A Meta-Analysis of Weather on Consumption

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Abstract

Weather plays a significant role in people's daily lives, shaping their behaviors and decisions. Its influence on consumption has been widely examined. However, existing findings remain inconsistent and often lack clear conceptual definitions. To address these issues, this paper conducts a meta-analysis. We investigate 140 effect sizes (18,299 unique participants) from 26 experimental studies, examining five moderators: weather type, time, consumption outcomes, culture, and product type.

Findings reveal that favorable weather influence consumption stronger than unfavorable weather, and this effect exhibits high heterogeneity. The non-significant results for weather types indicate that simulated weather produces effects comparable to ambient weather. Actual consumption and individualistic cultures amplify the main effect of weather, whereas predicted weather and consumption intentions weaken it. Furthermore, product category (food vs. non-food) does not moderate the effect but interact with consumption outcomes and cultural differences. These results explain the inconsistencies and provides a theoretical foundation for marketers.

Keywords: weather, consumer behavior, meta-analysis

Track: Consumer Behaviour

1. Introduction

1.1 Background

Weather shapes people's daily behavior and is widely treated as a decision relevant variable across numerous fields. In finance, for instance, extensive research links weather conditions to stock market volatility (Jiang and Kang, 2024). In management, studies show that temperature and heat stress can affect leaders' judgment and decision quality (Escobar Carias et al., 2024). Economic research documents relationships between weather, productivity shocks, and broader market dynamics (Letta and Tol, 2019). Across disciplines, evidence suggests that weather is not merely a "background" phenomenon, but an environmental factor that can shift preferences, constraints, and behavior.

Within marketing, scholars have increasingly examined how meteorological factors influence consumer behavior (see e.g. Park and Hadi, 2020; Schlager et al., 2020). Prior work suggests that weather affects both physiological responses and purchasing choices (Keleş, Gómez-Acevedo and Shaikh, 2018; Sawka et al., 2012). In parallel, firms are integrating weather-related signals into their marketing activities. Organizers of sporting events, theme parks, and music festivals account for weather when setting ticket prices and forecasting sales (Wilmink-Thomas, 2021), while companies such as Molson Coors Brewing have partnered with platforms like Facebook to deliver targeted mobile advertisements based on real-time weather conditions (Grewal et al., 2016).

1.2 Research gaps and objectives

Despite this growing body of work, significant inconsistencies remain in the findings. Approximately 55% of the studies report a positive effect of favorable weather on consumption, whereas the remaining 45% report a negative effect (see Table 1). Several studies report that sunny, warm weather enhances consumers' perceptions of products, increases purchase intention, and elevates their valuation of product worth (Murray et al., 2010; Zwebner et al., 2014). Yet other research presents contradictory evidence. Govind et al. (2014), for instance, found that inclement weather was associated with increased sales of tobacco and alcohol, while sunny, warm conditions yielded the opposite effect. These inconsistencies have constrained theoretical development, making it difficult to intuitively

understand how different weather conditions influence consumption and why effects vary so significantly across studies.

Table 1. Prior study's effect directions

Effect direction	Number of effects	Percentage
Favorable weather is associated with higher consumption	k=77	55%
Unfavorable weather is associated with higher consumption	k=63	45%

One contributing factor to these discrepancies may be the varied conceptualizations and operationalizations of "weather effects." Indeed, the very notion of what constitutes "weather" remains under-theorized. No unified framework currently exists to document or categorize the diverse meteorological variables, such as sunlight (brightness), temperature, precipitation into a single framework that accounts for their distinct influences on consumer behavior. This conceptual ambiguity leads us to our central research question, what is the effect of weather on consumer behavior, and how can weather be systematically conceptualized to better understand its multifaceted influence?

2. Concept overview

Kotler (1973) pioneered the introduction of the environmental ambiance concept into marketing, proposing that external physical environments (such as temperature) can directly impact consumer behavior through sensory perception. However, subsequent studies exhibit significant variations in defining "weather." Most studies have followed traditional approaches, defining weather using raw descriptive labels such as "sunny," "rainy," "warm," or "cold." While these labels facilitate experimental operations, they complicate cross-study comparisons.

