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McNair Special Issue



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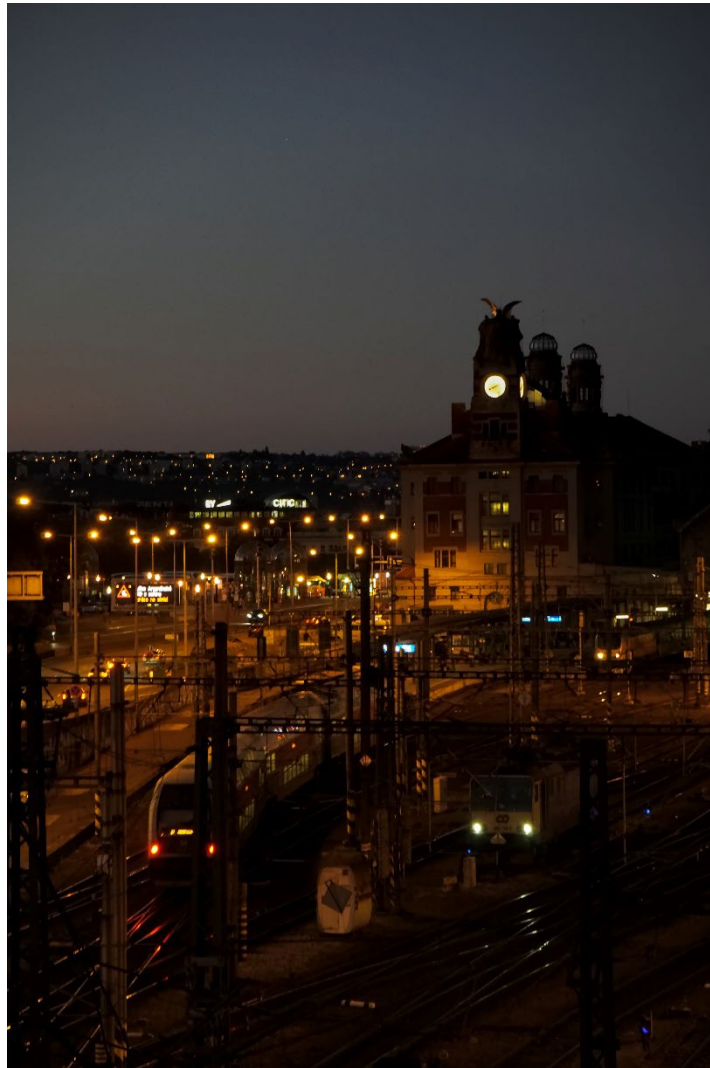
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Cover Art: “Prague Main Station”

Rowan Glass*

The main railway station of Prague, Czechia, photographed at dusk in early September 2023. This scene caught my eye for its interplay of light and texture, wherein the lights of one of the station's 600 daily trains reflect off a meshwork of steel rails as it pulls into the platform, and the glow of the station's historic clocktower shines bright against a darkening sky. Above, the last of the day's light gives way to impending night.

Medium: Digital photography, Sony a6400, FE 3.5-5.6/28-70. Edited in Darktable.



*Rowan Glass (rowan.ff.glass@gmail.com) graduated from the University of Oregon in Spring 2023 with a major in Cultural Anthropology and minors in Latin American Studies and History. A combination of lifelong wanderlust and academic research has taken Rowan far afield across Latin America, the former USSR, West Africa, and Europe. Aside from editing with OURJ, Rowan is engaged in long-term ethnographic fieldwork with the Kamëntšá people of the Sibundoy Valley, a unique crossroads between the Andes and the Amazon of southwest Colombia. Rowan's research in Colombia focuses on the Kamëntšá struggle for cultural survival and ecosovereignty over their ancestral territory. Similar themes animate Rowan's interest in subaltern resistance movements around the world; he interned with several NGOs in Senegal in the spring and will be filming a documentary with the Zapatistas of southern Mexico this winter. Rowan also enjoys photography, creative writing, and indie films.



Letter from the Editors: “What is a Special Issue?”

