

Introducing Cultural Entropy as a Framework for Understanding Cultural Tourism

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This paper explores cultural entropy as a novel framework for understanding cultural tourism. It examines how increasing cultural complexity impacts authenticity, sustainability, and accessibility, highlighting strategies to manage uncertainty in cultural interactions. Using a simple model that relates a tourist's utility to their capacity for cultural entropy and the carry cost in entropy of multiple cultural competencies, an optimal number of cultural alternatives is deduced based on their relative preference between the number of alternatives and cognitive space to savor them. Future research into managing entropy as it relates to tourist impact on cultural homogenization, heritage conservation and visitor engagement are suggested.

Keywords: entropy, internal environment, cognitive space, carry cost, culture

INTRODUCTION

Cultural tourism is generally defined as a type of travel motivated by the desire to experience and engage with a destination's heritage, traditions, arts, and ways of life. It is one of the fastest-growing segments of the global tourism industry. It encompasses various activities, including visiting historical sites, participating in cultural festivals, engaging in artistic performances, and experiencing local customs. According to the United Nations World Tourism Organization (UNWTO, 2023), cultural tourism accounts for a significant share of international travel, with millions of tourists seeking meaningful and immersive cultural experiences each year. Cultural tourism research has grown rapidly in fields such as cultural consumption, cultural motivations, heritage conservation, cultural tourism economics, anthropology, and the relationship with the creative economy (Richards, 2018).

Cultural tourism is also crucial in promoting cross-cultural understanding, supporting local economies, and preserving both intangible and tangible heritage. It is a key driver for sustainable development, offering destination communities opportunities to showcase their identities while generating revenue through responsible tourism practices. However, the growing demand for cultural experiences also challenges authenticity, sustainability, and accessibility (Lexhagen, Ziakas, & Lundberg, 2022).

Cultural tourism operates within an entropic system, where visitors and hosts exchange cultural information through various interfaces, such as language, symbols, rituals, performances, and artifacts. This study aims to introduce cultural entropy as a lens to analyze cultural tourism. Using this proposed framework, we can better understand how stakeholders manage uncertainty, negotiate authenticity, and

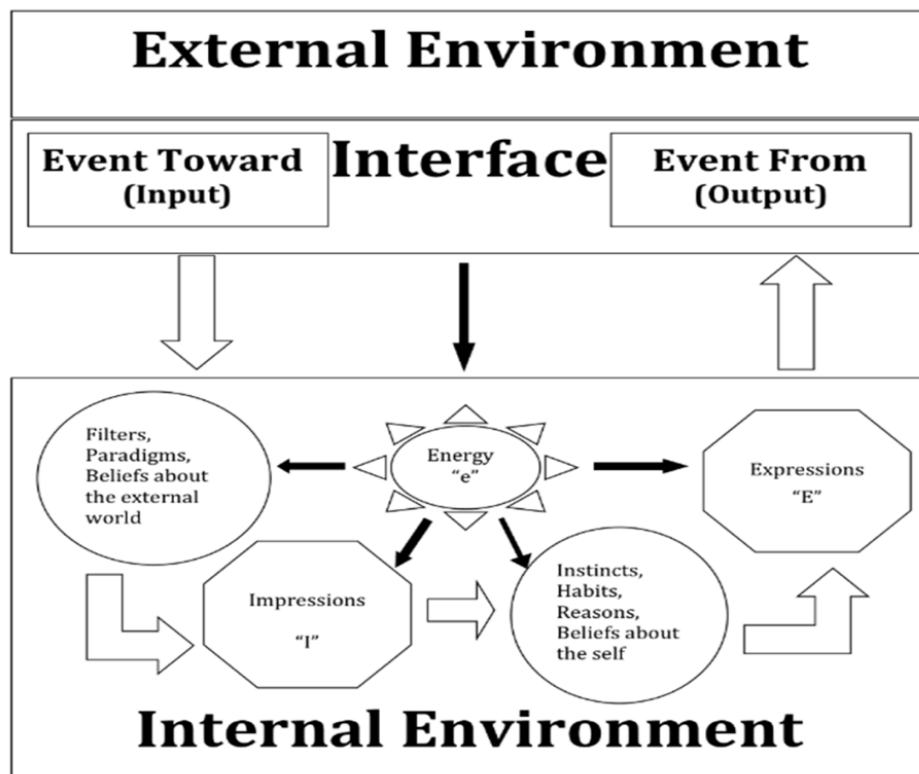
shape visitor experiences in a constantly evolving tourism landscape and how to analyze the complexities of cultural tourism.