This study constructs a classification framework for favorable and unfavorable weather based on previous research manipulations. Rind and Strohmetz (2001) explicitly categorize clear skies as favorable and rainy/cloudy days as unfavorable. Moreno (2010) further refines this classification, noting that rainfall is the most negatively evaluated weather attribute, followed by temperature extremes, strong winds, and overcast skies. This evidence indicates

that for broad research designs, clear skies and warmth serve as primary bases for favorable weather condition manipulations. These include not only actual clear and warm conditions but also simulated ones through semantic and visual imagery. Conversely, weather factors associated with rainfall, cold, heat, or severe conditions form the basis for adverse weather manipulations. Such factors inhibit positive emotion generation and may foster negative emotions through unpleasant experiences. Even unfavorable weather forecasts learned through reading textual reports can induce negative emotions (Ho et al., 2024).

This study identified several moderating variables that may influence the weather effect. The conceptual model is illustrated in Figure 1. Different types of weather cues (environmental cues versus psychological cues) may introduce research biases. Additionally, time orientation (predicted versus actual weather) may yield different outcomes due to varying psychological complexities. Third, contextual factors—such as product attributes (food vs. non-food) and cultural (individualism vs. collectivism) —influence pathways through which weather affects consumer behavior. Fourth, methodological differences may also moderate outcomes, such as sample composition (student groups vs. other groups) and experimental design (between-subjects vs. within-subjects/mixed designs).

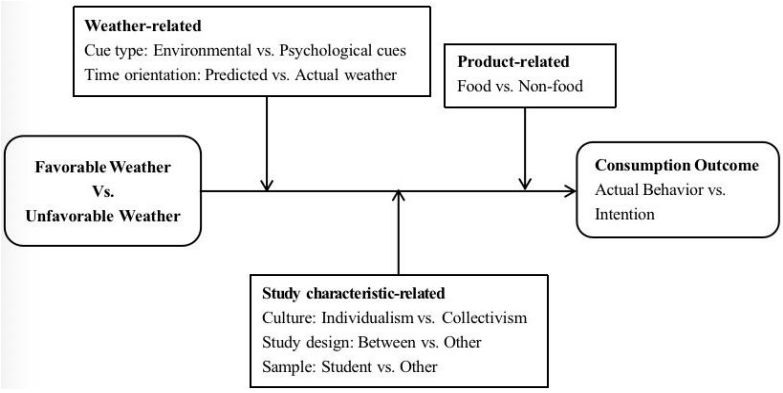

Figure 1. conceptual model

3. Reseearch methodology

This study uses a meta-analytic approach to systematically synthesize prior empirical research on how weather influences consumer behavior. To identify studies exploring the relationship between weather and consumption, we conducted an extensive literature search.

Data collection commenced in April 2024 and concluded in July 2025, resulting in a total of 319 published and unpublished studies. It includes 26 studies and 18,299 independent observations.

To ensure the validity of studies included in this meta-analysis, we screened the retrieved articles against predefined inclusion criteria. The PRISMA search flow is outlined in Figure 2. And we propose a set of coding methods for moderators, with detailed classification criteria and relevant examples presented in Table 2.

