristics, even after the consumption experience. They must trust the seller or the quality indicators.

h) Better for Arthritis (experience)

i) More doctor/pharmacist recommended (credence)

j) Also against heart attack (credence)

k) Against all menstrual syndromes (experience)

(3) If a commercial was comparative, which brand (class of drugs) was it compared to:

a) Advil

b) Tylenol

c) Aleve

d) Aspirin

e) Other regular

f) Other Ibuprofen/NSAID

g) Prescription

(4) What characteristics were mentioned in ad (in a noncomparative way):

I Purpose of drug

a) Legs/muscle (experience)

b) Menstrual (experience)

c) Back (experience)

d) Arthritis (experience)

e) Heart attack (experience)

f) Sinus (experience)

g) Sleep (experience)

h) Headache (experience)

i) Children's (experience)

II Characteristics indicating efficiency and/or safety

a) Trusted/Safe (credence)

b) Long lasting (experience)

c) Strong (experience)

d) Fast (experience)

e) Gentle on stomach (experience)

f) Doctor Recommended (credence)

III Other characteristics

a) Every pain relief (credence)

b) Non habit forming (credence)

c) New product (credence)

d) Warning: overdose, label (credence)

7 Content Analysis

Classic content analysis in marketing describes the informative content of advertisements by counting the number of "cues" (or characteristics) mentioned. We use a set of cues described in the previous section that are specific to the OTC analgesics industry. We find that during the sample period 2001-2005, the average number of cues per ad (both comparative and noncomparative) is 2.7 and the median is 3. We then analyze comparative and noncomparative ads separately. Figure 2 juxtaposes comparative and noncomparative ad histograms. Consistent with previous research (Chou et al (1987) and Harmon et al (1983)) we find that comparative ads have a slightly higher number of cues (the average number of cues is 3.13 and the median is 3) than noncomparative ads (the average is 2.47 and the median is 2).

This type of distribution is common in standard content analysis studies. Compared to the classic study, using the traditional 14 information cues proposed by Resnick and Stern, it indicates on average more information cues than is usual. However, this is probably due to the much more narrow classes of information cues used in the diagram (and the current analysis). There is no particular reason at this point to suppose there is either consistently more or less information content in pain reliever ads than ads in other sectors.

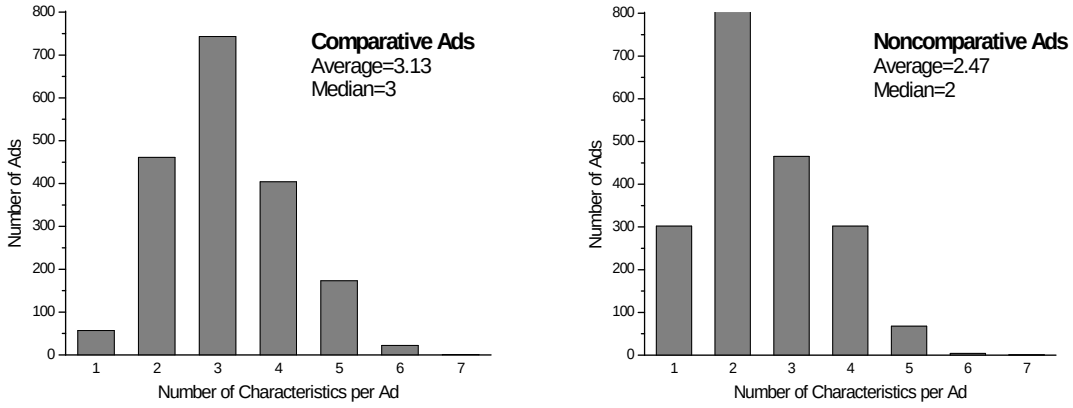

Figure 2. Histogram of Number of Advertising Characteristics for Comparative and Noncomparative Ads (2001-2005).

7.1 Advertising Characteristics

Many ads mention several characteristics, or have several targets (see Tables 5 and 8; Figures 3 and 4 for a breakdown along these lines). The effectiveness of an advertising message in any single dimension is presumably diluted if it addresses other dimensions within the same

message (for example, for information congestion within the consumer's memory). Put differently, a message with a single theme is likely to have a bigger impact on that theme than if there are several themes within the same message. Even if different themes got the same airplay within the same message, it is unclear what the trade-off is between effectiveness per theme and number of themes per message. For example, the congestion effect might be dominant and one pure theme in each of two messages might dominate two messages of two themes each. The relation between number of themes and effectiveness per theme remains an interesting topic for future research, and the content analysis is a very useful place to start an empirical investigation of this topic.

One way to code a congestion effect is to assume that each characteristic generates an impact in proportion to the fraction of the message devoted to this theme. Even this method would involve presuming perfect fungibility between contents (so 3 messages with each divided into 3 themes would perfectly substitute for 3 messages with each on a different theme). However, it is often hard in practice to attribute airtime within a particular message to specific components, and the coding time increases dramatically. The simplest approach, and the one we present the data for below, is to assume that the effectiveness of any ad to any characteristic dimension is proportional to the inverse of the number of characteristics mentioned. That is, if n characteristics are mentioned, each is weighted as $1/n$ of the ad.

