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When Consumers Diet, Should Producers Care? An Examination of Low-Carb Dieting and U.S. Orange Juice Consumption

Leigh Ann Love, James A. Sterns, Thomas H. Spreen, and Allen F. Wysocki

From 2000 through 2004, per-capita orange juice purchases decreased by 12.3 percent in the United States, while the popularity and media coverage of low-carbohydrate dieting exploded. Content analysis was used to count selected newspaper articles topically related to low-carbohydrate dieting, the Atkins diet, and the South Beach diet. These data were included in a national orange juice demand model, where purchase data served as the independent variable and proxy for consumer demand of orange juice. Results indicate that media coverage of low-carbohydrate diets and dieting was negatively and significantly related to demand for orange juice in the United States.

Fruit and fruit juices have been generally accepted by the public and nutritionists as excellent nutrient sources and important additions to a healthy diet, and are included within the United States Department of Agriculture dietary guidelines for healthy eating (USDHHS and USDA 2005). Culturally, orange juice has a direct association with breakfast meals. In the United States, these preferences have come under attack by low-carbohydrate diet proponents and adherents.

In the 1970s, a book detailing the benefits and guidelines for a low-carbohydrate lifestyle was written by Dr. Robert Atkins, eventually selling 10 million copies worldwide. After the diet faded from public view for nearly two decades, Atkins republished the diet book in 1992 as *Dr. Atkins' New Diet Revolution*. This book triggered another wave of high-protein, low-carbohydrate dieters, although the diet did not reach widespread popularity until the late 1990s, when Atkins' book achieved bestseller status. This status has directed public and media attention toward low-carbohydrate lifestyles developed by Dr. Atkins and others who have created similar diet plans that follow the low-carbohydrate diet philosophy. These diets, in many cases, specifically encourage diet adherents to decrease or completely eliminate consumption of fresh fruit and/or fruit juices while dieting.

On average, an eight-ounce glass of orange juice has 27 grams of carbohydrates. Many low-carbohydrate diets advocate limiting daily carbohydrate intake; the Atkins diet recommends that dieters

limit daily carbohydrate consumption to 20 grams per day during the first phase of the diet and to 30 grams per day during the second phase of the diet. Because daily carbohydrate limits recommended by low-carbohydrate diet proponents are less than the amount of carbohydrates in an eight-ounce glass of orange juice, orange juice is a food product considered high in carbohydrates, and consumption is typically reduced by consumers who choose to follow a low-carbohydrate diet.

Florida orange juice growers hold the low-carbohydrate dieting trend at least partially responsible for recent decreases in United States per-capita orange juice consumption. According to Weinraub (2004), who reported research conducted by ACNielsen for the Florida Department of Citrus that involved random surveys of 2,600 U.S. households in December 2003, 26 percent of the people surveyed intentionally reduced their orange juice consumption in 2003. Of that 26 percent, 35 percent reported that they did so due to low-carbohydrate dieting. This is particularly important to the Florida citrus industry, since Florida growers supply, on average, 85 percent of all orange juice consumed in the U.S. (based on 1999 to 2005 data provide by the Florida Department of Citrus).

Previous Studies

Within the field of agricultural economics, several studies have been conducted investigating the relationship between media coverage and demand for various food products. Most of these studies concentrate on the demand impacts of how various food-safety risks are portrayed in the media, both in the United States and abroad. In these studies, media

Love is a graduate student, Sterns is assistant professor, Spreen is professor, and Wysocki is associate professor, Institute of Food and Agricultural Sciences, Food and Resource Economics Department, University of Florida, Gainesville.

coverage is considered on two levels—sustained media coverage and heightened media coverage. According to Kalaitzandonakes, Marks, and Vickner (2005), sustained (long-term) and heightened (short-term) media coverage are distinguishable by the length of time an issue is the subject of media coverage.

Kalaitzandonakes, Marks, and Vickner (2005) investigated the relationship between GM ingredient labels, sustained GM-related food risk as portrayed in the media, and demand for frozen and canned food items in the Netherlands. They determined that Dutch consumers did not significantly change their purchasing behavior toward biotech foods in response to long-term media coverage. This is the only study found thus far that indicates demand was not significantly changed due to media coverage. Additionally, the media attention directed toward the U.S. Starlink corn case was considered by Kalaitzandonakes, Marks, and Vickner with regards to heightened media coverage of the issue. Results of the research indicated that acute media coverage did influence consumer purchasing behavior and that those changes in consumer demand affected primarily those branded products that were directly identified by the media. The research, however, indicated that the overall change in consumer demand was temporary and rather small.