Kyla Schmitt,* Jay Taylor**

The returning reader may identify that there is something a little different about this issue of OURJ. As a journal and as an organization, we continually strive to increase OURJ’s interconnectedness with the various research-focused groups and institutions we share our spaces with on campus. This year, in partnership with the University of Oregon’s McNair Scholars Program, we mint the McNair Special Issue, functioning to strengthen OURJ’s role as a research facilitator on campus and deliver on our mission to serve the University of Oregon’s undergraduate community through tailored publication opportunities for underrepresented groups of scholars.

As we begin this new academic year, this inaugural Special Issue highlights the capstone research projects of members of the McNair Scholars cohort of 2023, whose pursuits span psychology, physics, cinema studies, and anthropology. McNair Scholars are first-generation and traditionally underrepresented college students seeking doctoral degrees in diverse areas of study. Through publishing with OURJ, they gain valuable experience and resume material, able to enter the next chapter of their academic careers with a publication (or two) already under their belts.

We are excited and honored to share in this Special Issue a selection of research and art crafted by four recently graduated McNair Scholars. We are grateful to have been a part of their scholarly development process, and we look forward to this new era of partnership between OURJ and the wonderful organizations—of which the McNair Scholars program is one—supporting undergraduate research on campus.

We hope that you enjoy this inaugural McNair Special Issue!

**Kyla Schmitt, Editor-in-Chief (Publications), is a rising junior majoring in Environmental Science and Humanities and minoring in English and Economics while pursuing a degree from the Clark Honors College. Kyla's academic interests include wildlife ecology, contemporary history, rhetorical writing, and behavioral economics. Her latest publication sought to characterize the health, behavior, and habitat preferences of Tryon Creek's native signal crayfish population. Beyond the classroom, Kyla coaches high-school forensics and competes in collegiate forensics, conducts field research with the Tryon Creek Watershed Council and the Sutherland Lab, and spends plenty of time outdoors.*

***Jay Taylor, Editor-in-Chief (Outreach Coordinator), is a senior at the UO majoring in Linguistics. They have served as the Financial Coordinator for the University of Oregon LGBTQA3 office and co-president of the UO Model United Nations club and now help lead the Board and Card Gamer's Association for Maximum Nerderly (BACGAMN). Jay discovered a strong interest in research when they presented on the topic of mental health in South Korea at the 2020 Oregon Undergraduate Research Symposium. Currently, their research examines autism in a new, non-clinical context. They are passionate about learning new languages and teaching, and they hope to make the world a better place through education for all ages and individuals, regardless of background. In their downtime, they enjoy video games, hiking, and playing board games with friends.*

Art Feature: “Our Pirogue—Snapshots of a Senegalese Fishing Community”

Rowan Glass*

(1) Dozens of Senegalese pirogues, traditional fishing boats, cluster at the edge of Guet N'Dar, a neighborhood of Saint-Louis, former colonial capital of French West Africa. In Guet N'Dar, as in most Senegalese coastal communities, fishing is the mainstay of the local economy.

(2) Most fishermen from Guet N'dar, like Babacar, spend much of their lives at sea. Sometimes they also lose them at sea; Guet N'dar is one of the main embarkment points in West Africa for clandestine migration to Europe. The same pirogues that are designed to hold crews of no more than a few dozen are frequently overburdened with over a hundred migrants. Babacar is a survivor of one such voyage.

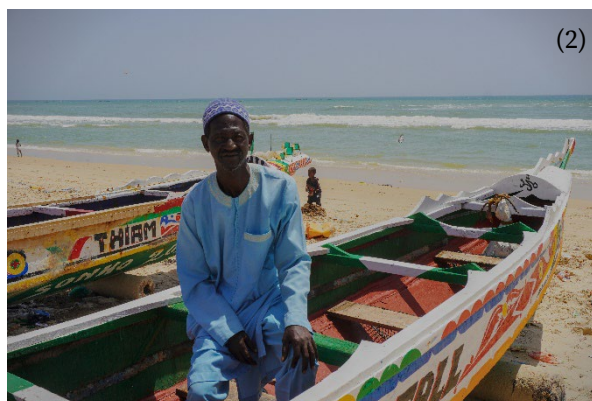
(3) A small fishing crew heads to sea to try their luck with the catch. Some fishing trips last hours, others days, some even for weeks. Increasingly, the fishermen come back empty-handed; the sea is losing its fish, they say.