CULTURAL ENTROPY

Entropy, originally a concept in thermodynamics and physics, refers to the measure of disorder or randomness in a system, which decreases the available energy to do work. In information theory, entropy represents the level of uncertainty or unpredictability in a dataset (Shannon, 1948). The greater the number of possible states a system can exist in, the higher the entropy. Entropy quantifies the average level of uncertainty of information. Shannon describes a data communication system composed of a source of data, a communication channel, and a receiver.

We can conceive of an individual’s internal environment (the receiver) existing within an external environment (the source of data) that is mediated through an interface (the data communication system). The specifics of the interface (symbols, objects, mediums of exchange, etc.) are an expression format of the cultural milieu. Figure 1 represents how we try to understand the concept of cultural entropy in terms of processing events and experiences.

**FIGURE 1
INTERNAL/EXTERNAL ENVIRONMENTS AND INTERFACE**



In the context of culture, entropy can be used to analyze the diversity, fluidity, and unpredictability of cultural exchanges. Cultural entropy refers to the level of disorder, unpredictability, and information overload in cultural interactions, particularly with respect to meaning of objects. (McDonell, 2014) In multi-cultural or tourism-driven environments, this can also be understood as the psychological/informational cost of cultural literacy required for a meaningful or worthwhile experience. A low-entropy cultural environment is one in which meanings, traditions, and social norms are well-defined and stable. In contrast,

a high-entropy environment is characterized by rapid cultural shifts, multiple competing interpretations, and increased uncertainty in active interactions.

When we interact in society, we make tacit assumptions about meanings, definitions and values. For example, in Hong Kong, traffic drives on the left side of the road, whereas in New York, it is on the right side. If you drive on the left side, the first culture will not express much about your driving, while the second will pay close attention and yell at you, as it is now perceived as very dangerous. Entropy would represent a measure of the expected surprise (i.e., potential misunderstanding) of their cultural state. In a monoculture, the probability is 1 for knowing the person's culture, and the entropy is 0. In a world with zero cultural entropy, an individual minimizes the cognitive costs of discerning what other people are communicating and/or how they intend to act. This provides greater energy and resources for actions and experiences at that moment. As the number of equally represented cultures increases, entropy increases. Note that entropy only captures uncertainty. As in our example above, the cost or losses associated with getting the cultural signals incorrect can be great indeed.

Individuals have a finite capacity to hold entropy (Keshmiri, 2020). This limit arises from our physical and social nature. Recognizing this can be useful when considering various proposals for responding to society's challenges. Over time, as an individual faces increasing numbers of alternative cultural states, the implied entropy can exceed capacity. What might we expect to happen? Based on Axelrod (2017) one reaction would be to start ignoring alternatives. One reduces entropy by reducing the number of small probability alternatives through grouping those together as an "all other" state. It is a type of "othering" that is unavoidable when faced with so many alternative cultures that there is no bandwidth to make decisions, choices, and actions. This relates to bandwidth optimization in neuroscience (Shimazaki and Shinomoto, 2010). If autonomy is to be preserved and dysfunction avoided, the individual at their limits will collapse multiple alternatives into a smaller set (Churchland, 2008). The issue here is the capacity to respond to the world, not necessarily wanting to disrespect others. It serves as a reminder that understanding a person's state of mind requires knowledge of their preferences for outcomes and experiences, as well as their limitations in expressing them.

Another way to interpret the limits individuals face is as a "carry cost" of cultural appreciation. The importance of carry cost for financial investments is well researched (Fung, Hsieh, and Leitner, 1993). Whereas pure exploration, or travel as a novel experience, might benefit from less preparation, tourism as an industry benefits from clients being more prepared to enjoy their experiences. This can occur through training, education, and other means of cultural exchange, similar to how wine tasting can increase demand for a particular brand of wine. However, this knowledge requires mental efforts to carry these cultural appreciations, so that they are accessible at the moment a tourist experiences an event. With an increasing number there is also the potential for confounding.

Cultural Entropy in Tourism

Cultural entropy presents both opportunities and challenges for the development of tourism. On the positive side, high cultural entropy fosters innovation, diversity, and dynamic cultural evolution. Destinations with high cultural entropy, such as cosmopolitan cities or heritage sites influenced by multiple civilizations, often offer rich, multi-layered experiences that appeal to international travelers seeking diverse cultural engagement. These environments encourage cultural fusion, cross-cultural dialogues, and the continuous reinvention of traditions to meet contemporary tourism demands (Richards, 2018).