This approach deals with the double counting problem mentioned below, but it may err on the side of underestimating the impact of a characteristic in a message, for two reasons. First, there might be weak congestion effects. Second, the other characteristics might be less powerful. For example, we will in practice divide the weight per attribute in three if an ad targets two rivals for being slower to act, but also mentions the particular drug is for arthritis. This means we will code the ad as being one-third attack on slowness for each of the two targets, and one third a positive ad for own arthritis characteristic. In that sense, the "equal-weighting" approach we have just described might tend to underestimate the expenditure on comparative advertising characteristics.

Figure 3 depicts the histogram (weighted by dollars spent on each ad) of types of characteristics mentioned in ads during our analyzed period. Efficiency characteristics are the ones with the highest expenditures (Fast, Strong, Long Lasting). We will return to the analysis of these histograms in Section 8 of this paper. The breakdown of advertising expenditures (using the equal division method) by 8 major brands across different characteristics is given in Table 5.

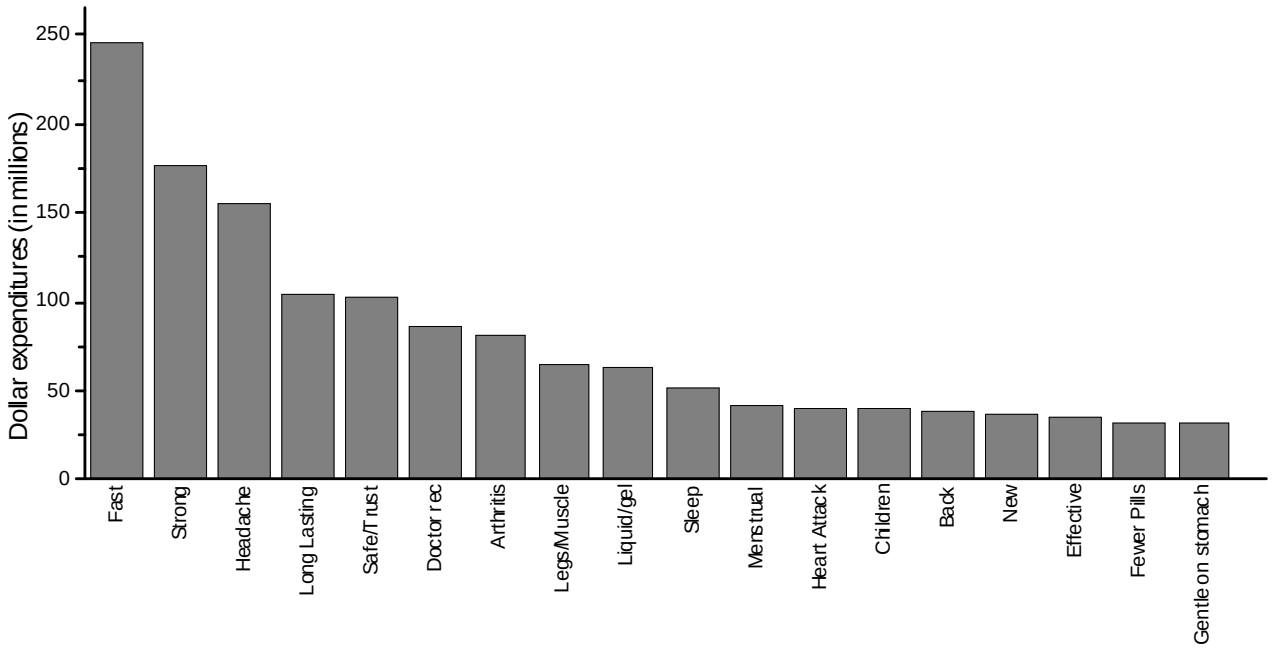

Figure 3. Histogram of Types of Characteristics Mentioned in Ads.

Characteristic	Advil
Strong	$70,699
Fast	$58,808
Liquidgel	$50,957
Headache	$27,112
Legs/muscle	$22,073
Doctor rec	$16,844
Gentle on stomach	$15,553
Arthritis	$12,939

Characteristic	Aleve
Long Lasting	$46,180
Arthritis	$36,925
Fewer pills	$32,473
Doctor rec	$27,255
Strong	$26,275
Trust/Safety	$8,479
Back	$5,070
Effective	$3,016

Characteristic	Bayer
Heart attack	$40,392
Trust/Safety	$25,724
Strong	$24,033
Back	$18,107
Legs/muscle	$9,194
Arthritis	$7,466
Headache	$7,016
Doctor rec	$5,577