(4) When a boat returns with its haul, local merchants—mostly women—flock to the banks to offer a competitive price. The shore is a constant flurry of back-and-forth, rapid-fire negotiations between buyers and sellers, each trying to snag the best deal.

(5) Once the fishermen have made the sale, the merchants head to the shipment depot. Here, men in tall rubber boots haul millet grass baskets full of fresh fish into refrigerated trucks bound for other cities.

(6) Of the fish that stay in Saint-Louis, some are destined for the luxurious colonial-era hotels where tourists stay during visits to the historic center of Saint-Louis. Here, the fish fetch prices far higher than most fishermen could afford. A bridge is all that separates the poverty of Guet N'Dar from the insular wealth of Saint-Louis.

Medium: Digital photography, Sony a6400, FE 3.5-5.6/28-70. Edited in Darktable.



*Rowan Glass (rowan.ff.glass@gmail.com) graduated from the University of Oregon in Spring 2023 with a major in Cultural Anthropology and minors in Latin American Studies and History. A combination of lifelong wanderlust and academic research has taken Rowan far afield across Latin America, the former USSR, West Africa, and Europe. Aside from editing with OURJ, Rowan is engaged in long-term ethnographic fieldwork with the Kamëntšá people of the Sibundoy Valley, a unique crossroads between the Andes and the Amazon of southwest Colombia. Rowan's research in Colombia focuses on the Kamëntšá struggle for cultural survival and ecosovereignty over their ancestral territory. Similar themes animate Rowan's interest in subaltern resistance movements around the world; he interned with several NGOs in Senegal in the spring and will be filming a documentary with the Zapatistas of southern Mexico this winter. Rowan also enjoys photography, creative writing, and indie films.



Comparing Verbal Descriptions of Image Memories with Natural Language Processing

Julian Gamez*

Abstract

A goal of memory research is to understand how the brain remembers similar events. Analyzing data from human subjects, we explore how competition between memories of images influences their recall by answering the question *Does studying images from similar or differently themed categories affect the verbal content used to describe them?* The competitive condition was composed of images from a single category (“Pond 1,” “Pond 2”), whereas the non-competitive condition was a set of images from different categories (“Pond 1,” “Library 1”). Specifically, we aimed to quantify how verbal memories of these images varied depending on the study condition. To quantify subjects’ verbal memories, we used natural language processing to map subjects’ descriptions of the images onto points in a high-dimensional “text embedding” space. We performed dimensionality reduction and clustering analyses on these text embeddings and found that semantic representations of images studied in the competitive condition were similarly differentiated compared with those in the non-competitive condition. Our results suggest that verbal memories of images were influenced by the similarity of subjects’ memories and that highly similar memories may push their respective representations away from one another.

1. Introduction

One of the main regions of interest involved in learning and memory is the hippocampus (Eichenbaum, 2000). Investigation of place cells in the rodent hippocampus has been able to demonstrate that perceived environmental differences can affect patterns of neural activity recorded in this brain region (Colgin et al., 2008). These patterns of activity are subject to sudden changes that come about when the rodent moves through space over time. It has also been shown that these patterns of neural activity can be affected by internal differences that reflect change due to experience (Bostock et al., 1991). The change in hippocampal neural activity tied to

the rodent’s movement and experience is referred to as “remapping.” Remapping highlights a connection between the reported differences in rodent hippocampal activity and the study of memory interference in humans. Since many events that a person might experience are likely to share similar physical features or have been presented at a common point in time, it is appealing to posit that interference between episodic memories, particularly highly similar memories, could be resolved through this process of hippocampal remapping.