Van Ravenswaay and Hoehn (1991) investigated the relationship between demand for apples following the Alar scare and sustained media coverage of the food-safety issue relating to apple consumption in light of the food scare. Their research indicated a relationship between media coverage and subsequent decrease in demand for apples. Overall, they estimated that demand for apples decreased by 30 percent during the six-year study.

Verbeke and Ward (2001) investigated the relationship between meat consumption and sustained media coverage of hormones and BSE (Bovine Spongiform Encephalopathy, otherwise known as Mad Cow Disease) from 1995–1998 in Belgium and the United Kingdom. Their research indicated a reduction in consumer expenditures on beef over four years by 2 percent in Belgium. In addition, demand for beef in the United Kingdom decreased by 40% after the link between BSE and vCJD (Variant Creutzfeldt-Jakob Disease) was reported.

Piggott and Marsh (2004) investigated the impact of heightened media coverage of *listeria*, *salmonella*, *E. coli*, and BSE on U.S. demand for

beef, chicken, and pork. Their research revealed that consumers reacted to contemporaneous media coverage of such risks only. Although this result held over a twenty-year period, the research indicates that the overall economic effects from such consumer response were relatively small.

Swartz and Strand (1981) considered the impact of kepone contamination (a potential carcinogen) on demand for oysters in certain U.S. markets. Their research found that the media had a moderate but temporary negative impact on demand for oysters. After consumer reaction to media coverage of kepone contamination wore off, the research indicates that U.S. consumption of oysters returned to previous levels.

Each of these studies has linked consumer demand of food items with some event. Typically, the events considered for analysis have focused on food risks as reported by the news media. Therefore, a gap exists in the literature with regards to consumer demand of food items and an event such as a popular dieting trend. This study aims to link the popularity of the low-carbohydrate dieting trend and U.S. consumer purchases of orange juice to determine whether or not a popular dieting trend as reported by the news media has a significant and negative impact upon demand.

Problem Statement

Given decreases in U.S. orange juice consumption since the late 1990s and the high volume of diet- and health-related information made available to the consuming public via various channels in the mainstream media, citrus growers wanted researchers to investigate the relationship between increased media attention toward low-carbohydrate diets and decreased orange juice purchases in the United States.

By addressing this problem and related issues, a better understanding of diets and dieting in the United States and the effect that such consumer behavior has upon the purchasing of food products—specifically orange juice—can be attained. Such information can be vital to the agricultural sector and specific agricultural industries when faced with potential changes in demand for food products due to diet trends and associated purchasing and consumption behaviors.

To first identify whether or not the potential of a relationship between orange juice consumption

and media coverage of low-carbohydrate diets does exist, annual orange juice purchases and a count of news articles reporting low-carbohydrate diet information were compared (Figure 1). In 2000, orange juice purchases began to decline steadily; annual per-capita purchases decreased by 12.3 percent by 2004 while newspaper articles about low-carbohydrate diets increased by 700 percent. This indicates that decreases in U.S. orange juice purchases are negatively correlated with increases in diet media coverage relating to low-carbohydrate diets as printed in U.S. newspapers.

Hypotheses

Two hypotheses are purposed and tested concerning the relationships between low-carbohydrate diets and orange juice purchasing habits: that there is an inverse relationship between consumer demand for orange juice and low-carbohydrate diet media coverage, and its statistical corollary that low-carbohydrate diet media coverage is a statistically significant explanatory variable when modeling U.S. orange juice demand.

To address these hypotheses, U.S. orange juice purchase data from October 1995 through January

2005 were used to estimate consumer demand. The content-analysis method was then used to generate quantified measures of low-carbohydrate-diet media coverage; collected media coverage was then overlaid to coincide with purchase-data periods. The model for consumer demand was then defined as a function of a set of independent variables, including a diet media-coverage variable representing the frequency of media articles about low-carbohydrate diets and dieting. Other explanatory variables in the demand analysis included real price, existence of field staff working for the Florida citrus industry, and per-capita discretionary income.