Characteristic	Tylenol
Fast	$71,730
Trust/safer	$60,559
Sleep	$51,388
Long lasting	$41,757
Doctor rec	$31,184
Headache	$25,251
Childrens	$24,151
New	$24,038

Characteristic	Excedrin
Headache	$88,771
Fast	$73,751
Effective	$14,829
New	$12,058
Sinus	$6,220
Doctor rec	$3,016
Strong	$2,375

Characteristic	Motrin
Strong	$41,817
Fast	$35,022
Legs/muscle	$15,814
Childrens	$13,966
Headache	$3,861
Long lasting	$3,346
Doctor rec	$1,893
Back	$1,444

Characteristic	Pamprin
Menstrual	$3,477
Long lasting	$2,704
Fast	$1,657
Trust/Safety	$1,105
Back	$730
Headache	$730

Characteristic	Midol
Menstrual synd	$33,021
Headache	$908

Table 5. Who Advertises What and How Much. Cumulative 2001-2005 data (in $000).

The observed patterns indicate quite an informative role of advertising for brands. Advertising tells consumers that the brand delivers the characteristics as opposed to a persuasive advertising scenario where advertising increases desirability of the particular characteristic.

However, advertising here may actually play both roles: first indicating that the particular product has an advantage in one characteristic, while simultaneously enhancing consumers' valuations of that characteristic. We return to this discussion in section 8.

7.2 Content Analysis of Comparative Advertisements

One of the major contributions of our paper is the consistent analysis of comparative advertising ads in one particular industry. Analyzing the subset of advertising videos that were comparative reveals a lot of interesting patterns. Table 6 presents a summary of the frequency of the number of brands targeted and the number of characteristics mentioned. A single competing brand is targeted in a little over half of all the comparative advertising cases. Two brands were mentioned in almost a quarter of the ads. There were even a few cases where an ad was targeting and naming 3 different competitors. The remaining 23% of the comparative ad cases were comparisons against a general class of competing products, such as prescription, NSAIDs or other regular pain relievers. As can be seen from the second column in Table 6, more often than not (around 68% of the time) two or more characteristics were mentioned in a comparative statement (e.g. "faster" and "stronger" coupling).

	Brands/Ad	*Charac-teristics/Ad*
1	51.10%	41.93%
2	24.05%	46.61%
3	1.83%	9.58%
4	0.00%	1.88%
Mean:	**1.05**	**1.71**
Median:	**1**	**2**

Table 6. Frequency of Direct Comparative Ads Targeting Specific Number of Brands and Characteristics.

Figure 4 shows which characteristics were mentioned in comparative statements (and how many dollars were spent on such characteristics). Again, the efficiency characteristics such as Stronger, Faster and Longer lasting are used most in comparative claims. We return to the more detailed comparative ad analysis and the issue of who targets whom in the sections below.

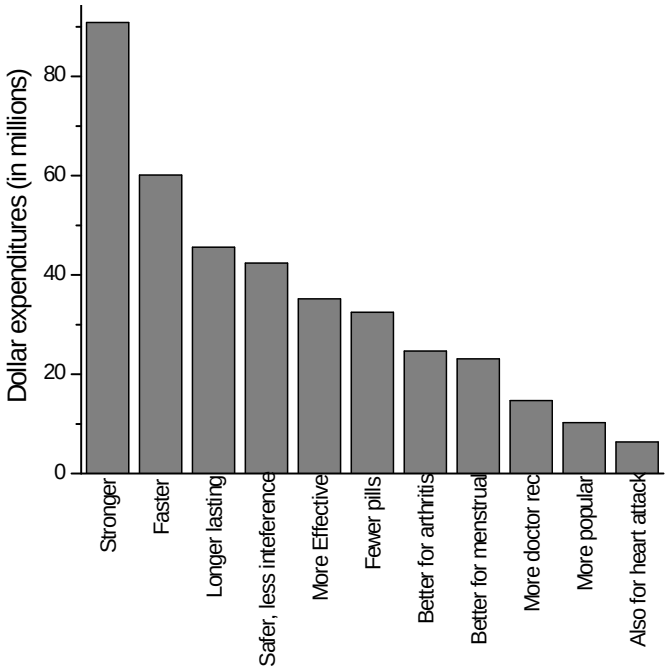

Figure 4. Histogram of Characteristics Mentioned in Comparative Ads.

7.2.1 Targeting in Comparative Advertising

One of the most interesting aspects of the coded data is the information about who targets whom. The complete picture of cross targeting (listing both the targets and the comparative characteristics) is presented in Table 8. Table 7 summarizes the comparative advertising target matrix. The important observation from these tables is that all nationally advertised brands used comparative advertising during the sample period. However, the brands against which comparisons are made are only a subset of the nationally advertised brands. The targets are Tylenol, Advil, Aleve, and Excedrin.