In human subjects, remapping can also be thought of in terms of the “repulsion” that has been observed when similar memories

*Julian Gamez (jgamez@uoregon.edu) is graduating with a Bachelor of Science in Psychology and a minor in Entrepreneurship. Julian’s research project titled “Comparing Verbal Descriptions of Image Memories with Natural Language Processing” was mentored by UO Professors Dr. Brice Kuhl of Psychology and Dr. James Murray of Biology and Mathematics, as well as assisted by graduate student Anisha Babu of the Kuhl lab. He plans to attend continue research after graduation to further explore how neuroimaging and computational methods can be used to study learning and memory.

overlapping in representational space appear to move away from each other. In one behavioral experiment, subjects studied nearly identical images of objects paired with faces, with the colors of the objects serving as the independent variable (Chanales et al., 2021). This study found that subjects' "color memories" for objects sharing a high degree of color similarity were reported as being more different from one another than the objects' actual appearances would suggest. Repulsion among highly similar color memories was most pronounced in subjects who displayed the fewest interference errors during associative recall. This finding is consistent with the notion that interference between similar memories drives remapping and reduces interference.

Previous cognitive neuroscience research in humans has explored this prediction further using fMRI experiments to test recall (Favila et al., 2016; Wanjia et al., 2021). In one experimental paradigm, subjects studied paired images of similar objects and scenes (Wanjia et al., 2021). For example, one pairing might include the object "Guitar 1" and the scene "Lighthouse 1," whereas another pairing might be "Guitar 2" and "Lighthouse 2." Subjects were tasked with learning these associations over multiple pairing trials. During the testing phase, the scenes were presented to the subjects, where the subjects' goal was to correctly identify the object associated with the scene. Learning was defined to have occurred once subjects could verbally recall these associations with high confidence. The study found that changes in certain subregions of the hippocampus shared a correspondence with learning over time—something that has similarly been found in rodent experiments examining activity in those subfields (Lee et al., 2004). More specifically, memories that shared a high degree of similarity before learning had occurred displayed a greater decorrelation amongst their hippocampal representations after memory interference had been resolved.

Taken together, these findings suggest that

hippocampal representations of episodic memories that are very similar to one another become differentiated as their interference with one another is minimized across learning trials. Notably, this repulsion effect can be captured by the extent to which these similar representations shift according to a reduction in interference. Our data analysis here attempts to extend this research to verbal memories by investigating whether this repulsion effect occurs for verbal descriptions of similar images in different behavioral conditions by using natural language processing techniques to quantify the degree of similarity between descriptions of related versus unrelated images.

2. Methods

Our data analysis is based upon a study of 120 participants at the University of Oregon (Figure 1). After providing their consent to participate, subjects were asked to study six different categories of scenes ("Indoor Pool," "Library," "Downtown Street," "Soccer Stadium," "Ice Skating," or "Pond"), each containing six unique images. During the study phase of the experiment, subjects were presented with images from these categories paired with an image of a random human face (Figure 1a). Subjects in the baseline condition studied scenes belonging to different categories, whereas those in the competitive condition studied images belonging to the same category. During the testing phase, subjects' memories were measured by how well they could recall the scene associated with the presented face from the study phase (Figure 1b). Subjects were then asked to use at least ten words to verbalize their memory of the studied images in as much detail as possible.

Subjects' words and phrases were recorded as the verbal memory input, and a natural language processing (NLP) algorithm called MPNET was used to convert the verbal memories into numeric values representing how images were remembered by subjects during the testing phase

(Song et al., 2020). This process allowed us to code the different descriptions that subjects provided into a set of numbers that could help us analyze the language people used to communicate their memory of an image. This tool generated a quantitative representation of subjects' verbal memories of scenes by transforming words and phrases into a 768-length vector through a process known as a "text embedding." Each column of the dataset can be thought of as a "feature" value of the text embedding, with 768 features per image (Figure 1c). The feature values of the subjects' verbal memories across both conditions were pooled together to perform most of our analysis.

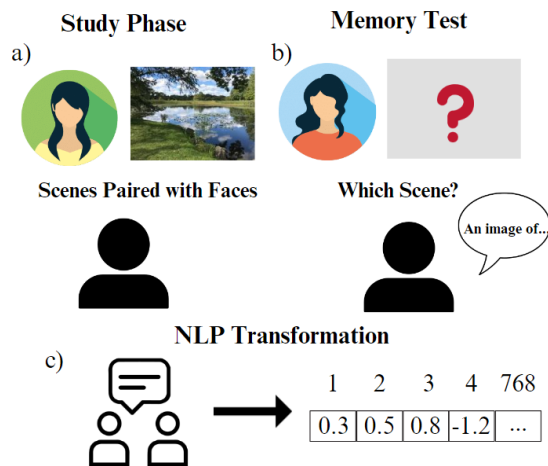


Figure 1. (a) Subjects studied images of scenes paired with a random human face. (b) Subjects' memories of scenes were tested when they were asked to remember and describe the correct scene that was associated with the face from the study phase. (c) The verbal descriptions of scenes from memory became transformed through the NLP MPNET model into numeric variables used to represent the meaning of the subjects' responses.