Data Collection

Retail sales in the form of national scanner data were collected for orange juice purchases in the United States on a four-week basis, for a total of 122 purchase periods. These scanner data represent volume sales in all ACNielsen retail outlets, including U.S. grocery store chains with annual sales greater than \$2 million, Wal-Mart stores (excluding Sam's Club), and mass merchandisers and drug stores with annual sales greater than \$1 million. This data set includes most but not all consumer purchases; most

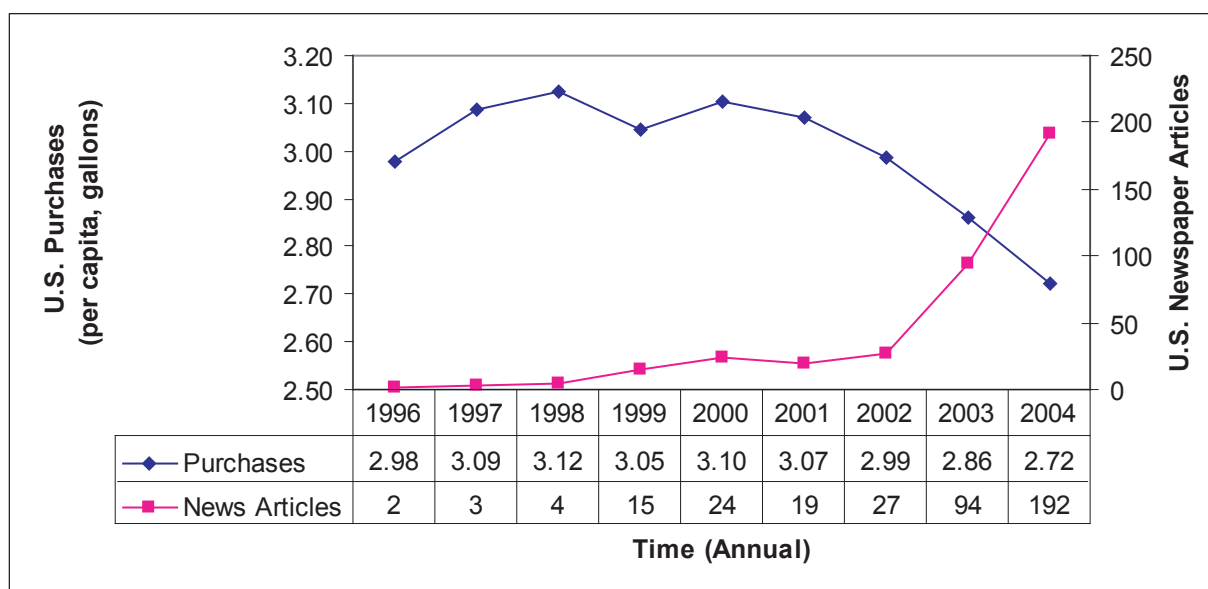


Figure 1. U.S. Per-Capita Orange Juice Purchases (As Reported By ACNielsen) and Newspaper Articles on Low-Carbohydrate Diets and Dieting, Annual Totals 1996–2004.

notably missing are consumer purchases at food-service outlets (e.g., McDonalds, etc.), smaller grocery retail chains, and convenience stores.

According to the American Dietetic Association (2002), 23 percent of people surveyed indicated that they use newspapers as a primary source of health information, compared to 14 percent who reported that they rely on doctors and dieticians for health information. In addition, the International Food Information Council (2003) reported that 11 percent of all newspaper, magazine, and television articles published in 2003 addressed obesity and/or weight management. These findings are indicators that newspapers are an important media outlet for disseminating information about health and diet issues. Therefore, newspaper articles were used as a proxy for the public's overall media exposure about low-carbohydrate diets and dieting.

Articles from national newspapers printed from October 1995 through December 2004 were collected and analyzed. These newspapers were the *New York Times*, *Los Angeles Times*, *Washington Post*, and *USA Today*. These four newspapers are four of the five top-ranked newspapers in terms of daily circulation, representing a total daily circulation of over 6.5 million readers (Audit Bureau of Circulations 2004). It is important to note that the *Wall Street Journal*, reported as the second highest circulated newspaper, is not included in the analysis. It was excluded because of its business-reporting format and the potential biases inherent in its topical focus and its readership relative to the other mainstream publications.