T > / A v	Advil	Aleve	Excedrin	Tylenol	Total Direct CA	Total CA
Advil	0	$44,368	$15,867	$212,290	**$212,290**	**$231,770**
Aleve	0	0	$1,118	$143,266	**$144,384**	**$171,834**
Excedrin	0	9047	0	$31,185	**$31,185**	**$35,057**
Tylenol	25164	$48,516	$3,125	0	**$48,516**	**$130,440**
Midol	$25,350	0	0	$33,929	**$33,929**	**$33,929**
Motrin	$43,241	$43,195	0	0	**$43,241**	**$43,241**
Pamprin	$2,568	$679	0	$2,568	**$2,568**	**$10,326**
Bayer	$26,121	0	0	28082	**$31,217**	**$42,337**
Total	**$122,444**	**$145,805**	**$20,110**	**$451,320**		

Table 7. Comparative Advertising Targeting Matrix. (T- Target Brand, A- Advertiser)

The figures in the left block of Table 7 are the amounts spent on any advertising which mentions the specified target. However, since a particular ad may mention two or more targets, a single ad expenditures may be counted more than once. This is why the sum of the numbers on the left do not add up to the total Direct CA figure in the first of the two right columns: this figure is the sum of spending conditional on the ad having an explicit target. The second (and last) column on the right, Total CA, also includes comparative ads that do not specify the target by name, but may be more generic (e.g., Tylenol attacking NSAIDs). Likewise, Midol attacks Tylenol every time it attacks Aleve; Motrin almost always attacks the pair Advil and Aleve. Bayer is the other attacker with some ads against a brand other than Tylenol. Tylenol attacks Aleve in every direct attack ad, and half of these also attack Advil.

Target > Advertiser v	Advil	Aleve	Excedrin	Tylenol
Advil	0	**Total** **$22,680** Stronger/As strong $9,043 Longer Lasting $5,056 Faster $3,987 Effective $2,297 Arthritis $2,297	**Total** **$7,974** Faster $3,987 Stronger/As strong $3,987	**Total** **$108,566** Stronger/As strong $48,955 Faster $42,655 Long Lasting $9,382 Arthritis $5,277 Effective $2,297
Aleve	0	0	**Total** $560 Long Lasting $280 Fewer pills $280	**Total** $97,242 Long Lasting $34,886 Fewer pills $32,193 Arthritis $14,655 Stronger/As strong $12,492 Effective $3,016
Bayer	**Total** **$11,103** Heart attack $6,324 Effective $2,726 Stronger/As strong $1,158 Interference/safer $895	0	0	**Total** **$11,623** Heart attack $6,324 Effective $2,726 Faster $2,261 Stronger/As strong $312
Excedrin	0	**Total** **$6,032** Effective $3,016 Doctor rec $3,016	0	**Total** **$16,009** Effective $12,993 Doctor rec $3,016
Midol	**Total** **$16,052** All menstrual syn $16,052	0	0	**Total** **$20,342** All menstrual syn $20,342
Motrin	**Total** $28,828 Faster $14,414 tronger/As strong $14,414	**Total** **$28,796** Faster $14,398 Stronger/As strong $14,398	0	0
Pamprin	**Total** **$1,462** All menstrual syn $1,108 Long Lasting $354	**Total** **$679** All menstrual syn $679	0	**Total** **$1,462** All menstrual syn $1,108 Long Lasting $354
Tylenol	**Total** **$16,497** More Popular $9,716 Interference/safer $4,061 Stronger/As strong $1,158 Effective $781 Faster $781	**Total** **$26,328** Interference/safer $13,892 More Popular $9,716 Stronger/As strong $1,158 Effective $781 Faster $781	**Total** **$1,562** Faster $781 Effective $781	0

Table 8. Characteristics of Brands Targeted by Comparative Advertising: Dollar Expenditures (in Thousands) by Advertiser Using Equal Division Approach.

Using the relative efficiency and safety information discussed above we positioned most brands in a product characteristics space and marked the "attack" patterns depicted in Figure 5. Most of the arrows point to Tylenol – the leader brand. We analyze these attack patterns in section 8.

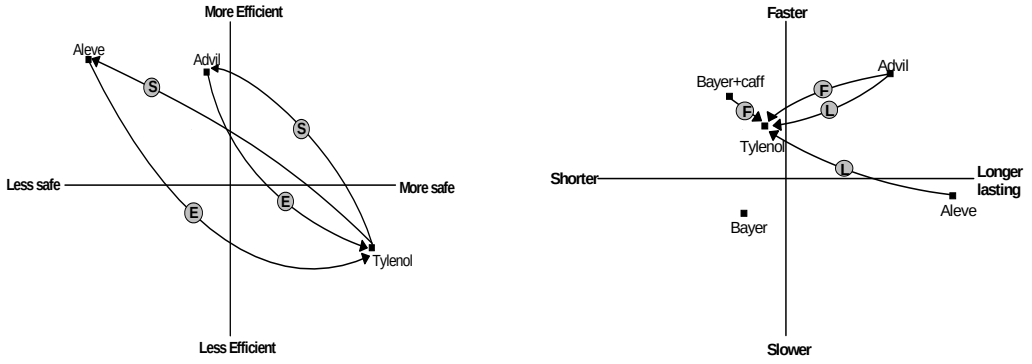

Figure 5. Targeting in Comparative Advertising. "E" refers to "attack" on general efficiency grounds, "L" – on length, "S" - on strength and "F" – on speed of pain relief.