We normalized the dataset around a standard normal distribution with a mean of 0 and standard deviation of 1. After performing normalization on the dataset of verbal memories, we conducted principal components analysis (PCA) on the text embeddings to reduce the number of features—or dimensions—corresponding to the verbal memories of scenes. PCA is a mathematical technique that can help

improve interpretability of large datasets. Instead of using all 768 features created through the NLP transformation process, PCA allowed us to "compress" our dataset into its principal components. The principal components represent linear transformations of the text embeddings into unrelated variables that can be used to communicate the maximum amount of information about the verbal memories while reducing the number of overall features used to express the dataset. We were able to reduce the number of features from the initial 768-length vector generated by the NLP algorithm to six principal components and plotted the proportion of variance explained by each component in either condition.

After the PCA dimensionality reduction, we then used a k-means clustering algorithm to group verbal memory representations together based on their similarity. While PCA reduces the number of dimensions of the data to display it in a more concise way through the creation of principal components, k-means clustering attempts to represent the data in the form of the tightest clusters. The assignment of each data point to a cluster is determined by how far away the point is from the center of the cluster, with the objective of maintaining a tight cluster. We decided to use six clusters for our k-means clustering of the principal components by measuring the within-cluster sum of squares error to determine the point at which an increase in the number of clusters would provide diminishing returns for our analysis. We plotted the within-cluster sum of squares error found in either condition and created graphs containing subplots of the clustering results to compare baseline and competitive verbal memory representations in the PCA space.

3. Results

PCA dimensionality reduction on our dataset revealed a decline in the amount of variation amongst the text embeddings that could be

explained by each subsequent component following the fifth component (Figure 2). We found that five principal components could explain over half of the cumulative variance in the verbal descriptions (Figure 3). This supports the idea that dimensionality reduction can be used to explore the same data with fewer variables, improving the quality of visualization.

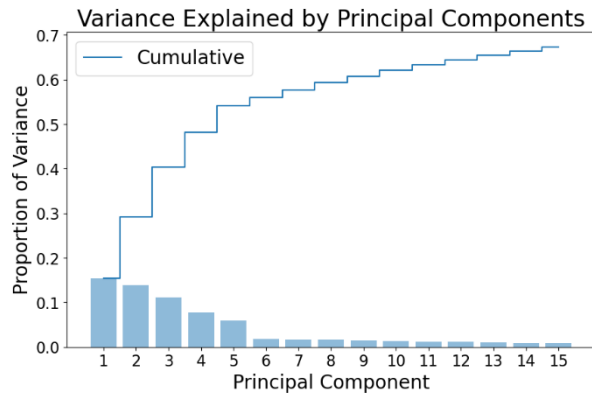


Figure 2. Proportion of variance captured by principal components constructed from the pooled set of text embeddings and plotted according to explained variance.

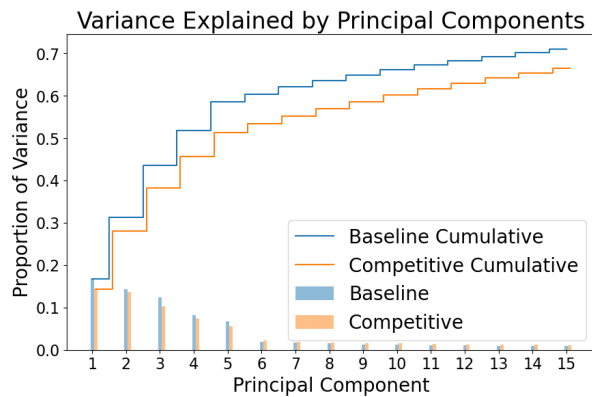


Figure 3. Proportion of variance captured by principal components constructed from data separated by condition and plotted according to explained variance.