Using a standard content-analysis protocol, articles were identified and analyzed based upon

their topical relevance. Electronic databases (e.g., Factiva, Lexis-Nexis) were used to generate search strings for locating articles with topical relevance to low-carbohydrate dieting and the two most popular low-carbohydrate diets, the Atkins diet and the South Beach diet. Search strings were used to accurately sample the article population, although by necessity search strings did vary slightly between databases (i.e., the databases had slightly differing search protocols). Searches and article sampling were based only upon words and phrases meeting the sampling criteria as found in either the headline or first paragraph of each article.

This data-collection protocol is based upon a nine-step process for content analysis proposed by Neuendorf (2002). Suggestions were also adopted from Kassirjian (1977) and Kolbe and Burnett (1991), who have written about methods to assure validity in content analysis.

Table 1 indicates the total number of articles captured by the search strings and identifies the number of articles identified as exempt from analysis. Those exempt articles meet one of the following criteria: duplicate articles between the two sample categories or articles which were predominantly recipes or bestseller lists.

Demand Analysis

As previously discussed, data were used to model consumer response to media coverage of low-carbohydrate diets when changes in the purchases of orange juice are considered. The U.S. retail purchases of orange juice data set from ACNielsen is the proxy used for the model's dependent variable,

Table 1. National Newspaper Sample, All Issues Published from Oct. 1995 through Dec. 2004.

Publication name	Search terms		Excluded: duplicates, unrelated topic	Total sample
	low and "carb" and diet	Atkins or South Beach and diet		
<i>USA Today</i>	60	117	104	73
<i>New York Times</i>	80	110	72	118
<i>Los Angeles Times</i>	128	121	128	121
<i>The Washington Post</i>	61	74	61	74
Grand total	329	422	365	386

U.S. consumer demand for orange juice. The demand for orange juice is expressed as a demand equation:

$$(1) D_t = f(\text{RP}, \text{DC}, \text{ST}, \text{PCINC}, \text{PCGAL}_{t-1}, \text{P2} \dots \text{P13}).$$

RP is real weighted price per gallon of orange juice over four-week periods beginning with the period ending on October 7, 1995 and includes purchases made of 100% orange juice (including reconstituted, not-from-concentrate, and frozen concentrate) at most major outlets, including drug stores, mass merchandisers (i.e., Wal-Mart, Target, etc), and grocery stores with annual retail sales of two million dollars or more. Prices were weighted with regards to market share for each orange juice.

DC, national newspaper diet media coverage, represents weekly counts of articles collected from national newspapers meeting search requirements for topical relevance to low-carbohydrate dieting and the Atkins and South Beach diets. Counts of articles were made from October 1995 to December 2004.

ST, existence of FDOC field staff, is a dummy variable representing the existence of Florida Department of Citrus field staff who worked with retailers and food service providers to promote Florida citrus. Since March 2001, field staff has largely been eliminated.

PCINC, per-capita personal disposable income, represents monthly income less taxes; to account for inflation, aggregate personal disposable income was deflated by the Consumer Price Index (Base Year = 1984) and then placed on a per-capita basis.

PCGAL_{t-1} is a dependent variable lagged by one period, representing per-capita purchases of orange juice made during the previous period. It is a measure of habit persistence, which allows for the effect of purchases in the previous period upon current demand for orange juice.

P2...P13 are seasonal dummy variables representing 13 four-week periods annually, with the first four weeks of January as the base reference.

Empirical Results

The demand equation was expressed in per-capita terms and followed a linear functional form. The resulting model (Table 2) explained over 96 percent of the variation in retail purchases, and all the

parameters had the expected signs—specifically, consumers' disposable income, lagged purchases, and the presence of field staff promoting orange juice consumption were positively related to juice purchases, while real price and diet media coverage were negatively related.

The relationship between per-capita purchases and purchases from the previous period were positive and significant, returning a coefficient of 0.64 and a t-statistic of 12.20. This is consistent with theories of consumer behavior that suggest consumer purchases are often strongly linked to habits and routines. The model results indicate similar behavior, i.e., that purchases of orange juice are based on habit and consumers who previously purchased orange juice are more likely to purchase orange juice again than are those consumers who have not previously purchased orange juice.