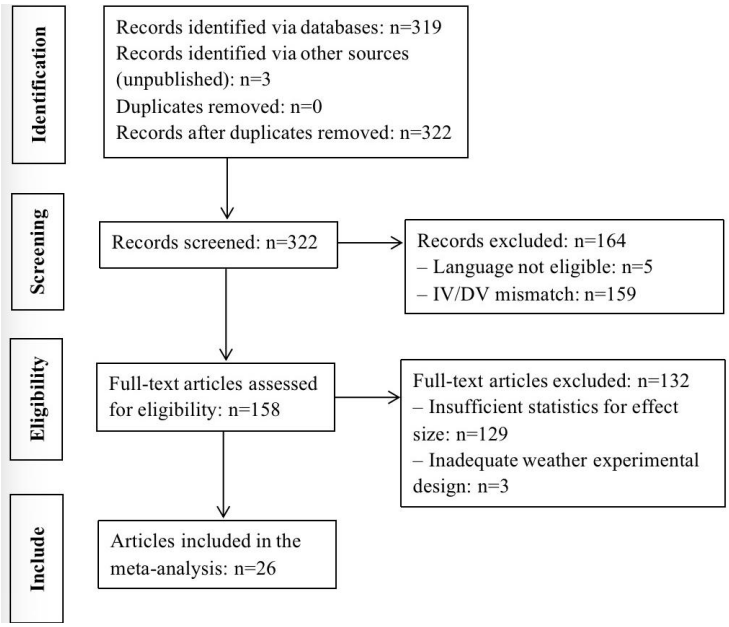

Figure 2. PRISMA search flow

Table 2. Moderator table

Variable	Description	Dummy Coding	Rationale
Weather			
Cue type	Whether the independent variable (weather factor) in the experiment is an environmental cue or psychological cue.	1=Psychological cue 0=Environmental cue	E.g. Rai et al. (2017) manipulated weather as temperature conveyed by picture (Psychological cue). Hong and Sun (2012) manipulated weather as ambient temperature (Environmental cue).

Time Orientation	Whether the weather factor in the experiment was predicted or actual.	1=Prospective 0=Present	E.g. Ho et al (2024) manipulated weather as imaging the next few days will be stormy (Predicted). Schlager et al. (2020) manipulated weather variable as current ambient sunlight (Actual).
Outcome			
Consumption outcome	Whether the outcome is a measure of actual behavior or intention.	1=Intention 0=Real behavior	E.g. Hadi and Block (2019) asked participants to report their willingness to pay insurance (Intention). Govind et al. (2020) required participants to select gift cards and use them (Actual behavior).
Product			
Food	Whether the product in the experiment was food or non-food.	1=Food 0=Non-food	E.g. Lin and Kuo (2019) conducted an experiment on juice (Food). Govind et al. (2020) conducted an experiment on hedonic gift card (Non-food).
Study characteristics			
Culture	Indicating the country's cultural orientation as individualistic or collectivistic.	1= Individualistic 0=Collectivistic	E.g. the country of Sinha and Bagchi (2019)'s study is American (Individualistic). The country of Hong and Sun (2012)'s study is China (Collectivistic).
Design	Whether the experimental design is between groups or other (within groups, mixed).	1=Between 0=other	E.g. Van Acker et al. (2016) used a between subject experimental design (Between). Sinha and Bagchi (2019) used a mixed experimental design (Other).
Student	Whether participants are students or not.	1= Student 0=other	E.g. the participants in Lundberg and Chavez (2025) were all university students (Student). Park and Hadi (2020) recruited participants through Mturk (Other).

4. Findings and discussion

The analysis results indicate that favorable weather conditions have a significantly greater stimulating effect on consumption than adverse weather conditions, and this effect exhibits high heterogeneity (see Table 3). Meta-regression results indicate that this heterogeneity can be partially attributed to time orientation, outcome type, and cultural context (see Table 4). The weather effect weakens when the informational focus is on prediction rather than current conditions, and when outcomes capture intentions rather than actual behavior. Conversely, in individualistic cultural settings, the weather effect is stronger than in collectivist cultural settings. This indicates that the impact difference between simulated weather and physical environmental weather is not significant.

Furthermore, this study identified two significant interaction effects. First, the outcome × product type interaction indicates that the strength of the weather effect depends on the specific combination of outcome type and product typey, rather than on either factor alone. Weather significantly influences consumption intentions for food products and actual behavior for non-food products, while its impact on non-food intentions and food behavioral outcomes is weak. In other words, favorable weather markedly increases anticipated consumption of food items while simultaneously boosting actual consumption of non-food products.

Second, the culture × product category interaction indicates that cultural variations in the weather effect differ across product categories. The individualism-enhancing effect observed in moderator analyses primarily concentrates in the non-food domain. That is, for non-food consumption, weather effects are significantly stronger in individualistic cultural contexts than in collectivistic ones. However, this cultural difference largely disappears in food-related outcomes. In food contexts, favorable and unfavorable weather exhibit no systematic differences in their impact across cultural groups.