Likewise, this result informed us that retaining more than five principal components to represent the information expressed by the text embeddings would only be marginally beneficial at capturing any additional information about the content of the verbal memories. Furthermore, to ensure that our k-means analysis would also be reflective of the most important information captured by the NLP algorithm for assessing

similarity, we chose to keep six principal components to perform clustering analysis on the verbal memories delivered by subjects. By measuring the within-cluster sum of squares error and plotting it as a function of the number of clusters, we were able to observe the point at which adding more clusters into our analysis would not provide any noticeable increase to the tightness of each cluster (Figure 4; Figure 5).

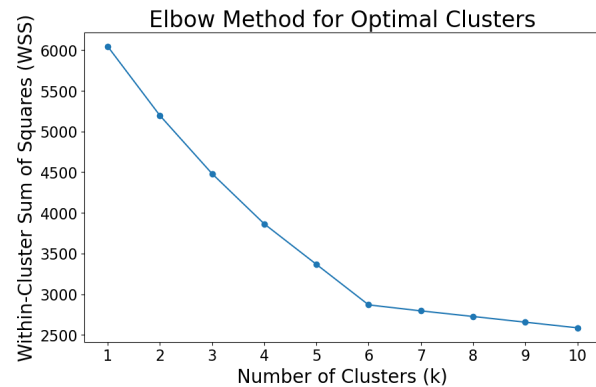


Figure 4. Elbow method plot constructed from the pooled set of principal components, useful for finding the optimal number of clusters to group principal components. The within-cluster sum of squares error decreases as the number of clusters increases. The “elbow” can be seen where the number of clusters approaches six.

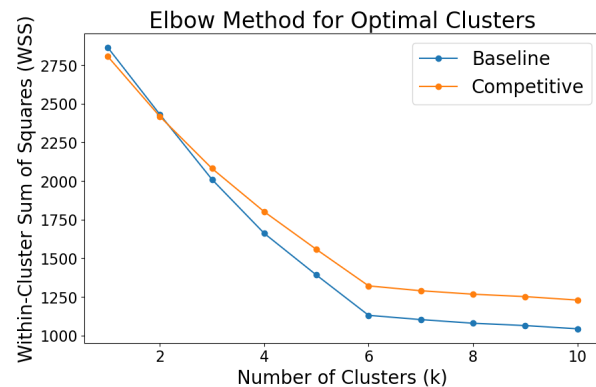


Figure 5. Elbow method plot constructed from the separated data of principal components in each condition.

Reducing the 768-length vectors of text embeddings via PCA allowed us to qualitatively visualize how subjects in each condition recalled images using these new values to represent their words and phrases. We conducted this visualization by generating subplots to compare the different principal components across both

conditions using the six predefined clusters (Figure 6). Moreover, though we had to select the number of clusters for our k-means analysis, verbal memories of each category appear distributed according to each of the six categories of the behavioral experiment. This finding reinforces our decision for the selection of six clusters, as it confirms that information about images from the same categories in the dataset aggregated together.

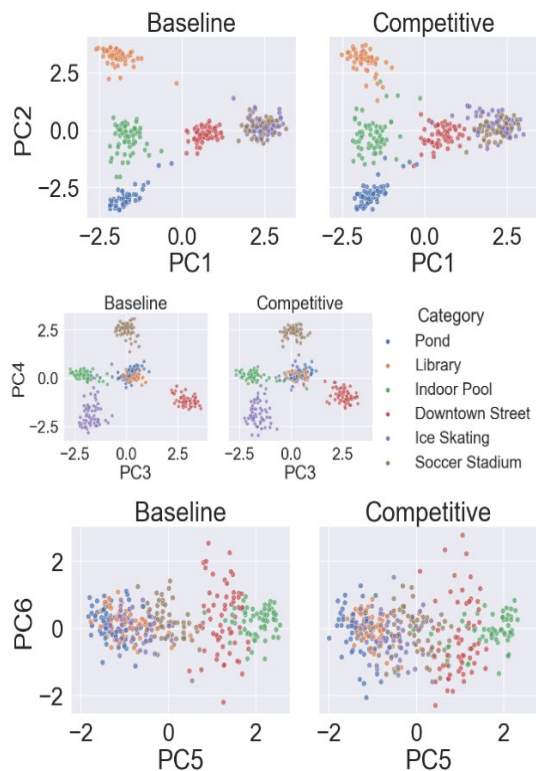


Figure 6. K-means clustering results separated by condition and plotted according to information represented along each principal component. The categories are distinguished by color to highlight the effects of the clustering on their separation.