8 Hypotheses

In this section we construct several theoretical hypotheses and test them against our data. These hypotheses do not require rigorous statistical techniques since they can be seen quite clearly from simple correlations in the data. For this reason, we do not need sophisticated statistical models in this paper for our current purposes. That said, we intend to carry out a more nuanced and elaborate econometric analysis with the data, using a structural econometric model. Of course, that approach in turn can be criticized because the structural model imposes strong behavioral assumptions. We therefore keep the structural work separate from the evaluation of the simpler empirical hypotheses about comparative advertising that are quite evident in the aggregate data.

H1. Targets: Leading brands will be targeted most by comparative advertising.

The conjecture that the brands with higher market shares will be most heavily targeted in comparative advertising stems in part from the recognition that higher market shares most likely reflect higher perceived quality or superior performance in some characteristic categories. Other brands can then try to influence consumer perceptions of their own worthiness by indicating stronger performance in some categories, and hence suggesting quality comparable to (or higher than) the highest one available. Targeting small brands (with, by extension, low perceived quality) would not provide as much potential boost in perceived quality. The flip side of this hypothesis analyzes which brands will actually instigate the targeting, which is the topic of the next hypothesis.

In the data we see only 4 targeted brands: Tylenol, Aleve, Advil and Excedrin. These brands are also the top four brands by market share. Table 9 lists the targeted brands, their

market shares, and comparative ad expenditure against those brands. Tylenol, as the market leader, is attacked the most. The second most attacked brand is Aleve, even though it is only third in terms of market share. Advil and Excedrin are third and fourth respectively. The data strongly support the hypothesis.

Target	CA Expenditure Against	Market Share of the Target
Tylenol	$451,320	27.88%
Aleve	$145,126	7.91%
Advil	$122,444	16.49%
Excedrin	$20,110	8.39%

Table 9. Targeted Brands and Comparative Ad Expenditure (in Thousands of Dollars)

H2. Targeters: Brands with low market shares will engage in more comparative advertising as a fraction of their total advertising (than brands with higher market shares).

As noted in H1, one possible reason for comparative advertising is to bring the consumer perception of one's brand up to the level of the target. Thus, if we view market shares as reflecting perceived qualities, as argued above, then brands will want to target those "above" them, and not those below them. There is another reason why brands may not wish to target those with lower market shares. Comparative advertising gives at least some publicity to rival brands, indicating the existence of other products. Top brands are unlikely to wish to acknowledge other brands, thus comparative advertising may be used as a tacit admission that the brand is not the market leader. Brands with low market shares may also signal a rising market position through an aggressive marketing strategy of comparison. In Table 10 we clearly see that the brands which use the most comparative advertising account only for very small market shares, whereas Tylenol, being the market leader, spends the least amount on comparative advertising.

Brand	CA/TA	Direct CA expend	Market share
Midol	87.55%	$33,929	1.67%
Aleve	61.60%	$144,384	7.91%
Advil	60.21%	$212,290	16.49%
Motrin	29.41%	$43,241	5.58%
Pamprin	24.65%	$2,568	0.56%
Bayer	17.98%	$31,217	5.45%
Excedrin	10.28%	$31,185	8.39%
Tylenol	8.42%	$48,516	27.88%

Table 10. Relative and Absolute Comparative Advertising Expenditures and Market Shares.

H3. Comparative advertising will target rival brands and not "stable-mates."

As comparative advertising is implicitly "negative" in terms of denigrating the performance of other brands, one would not expect one brand to extensively cannibalize another brand owned by the same parent company. This suggests a corollary that parent companies with fewer "stable-mates" will be more likely to engage in comparative advertising.

In the OTC analgesics market this is clearly true: McNeill owns both Tylenol and Motrin IB brands and Bayer owns Bayer, Aleve and Midol. None of these brands target their "stable-mates" in comparative advertising. (See the matrix of cross targeting in Table 8).

H4. A specific characteristic will only be advertised by one brand.

Each characteristic is unlikely to be advertised by more than one brand. However, it is possible (and consistent with the statement) that one brand could advertise more than one characteristic. This idea comes from parallel theoretical research by Anderson and Renault (2008). The research models the advertising of particular product attributes by firms, and (positive) advertising is assumed to heighten the consumer appreciation of the characteristic(s) that are advertised. This idea is termed the "sheening" of the characteristic, i.e., strengthening the consumer valuation of the good by strengthening the appreciation of its strongest constituent characteristics. Therefore, such advertising of a characteristic is likely to "raise all boats" for the brands that are strong in that characteristic and will thus most benefit the firm that is perceived to best embody that characteristic. Thus, the product that best embodies that specific characteristic will advertise it. The hypothesis is tested by looking at the matrix of information cues in advertising in Table 5.