The relationship between purchases and price was negatively related and significant, resulting in a coefficient of -0.008. As expected, the findings from this model indicate that as the price per gallon of orange juice increases, per-capita purchases of orange juice decrease. This is consistent with standard demand theory in microeconomics, which postulates an inverse relationship between price and demand.

The relationship between purchases and diet media coverage was negatively related and significant, returning a coefficient of -0.0002. This suggests that as diet media coverage in newspapers topically related to low-carbohydrate diets including the Atkins and South Beach diets increased, purchases of orange juice decreased. These findings indicate that the stated hypotheses should not be rejected and that the relationship between purchases of orange juice and diet media coverage is significant. The importance of these findings is discussed in the next section of the paper.

The relationship between purchases and the dummy variable representing the existence of field staff was positively related and significant. This suggests that the existence of field staff who worked with retailers and food service in promoting Florida citrus and helped retailers in the area of merchandising positively and significantly affected purchases of orange juice. This also suggests that decreases in purchases of orange juice may be due in part to the elimination of field staff who aided in promotion and merchandising efforts of orange juice.

The relationship between purchases and dispos-

Table 2. Estimated Model Results of U.S. Per-Capita Orange Juice Demand.

Variable	Description	Parameter	Std. error	t-Statistic
Intercept		0.115	0.016	7.33
PCGAL1	Dependent variable (t - 1)	0.641	0.053	12.20
RP	Real price	-0.008	0.001	-5.79
PDINC	Disposable income	58.502	10.600	5.52
DC	Newspaper diet media coverage	-0.0002	0.0001	-3.14
ST	Field staff	0.004	0.001	3.60
P2	Period 2 dummy variable	-0.019	0.002	-10.24
P3	Period 3 dummy variable	-0.009	0.002	-6.45
P4	Period 4 dummy variable	-0.018	0.002	-10.39
P5	Period 5 dummy variable	-0.016	0.002	-9.79
P6	Period 6 dummy variable	-0.016	0.002	-8.14
P7	Period 7 dummy variable	-0.016	0.002	-7.40
P8	Period 8 dummy variable	-0.012	0.002	-5.00
P9	Period 9 dummy variable	-0.008	0.002	-4.41
P10	Period 10 dummy variable	-0.008	0.002	-4.45
P11	Period 11 dummy variable	-0.011	0.002	-6.48
P12	Period 12 dummy variable	-0.008	0.002	-4.77
P13	Period 13 dummy variable	-0.006	0.001	-4.32
Total R ²	0.9649			
Regress R ²	0.9649			
Durbin-h	0.5641			
Pr > h	0.2864			

able per-capita income was positively related and significant, returning a coefficient of 58.502. This result indicates that orange juice is a “normal good” and corresponds with economic theory indicating that the consumption of normal goods juice increases with household income.

Finally, the relationship between the seasonal dummy variables, which represented the 13 four-week periods each year, and the dependent variable were all negative and significant. This suggests that demand for orange juice is highest during the first four-week period of each year. Though no direct link to theory necessarily predicts this outcome, orange juice consumption being at its peak demand during the height of winter (and perhaps winter cold season) is a plausible finding to the authors.

Elasticity at the Means for U.S. Orange Juice Demand

To determine the price, income, and information elasticities, the mean average of each variable was calculated. Those values and the measurements of elasticity for each variable are displayed in Table 3.

The price elasticity for orange juice is -0.24 , which indicates that as the price per gallon increases, demand for orange juice decreases. Since the absolute value of the price elasticity is less than 1.0, price elasticity is inelastic; indicating that price (at least within the price ranges observed) has a relatively small impact on demand.

The income elasticity is 0.14, which indicates

Table 3. Elasticity at the Mean for Price, Income, and Diet Media Coverage in the Model for U.S. Orange Juice Demand.

	Elasticity
Price (per gallon)	-0.241
Income (per capita)	0.143
Diet media coverage	-0.004

that as per-capita discretionary income increases, per-capita purchases increase. Since the elasticity is positive but less than 1.0, orange juice is classified as a normal necessity, which indicates that demand is not sensitive to changes in income (i.e., most likely there is a limited need to consume additional quantities of orange juice as income increases).