Upon plotting the clusters with respect to each of our principal components, we identified that the distribution of verbal memory representations in the PCA space using six predefined cluster segments captured differentiation between categories in either condition. While we have not specifically performed any statistical analysis on this relationship here, Figure 6 reveals a minor

qualitative difference in the tightness of clustering between conditions. This could suggest that when subjects study multiple scenes from the same category, their verbal recall tends to emphasize information that differentiates those scenes, though we cannot draw that conclusion based on these results alone.

4. Discussion

We showed using dimensionality reduction that verbal memories of similar images from the competitive condition, and of images studied under the baseline condition from unrelated categories, could be compared using text embeddings created with the NLP MPNET model. After normalizing the dataset and performing PCA and k-means clustering on text embeddings, we found that the plotted representations of verbal memories group tightly into six predefined clusters that become separated by category. This validates that the NLP algorithm was able to detect similarity between verbal recall, such that two images from the same category are found to group more closely together than two images from different categories. The clustering pattern of the principal components found in either condition suggests that scenes from different categories are differentiated by subjects' verbal memories delivered during the testing phase. The visual differences found by clustering the verbal memories address our question as to whether the content used to describe the images changes depending on the similarity of the studied images.

Based on the theory that inference occurs when memories compete for recall, we would have expected to see evidence of more diffuse clustering between the similar memories of each category in the competitive condition compared to the unrelated images seen in the baseline condition. However, our prediction that this differentiation would be more exaggerated when memories for two images compete to be remembered cannot be supported by our current

analysis. The subtle differences captured in Figures 3 and 5, rather, demonstrate the capacity for NLP to tease apart nuanced ways in which similar images become remembered differently as a result of interference. The qualitative results displayed in Figure 6 convey that these small variabilities between conditions can be represented graphically to the extent of the principal components' ability to capture variance from within either condition.

While the scope of our data analysis is not able to support conclusions about the involvement of specific subregions of the hippocampus that might be involved in learning to differentiate these scenes, it could be the case that memories remap according to prediction errors calculated through dissociations in the specified subregions (Dimsdale-Zucker et al., 2018; Keinath et al., 2020). Our findings support existing research that aims to assess how verbal memories taken at a recall during behavioral experiments compare to neuroimaging data from the same subjects while being scanned in an MRI machine.

Future research efforts might explore NLP text embeddings using representational similarity analysis to correlate representations in the brain at specific timepoints during learning (Kriegeskorte et al., 2008). NLP methods could help make inferences about the types of information that correspond to hippocampal remapping of specific memories. Performing analysis on text embeddings recovered before and after learning might reveal quantitative differences about how people remember images over time as interference is minimized. Our analysis of NLP text embeddings here is an important first step towards that goal by offering some justification for the use of these methods in the context of verbal memory analysis.

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Multidisciplinary Design Optimization of Portland State Aerospace Society (PSAS) Launch Vehicle 4

Aaron Casserly*

Abstract

Multidisciplinary Design Optimization is a field that enables the solution of challenging engineering problems involving multiple technical specializations and design/performance constraints. In this work, I optimize the design of the PSAS Launch Vehicle 4 (LV4). To that end, I evaluate different optimization approaches—such as RBFOpt Global Optimization, Nelder-Mead minimization, and Simplicial Homology Global Optimization with Nelder-Mead and COBYLA local minimization techniques, calculate structural analysis information for different stages of flight, outline a method of simulating fin “staging”—the dropping of a larger initial fin can at a certain altitude to reduce the required engine thrust and drag in the upper atmosphere and optimize fin parameters. I converged on the ideal design vector. This led to an apogee of 107 km with a 9.8 kN engine (realized with two 5 kN engines). Further debugging is required to resolve the apparent 120 km vehicle drift.