It is clear that the strong form of this hypothesis is rejected (each firm advertises significantly more than one characteristic). However, the weak form of the "sheening" model holds: the highest expenditure characteristic is different for most of the brands – Advil spends most money to emphasize that it is strong, Aleve, that it is long lasting, Excedrin that it is a headache medicine. Midol and Pamprin stress that they are for menstrual pain; Tylenol emphasizes speed, Bayer notes it is also good for heart attack prevention and treatment. Motrin, however, follows Advil in stressing strength. Hence, the top brands specialize in which characteristic they advertise the most.

H5. Comparative and general advertising claims will tend to involve experience attributes as opposed to credence ones.

Experience attribute claims are verifiable only after purchase/use, implying that verifying such claims involves considerable cost (actual consumption of a product). Alternatively,

credence characteristics cannot be fully verified, both prior to and post consumption. As a result, the buyer has to rely on third-party judgments (e.g., FDA) or on the seller's credentials (i.e. the undisputed record of honesty, competence and determination with respect to the quality). Hence, it is logical to assume that, other things being equal, consumers may demand more information for (or pay more attention to) experience characteristics than for credence characteristics.

In our case, out of 11 attributes that involved comparative claims, 6 of them can be classified as experience characteristics. Those 6 attributes are exactly the ones that are advertised most frequently. Indeed, the fraction of experience characteristics in total comparative advertising expenditures was nearly 80%.[10] Additionally noncomparative claims also involve higher frequency of experience characteristics compared to credence characteristics.

H6. Comparative advertising will target products with active ingredients different from that of the attacking product.

Given the distinct properties of active ingredients (AIs), it is reasonable to predict that products will not target other products with the same AIs, at least not on the basis of medical efficacy and safety claims. By inspecting Table 8, we observe that the four highest comparative advertising expenditures are spent against products with different AIs:

Advil (Ibuprofen) vs. Tylenol (Acetaminophen),

Aleve (Naproxen Sodium) vs. Tylenol (Acetaminophen),

Tylenol (Acetaminophen) vs. Aleve (Naproxen Sodium),

Advil (Ibuprofen) vs. Aleve (Naproxen Sodium).

From the 6 highest comparative ad expenditures, only one (the fifth one) is made against the product containing the same AI (Motrin vs. Advil – both contain Ibuprofen as an AI; however, the claim there was that Motrin is "as strong" as Advil).

9 Final Remarks

In this paper we investigate the advertising content of the OTC analgesics industry. This industry is characterized by high advertising-to-sales and comparative advertising levels. We have described the actual comparative advertising patterns used in the OTC analgesics industry, and linked this to the important characteristics of the products' active ingredients. We find that larger brands tend to be most targeted by comparative advertising. It is

[10] Using data from Table 6, the total amount spent (in $000 over the 5 years) on comparative advertising was $423,797; of this $334,364 was on experience characteristics, which constitutes 79% of the total.

smaller brands which tend to use relatively more comparative advertising in their advertising mix. Contrary to the conventional understanding that leading brands are not involved in comparative advertising, we do observe Tylenol comparing itself against Advil and Aleve. We also find that nationally advertised brands tend to specialize in which characteristics they advertise the most. This is consistent with the weak version of "sheening" theory where positive advertising of a specific characteristic is likely to "raise all boats" for the brands that are strong in that characteristic and will thus most benefit the product that is perceived to best embody that characteristic. We also show that the most heavily advertised characteristics, and especially the characteristics that were advertised in a comparative way can be deemed to be experience attributes. Lastly, we note that comparative advertising targets products with active ingredients different from that of the attacking product.

However, it is worth emphasizing that the patterns observed in this industry do not necessarily reflect what would be optimal in other contexts. For example, products have distinct and chemically different active ingredients, and advertising in the industry is governed by a self-regulating code of conduct by which firms usually provide evidence to substantiate the efficacy and safety claims. Nor, indeed, is it necessarily true that the products in this sample were choosing the best profile of advertisements. Even if we see the most successful brand (Tylenol) pursuing a particular advertising strategy, we cannot say whether that strategy was the cause of its success, or whether it might not have done better using another strategy. Our research does suggest future research directions which we hope to pursue to get a tighter grasp of the extent and type of advertising which is most successful for which firms.

With these caveats in mind, we can already draw some preliminary and tentative conclusions on comparative advertising. First, the most successful firm (Tylenol) does not engage much in comparative advertising. The question on causality is important here. It is not because Tylenol does not advertise comparatively that it is so successful. Its dominant market position goes back to before comparative advertising was widely used. Rather, finding itself in a position of market dominance, with high perceived product quality, it does not want to comparative advertise against its rivals in the OTC industry. To do so would draw attention to them, increase consumer awareness, and might even give more credibility to them. Instead, Tylenol compares itself (favorably, of course) to prescription drugs, which are widely perceived to be more potent. And presumably, by extension, Tylenol is safer because a prescription is not needed.