Collectively, these findings suggest that weather's influence on consumer behavior is inconsistent. Its impact depends not only on the time orientation of weather information and cultural context but also on the characteristics of the consumption object, the interactions among various factors, and whether the observed outcome is consumption intention or actual behavior.

Table 3. Results of Heterogeneity Test and Publication bias

k	d (SE)	p	95% CI	Q	τ^2	I^2
140	0.11 (0.05)	0.01	[0.02; 0.20]	911.51***	0.24 (0.03)	88.36%

Note: k = number of effect sizes; d = estimated Cohen's *d*; SE = standard error; 95% CI = 95% confidence interval; Q = Q-statistic; τ^2 = estimated amount of total heterogeneity; I^2 = total heterogeneity / total variability

. = p < 0.10; * = p < 0.05; ** = p < 0.01; *** = p < 0.001.

Table 4. Results of the mate-regression model

	k	N	β	SE	CI 95%	Pred. values
Intercept			1.00*	0.44	[0.14; 1.87]	
Cue type: psychological cue	80	12771	-0.09	0.12	[-0.32; 0.14]	0.07 [-0.06; 0.20]
Cue type: environmental cue	60	5528				0.16 [0.01; 0.32]
Predicted versus actual: predicted weather	10	1802	-0.39*	0.18	[-0.74; -0.05]	-0.25 [-0.58; 0.07]
Predicted versus actual: actual weather	130	16497				0.14 [0.05; 0.22]
Outcome: intention	115	15389	-0.39**	0.13	[-0.65; -0.13]	0.04 [-0.05; 0.13]
Outcome: actual behavior	25	2910				0.43 [0.20; 0.66]
Culture: Individualism	118	16409	0.32.	0.16	[0.00; 0.63]	0.16 [0.07; 0.26]
Culture: Collectivistic	22	1890				-0.15 [-0.44; 0.13]
Food versus non-food: food	66	10192	-0.10	0.30	[-0.69; 0.49]	0.06 [-0.27; 0.38]
Food versus non-food: non-food	74	8107				0.16 [-0.13; 0.45]
Design: between	138	18159	-0.77*	0.37	[-1.50; -0.05]	0.10 [0.02; 0.18]
Design: within/mixed	2	140				0.87 [0.15; 1.60]
Sample: student	89	10463	0.05	0.11	[-0.16; 0.26]	0.13 [0.02; 0.24]
Sample: others	51	7836				0.08 [-0.08; 0.23]
Intention x. food	61	9861	0.73*	0.37	[0.01; 1.45]	0.40 [0.08; 0.71]
Intention x. non-food	54	5528				0.06 [-0.08; 0.20]
Actual behavior x. food	5	331				0.05 [-0.47; 0.58]
Actual behavior x. non-food	20	2579				0.46 [0.24; 0.67]
Individualism x. food	57	9406	-0.73*	0.31	[-1.32; -0.13]	-0.32 [-0.74; 0.09]
Individualism x. non-food	61	7003				0.18 [0.05; 0.32]
Collectivistic x. food	9	786				0.09 [-0.28; 0.45]
Collectivistic x.	13	1104				-0.13 [-0.42; 0.16]

non-food

Note: k = number of effect sizes; N = sample size; β = beta co-efficient; SE = standard error; 95% CI = 95% confidence interval; Pred. value=predicted mean Cohen's d, 95% confidence interval
. = p < 0.10; * = p < 0.05; ** = p < 0.01; *** = p < 0.001.

5. Conclusion

This study refines the conceptualization of weather in marketing and establishes a classification framework for favorable and unfavorable weather. While preserving the original research methodology, we validate multiple potential influencing factors—weather cue type, time orientation, consumption outcomes, cultural differences, and product type. Several boundary factors also demonstrate significant moderating effects, helping to explain inconsistencies observed in prior research. Furthermore, we provide preliminary evidence of interactions between product category (food vs. non-food) and consumption outcomes/cultural differences, offering new perspectives for future research in this field. Together, these findings provide a theoretical foundation and fresh insights for researchers and marketers exploring the practical effects of weather on consumption.

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