On the other side, excessive cultural entropy can create barriers to meaningful engagement. A high level of cultural complexity and unpredictability may lead to miscommunication, cultural misunderstandings, and a sense of disconnection between tourists and host communities. Without effective mediation, such as guided storytelling, structured interpretation, or technological aids, tourists may struggle to grasp the deeper cultural significance of their experiences and reduce their engagement to a superficial consumption of cultural symbols and products.

As destinations increasingly cater to diverse audiences, the complexity of cultural exchange grows, leading to more significant variability in how we understand and experience cultural norms and symbols. Unmanaged cultural entropy can contribute to the erosion of local cultural identity as destinations modify

or oversimplify traditions to accommodate global tourism markets, leading to homogenization and the loss of unique cultural expressions (Smith, 2016).

Tourists and host communities need to navigate multiple layers of cultural meaning, often shaped by personal, historical, and societal contexts. This complexity is further amplified by differing interpretations of authenticity and heritage among stakeholders, including local communities, tourism operators, and policymakers (Cohen, 1988; Wang, 1999). The challenge for tourism destinations lies in constant adaptation as they engage with an evolving mix of visitors who bring different expectations, cultural backgrounds, and familiarity with local traditions (McKercher & du Cros, 2002).

A CULTURAL ENTROPY MODEL

The success of tourism is dependent on both the cost to supply and demand for tourist experiences. Advances in technology permit greater customization of production, an example being laptops. Customization increases the value to the consumer. If that increase is greater than the marginal cost of the customization, we would expect producers to provide it. Moreover, a product that can be readily consumed, as it works similarly to what a consumer is accustomed to, also tends to support demand for that product. In terms of tourism, the above shows up by providing travelers customizable itineraries (like optional sites), as well as increased standardization of tourist nodes (seen in the growing ubiquity of franchises). This presents a balancing act between the greater potential utility of having a larger feasible alternative set and the increased psychological and financial costs of maintaining these alternatives. The following is a variant of a model developed by Axelrod (2019).

We can imagine a tourist with a preference for a greater number of alternative cultural paths to choose from (N), as well as the cognitive space to savor them. The individual tourist has a constraining capacity of cultural entropy (H_c). Some is used toward the "carry cost" of cultural literacy, quantified as the entropy ($H(N)$) associated with the N paths. The remainder ($H_c - H$) is the space available to savor the path that is chosen. We represent these preferences using the following utility function:

$$U(N;H_c) = N^\beta * (H_c - H(N))^\gamma \quad (1)$$

The first order necessary condition for utility maximization is derived as follows,

$$dU/dN = [\beta N^{\beta-1} * (H_c - H(N))^\gamma] + [\gamma * N^\beta * (H_c - H(N))^{\gamma-1} * -dH/dN] \quad (2)$$

By assuming the greatest entropy associated with N paths as its carry cost, we get $H(N) = \ln(N)$. This implies that $dH/dN = 1/N$. Making this substitution, and setting the first derivative to 0, we get:

$$[\beta N^{\beta-1} * (H_c - H(N))^\gamma] - [\gamma * N^{\beta-1} * (H_c - H(N))^{\gamma-1}] = 0 \quad (3)$$

Solving for N , we get:

$$N = e^{H_c} * e^{(-\gamma/\beta)} \quad (4)$$

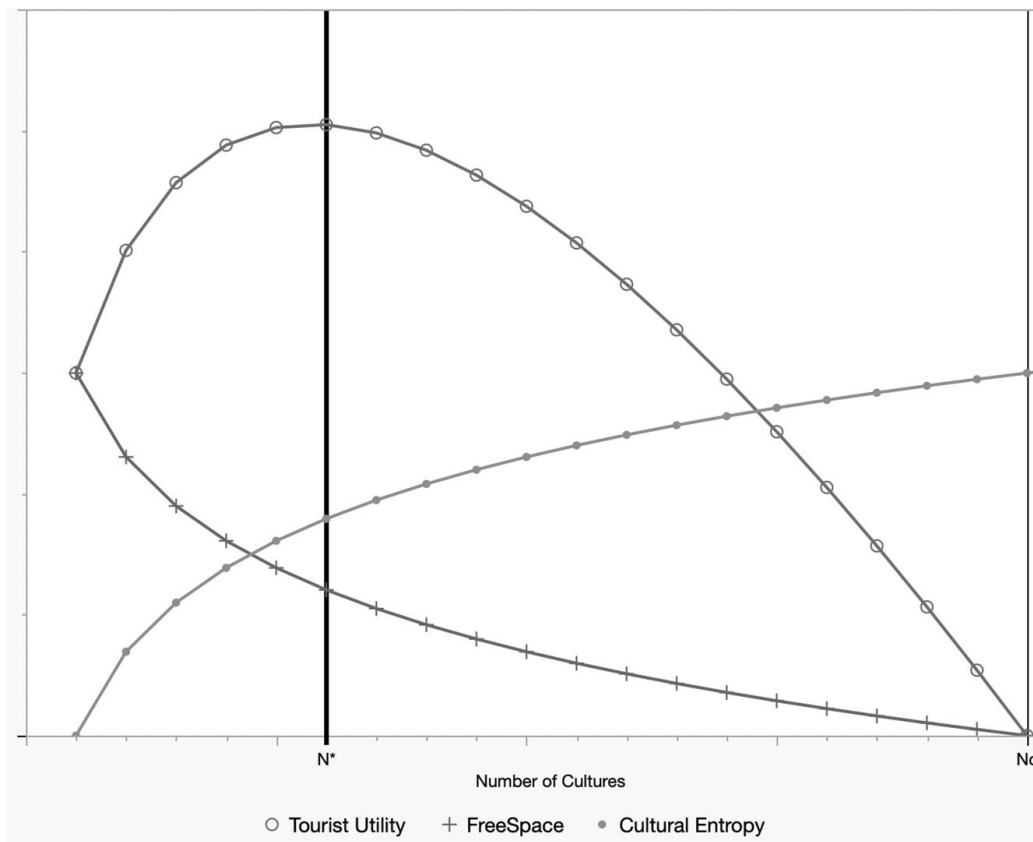
Notice that as the preference for savoring increases relative to having alternatives (i.e. $\gamma > \beta$), the optimal N *decreases*. Likewise, if having alternatives is a greater priority than savoring, the optimal N *increases*. We can also note that $\ln(H_c)$ is the lowest maximum paths (N_c) the tourist can carry, which implies that:

$$N = N_c * e^{(-\gamma/\beta)} \quad (5)$$

Figure 2 displays how utility, free space, and cultural entropy change as N increases. N^* represents the optimal number of culture alternatives relative to the tourist's preferences. The x-axis ends at N_c , where the tourist can no longer process their experiences.

While this is a very simplified, toy model, it gives us a useful insight. There is a trade-off between the number of cultures a tourist is willing to travel through and how deeply they can savor and appreciate each one as a distinct, indigenous culture. More sophisticated models can be developed in which the entropy capacity could change over time and with experiences, as well as the implications of savoring admixtures of cultures, as if there were only one global culture.

FIGURE 2
UTILITY, FREE SPACE, ENTROPY AND NUMBER OF CULTURAL ALTERNATIVES



APPLICATIONS AND FUTURE RESEARCH

Applying the cultural entropy model to the tourism context, helps to understand how cultural entropy shapes tourist experiences, destination management strategies, and the sustainability of cultural heritage. Three key questions can guide an inquiry: (1) How does cultural entropy influence tourist perceptions, engagement, and satisfaction? (2) How do tourism destinations manage cultural entropy to balance authenticity, accessibility, and sustainability? (3) Can cultural entropy explain cultural homogenization, othering, or commodification in tourism?

Future research should explore empirical applications of cultural entropy metrics in tourism studies and further refine the relationship between cultural diversity, visitor engagement, and heritage conservation. It can analyze cases from high- and low-entropy cultural destinations to explore answers to the key research questions. Such studies can aim to identify and highlight strategies for mitigating entropy-related

challenges, such as structured cultural storytelling, immersive guided experiences, interactive experiences, layered interpretation, AI-driven personalization, and other digital tools that provide real-time cultural context. Destinations that proactively manage entropy through these entropy-mitigating strategies can enhance cultural accessibility while preserving core heritage values.

CONCLUSION

The cultural entropy model is anticipated to offer a dynamic and adaptive lens for analyzing cultural tourism beyond traditional models and approaches. We expect it to contribute to the growing literature on cultural sustainability by providing a framework for understanding how tourism destinations navigate cultural complexity in an era of rapid globalization.

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