Second, firms push their strengths in their own positive advertising, and emphasize rivals' weaknesses in comparative advertising. However, according to FTC comparative claim verifiability and substantiation program, firms need to carefully pick and reason their comparative claims.

Third, aggressive advertising can be used to staunch lost sales following bad news. This happened during our sample with the late 2004 news shock to Aleve (and Naproxen Sodium in general). Aleve responded with a strong campaign, which successfully restored public confidence and turned around the plummeting sales.

This last episode leads us to suggest how future research can help identify the crucial issue of how effective comparative advertising is. In particular, with data on the timing and severity of shocks, we can address how firms responded, and how successful the response was. News stories are a good source of such data. A second useful source of information is the history of investigation or prosecution of misleading advertising by the FTC. This serves as a good proxy for the cost of running comparative ads as opposed to standard ads.

More research needs to be done on the theoretical side too, in terms of formulating models that describe the costs and benefits of raising one's own product quality (positive advertising) or denigrating a rival's quality (comparative ads). A full equilibrium model in this vein would enable us to find theoretical correlation between the amount and type of advertising done, and market share. This model could also indicate the advertising responses of firms to news shocks. The full picture would base the benefits from advertising on the underlying product characteristics (i.e., the chemical properties of the active ingredients).

Appendix A

Explanation of Medical Measures

Relative risk (RR) is the risk of an event (or of developing a disease) relative to exposure. Relative risk is a ratio of the probability of the event occurring in the exposed group versus the control (non-exposed) group.

$$RR = \frac{P(treatment)}{P(control)}$$

Relative risk is used frequently in clinical trial data, where it is used to compare the risk of developing a disease, in people not receiving the new medical treatment (or receiving a placebo) versus people who are receiving an established (standard of care) treatment. Alternatively, as it is the case with GI and CV relative risk numbers used in this paper, it is used to compare the risk of developing a side effect in people receiving a drug as compared to the people who are not receiving the treatment (or receiving a placebo). Thus, for example, a CV RR of 1.44 means that CV problems arise with 44% higher likelihood using the drug (vs. placebo).

Number-Needed-to-Treat (NNT) is computed with respect to two treatments A and B, with A typically a drug and B a placebo. If the probabilities P_A and P_B under treatments A and B, respectively, are known, then the NNT is computed as:

$$NNT = \frac{1}{P_B - P_A}$$

The NNT for a given therapy is simply the reciprocal of the absolute risk reduction ($ARR = P_B - P_A$) for that treatment. For example, in hypothetical migraine study, risk decreased from $P_B = 0.30$ without treatment with drug M to $P_A = 0.05$ with treatment with drug M, for a relative risk of 0.17 (0.05/0.3), a relative risk reduction of 0.83 ((0.3-0.05)/0.3), and an absolute risk reduction of 0.25 (0.3-0.05), the NNT would be 1/0.25, or 4. In concrete clinical terms, an NNT of 4 means that you would need to treat four patients with drug M to prevent migraine from recurring in one patient. Typically, the lower the NNT number, the more potent and efficient the treatment is.

Appendix B

Additional Active Ingredients and the List of Advertised Products

Some of the marketed pain relievers contain additional active ingredients that either help specific pain relief (as is the case with most menstrual pain relief formulas) or affect the efficiency of pain relief. The most common additional ingredients are the following:

Caffeine. Analgesic active ingredients combining caffeine with aspirin, acetaminophen, or both are also available as OTC drugs (Midol and Pamprin for menstrual pain, Excedrin for headache and migraine, Bayer for body aches). Caffeine is considered an analgesic adjuvant, that is, it enhances the analgesic effects of aspirin, acetaminophen and ibuprofen; yet it is ineffective when used alone. Caffeine appears to shift the analgesic dose-response curve upwards, thereby providing more pain relief for a given dose of analgesic.

Aspirin/Acetaminophen Combinations. Aspirin and acetaminophen combination enhance efficiency of pain relief by adding active ingredients that produce the same effect but by different channels. These combinations are expected to have lower side effects than aspirin alone. Excedrin, Midol and Pamprin use this mix.

Other Formulas. Night formulae (e.g., Tylenol PM) contain an additional ingredient, Diphenhydramine HCl, which is a sleep aid. Generally, any drug marketed for children (e.g., Tylenol Meltaways) contains a smaller dose of the active ingredient (as little as one-third of the adult dose). Drugs marketed for menstrual purposes (such as Midol or Pamprin) with acetaminophen based formulae often contain diuretics such as Pamabrom and Pyrilamine Maleate.

Table 11 shows all the advertised brands and their products together with the list of active ingredients, recommended dosage, and maximum number of pills one is allowed to take within 24 hours.