The elasticity of diet media coverage is -0.004 . This measurement of elasticity indicates an inverse relationship between diet media coverage and per-capita purchases of orange juice. It also indicates that the frequency of newspaper articles relating to low-carbohydrate diets has a relatively small effect on demand.

Research Implications

This study has examined the effect that recent trends in dieting have had upon purchases of orange juice in the United States and highlights three major issues: the impact of diet trends upon agricultural industries, the relationship between media coverage and a cultural phenomenon such as a dieting trend, and the use of content analysis as a tool to measure information and its potential impact upon demand for food products.

This research provides evidence that agricultural industries can be significantly impacted by societal phenomena like dieting and media coverage of diet trends. That may seem self-evident, but there are benefits to be gained from more fully understanding the processes that link changes in consumer demand to these societal phenomena. By identifying media coverage as a possible metric of changing demand (causation, a separate issue, is discussed below), the monitoring of media coverage becomes an “early warning system” for agricultural industries, allowing them to anticipate decreases (or increases) in demand for their products.

With obesity becoming an even greater concern for Americans, the popularity of diets and dieting is likely to increase, as will the potential for dieting trends to affect purchasing decisions and eating habits. Diets and dieting will continue to be an issue of interest within the agriculture sector, although the industries affected by a dieting trend may change as diet trends rise and fall in popularity. Understanding how information about dieting trends is accessed and applied by consumers will help affected agricultural industries in dealing with demand impacts of dieting trends. For example, industries may determine that rather than investing time and money in product development to meet constantly shifting consumer nutritional perceptions and demands, resources could be directed toward public-relations efforts to lessen the effect that even temporary shifts in consumer nutritional perceptions and demand might have upon a particular food product.

A second issue related to this research is whether media coverage mirrors, or creates, a cultural phenomenon such as the low-carbohydrate dieting trend. In other words, is there causation? Diet media coverage in this study (in terms of article counts) was considered a measure of the media’s influence in setting an agenda about weight loss and dieting—the media propelled changes in consumer demand. Alternatively, frequency of diet media coverage may only reflect societal norms, with media producers writing about observed trends. Simply stated, it is conceivable that in the context of this research, low-carb diet trends drove media coverage, and that change in consumer demand for orange juice simply correlates with increased frequencies of media coverage. Further research would be needed to establish the direction of causation. But even if dieting drove media coverage, agricultural industries could still track media coverage as a means to monitor changing consumer preferences

and use that information for planning purposes.

A third issue related to this research is whether or not content analysis is a useful method for measuring information and its potential impact upon evolving market trends and consumer tastes and preferences. Content analysis is an objective, systematic, and quantitative method to describe the content of any given communication. Its aim is to measure common words, tone, and/or sources of content to predict receiver or audience responses to a message. Types of messages that can be analyzed include written text, transcribed speech, verbal interactions, visual images, sound events, and even non-verbal behaviors. Given the findings of this research, the authors believe that content analysis has great potential as a research method for agricultural economists and others interested in anticipating consumer demand for particular food products.

Suggestions for Future Research

Identifying the next dieting trend is difficult and never certain. Although many nutritionists seem to indicate that consumers will become increasingly interested in the levels of saturated and unsaturated fats in foods, it is possible that the next dieting trend will be an extension of the low-carbohydrate dieting trend and be based on the effect that sugars have upon blood-sugar levels. This effect is known as the Glycemic index and is a component of the South Beach diet. An increased interest in the Glycemic index and the South Beach diet may continue the low-carbohydrate dieting trend.

Considering the impact that these or other future dieting trends may have upon various agriculture industries, further analysis of additional newspaper and magazine sources or other sources of diet media coverage may better define the life-cycle of a diet and consequently help affected agricultural industries to quickly respond to shifts in consumer purchase habits. Further research could also include confirmation that media can negatively affect purchases of food products, especially diet media coverage.

Understanding how consumers' access, process, and respond to diet and health information are other areas of potential future research. Of particular interest would be determining how consumer nutritional perceptions are translated from various diet media coverage sources and whether or not health

motivation is related to the frequency and magnitude of diet media coverage. As consumers access and apply diet information from various sources to their purchasing decisions, understanding how that accessed information is then translated into purchase decisions and eating habits will help agricultural industries understand the link between information and consumer demand. Such an understanding would help industries better respond not only to dieting trends but to general shifts in consumer tastes and preferences.

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