# of Prod	Brand and Product	Active Ingredients	Dosage	Max in 24 h
2	Advil liquid	Sol. 200 mg ibuprofen	1 every 4 to 6 h	6
	Advil (tablets, caplets, gel caplets)	Ibuprofen 200 mg	1 every 4 to 6 h	6
1	Aleve (tablets, caplets)	Naproxen Sodium 220 mg	1 every 8 to 12 h	3
3	Bayer	Aspirin 325 mg	1 or 2 every 4 h or 3 every 6 h	12
	Bayer Back and Body	Aspirin 500 mg. Caffeine 32.5 mg.	2 every 6 h	8
	Bayer Extra strength	Aspirin 500 mg	1 or 2 every 4 to 6 h	8
5	Excedrin (extra strength)	Acetaminophen 250 mg, Aspirin 250 mg, Caffeine 65 mg	2 every 6 h	8
	Excedrin (tension headache)	Acetaminophen 500 mg, 65 mg caffeine	2 every 6 h	8
	Excedrin (Migraine)	Acetaminophen 250 mg, Aspirin 250 mg, Caffeine 65 mg	2	2
	Excedrin (sinus headache)	Acetaminophen 325 mg Phenylephrine HCl 5 mg	2 every 4 h	12
	Excedrin (PM)	Acetaminophen 500 mg, Diphenhydramine citrate 38 mg	2	
6	Midol (menstrual complete)	Acetaminophen 500 mg, Caffeine 60 mg, Pyrilamine maleate 15 mg	2 every 6 h	8
	Midol (premenstrual)	Acetaminophen 500 mg, Pamabrom 25 mg, Pyrilamine maleate 15 mg	2 every 6 h	8
	Midol (cramps and body aches)	Ibuprofen 200 mg	1 every 4 to 6 h	6
	Midol (extended relief)	Naproxen sodium 220 mg	1 every 8 to 12 h	3
	Midol (menstrual headache)	Acetaminophen 500 mg, 65 mg caffeine	2 every 6 h	8
	Midol (teen formula)	Acetaminophen 500 mg Pamabrom 25 mg	2 every 6 h	8
2	Motrin IB	Ibuprofen 200mg	1 every 4 to 6 h	6
	Children's Motrin, Motrin Jr. Strength	Ibuprofen 100mg	2 or 3 caplets	4
3	Pamprin (multi symptom)	Acetaminophen 500 mg, Pamabrom 25 mg, Pyrilamine maleate 15 mg	2 every 4-6 h	8
	Pamprin (all day)	Naproxen sodium 220 mg	1 every 8 to 12 h	3
	Pamprin (cramp)	Acetaminophen 250 mg, Magnesium salicylate 250 mg, Pamabrom 25 mg	2 every 4-6 h	8
7	Tylenol Arthritis	Acetaminophen 650 mg	2 every 8 h	6
	Tylenol Regular	Acetaminophen 325 mg	2 every 4 to 6 h	12

Table 11. Advertised Brands and Their Products (2001-2005).

Appendix C

Determining the Efficiency Ranking of Active Ingredients

We reviewed a number of medical journal articles in attempt to rank the three efficiency measures (maximum level of pain relief achieved, onset to perceptible pain relief and duration

of meaningful pain relief) of the analyzed active ingredients The most common occurrence in medical articles was a comparison of only two or three active ingredients. If the article X said that the drug A is more efficient than the drug B (A>B) and the article Y said that the drug B is more efficient than C (B>C), then we conclude that A is more efficient than B and C (A>B>C). Below we also present the numbered list of references that were used to infer relative rankings. Table 9 lists all those relative relationships, references of medical articles (in parentheses), and gives the resulting ranking presented above in Table 3.

Time to Perceptible Pain relief (*Fast*)	**Maximum pain relief achieved (*Strength*)**	**Duration of meaningful time relief (*Longevity*)**
Sol Ibuprofen>Ibuprofen (1,6) Ibuprofen>Acetaminophen (1,5,6) Acetaminophen>Naproxen (10) Naproxen>Asprin (3)	Naproxen>Aspirin (3) Ibuprofen> Acetaminophen (2,6,5,7,10) Naproxen>Acetaminophen (2,4,7,8,10) Naproxen>Ibuprofen (4) Acetaminophen>Aspirin (10)	Naproxen>Aspirin (3) Ibuprofen>Acetaminophen (2,4,5,9,10) Ibuprofen/Sol Ib>Acetaminophen (6) Naproxen>Ibuprofen (4) Naproxen>Acetaminophen (2,4,8,9) Acetaminophen>Aspirin (10)
Resulting Ranking (Table 3):		
Soluble Ibuprofen Ibuprofen Acetaminophen Naproxen Sodium Aspirin	Naproxen Ibuprofen Acetaminophen Aspirin	Naproxen Sodium Ibuprofen/Soluble Ibuprofen Acetaminophen Aspirin

Table 12: Relative Efficiency Ranking of Different Analgesic Agents

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