1. Introduction

The Portland State Aerospace Society (PSAS) Launch Vehicle 4 is the fourth iteration of their student-built rocket. PSAS is a feeder organization for those interested in working in spaceflight and we care about optimizing it to give young professionals experience in relevant problem solving to real-world problems, and to achieve the above 100 km apogee target while meeting performance constraints. The constraints given to the optimizer are real-world engineering constraints that must be met for this to be realized. Previous optimization efforts included a design vector involving various components of the rocket, and my approach to include fin parameters and scale them down when a near optimal design was converged on was an improvement. The goals of this research project were to improve and extend the existing Multidisciplinary Design Optimization (MDO)

simulation code and to converge on a design vector satisfying engineering and performance constraints.

2. Methodology

Our approach minimizes the gross lift-off weight (GLOW) of LV4 without sacrificing apogee. Given the Tsiolkovsky rocket equation $\frac{\delta v}{v_e} = \ln \frac{m_0}{m_f}$, where v_e represents the effective exhaust velocity, δv the total change in velocity, m_0 the GLOW and m_f the final dry mass of the rocket, we isolate m_0 and construct an objective function. This approach has previously been characterized:

[M]inimizing GLOW while demanding a certain apogee is equivalent to simultaneously minimizing structural mass, maximizing engine performance, and balancing the conflicting goals of minimizing losses due to gravity and aerodynamics. Note

*Aaron Casserly (casser.aero@gmail.com) is a Jamaican immigrant and lawful permanent resident of the United States. He arrived in Oregon in April of 2019 and enrolled at the University of Oregon later that year. He is now a graduate with a Bachelor of Science in Mathematics and double minor in Physics and Computer Science with final GPA of 3.7/4. He plans to attend Northwestern University for a master's degree in electrical engineering in the Fall of 2024.

that the sources of this conflict are the incentive to expel propellant rapidly to avoid the cost of carrying propellant in a gravitational field and the incentive to reduce velocity in lower atmosphere since drag is proportional to air pressure and the square of velocity. (MDO Jupyter Notebook)

To represent our problem constraints, we use barrier and penalty functions. Both bind the generated rockets to a feasible region in the design space: barrier functions use an absolute constraint that may not be violated under any circumstances, whereas penalty functions slightly disincentivize convergence in sections of the design space far from a set of more lenient constraints.

Adding the objective, barrier, and penalty functions, we construct a pseudo-objective merit function, which takes in an array of values sufficient to describe the mathematical model of the rocket and its performance. Given that each evaluation of this merit function consists of simulating the rocket's trajectory, we are unable to use an optimization algorithm involving differentiation or a finite difference method. To navigate this limitation, we use a Nelder-Mead simplex method: a geometry-based optimization algorithm that does not perform well for higher dimensions but is satisfactory for our purposes. A genetic algorithm, which can handle higher-dimensional spaces, would also serve this function, but it incurs an additional computational cost.

The barrier and penalty functions are weighted by user-selected parameters before their addition to the objective function. Given that an overly low weighting will lead to the optimizer's neglect of the constraints and an overly high weighting to the optimizer ignoring the objective, we run an iterative sequence of Nelder-Mead optimizations, starting with very low weights and increasing them for every successive optimization. This gives the optimizer more global coverage of the design space early on

so that it may find a suitable neighbourhood and then restricts its freedom once it has done so.

The All-at-Once (AAO) problem statement is a fundamental optimization problem from which all others may be derived. It includes an objective/pseudo-objective function to be minimized with respect to a design vector and subject to certain constraints. For this problem, we are estimating the optimal design vector, \bar{x} according to $\lim_{n \rightarrow \infty} \mu_n = 0$, $\lim_{n \rightarrow \infty} \rho_n = \infty$, $f_n(\bar{x}) = m_{obj}(\bar{x}) + \mu_n \sum_i h_i(\bar{x}) + \rho_n \sum_j g_j(\bar{x})$.

$\bar{x}_n = \min_{\bar{x}} f_n(\bar{x})$, $\lim_{n \rightarrow \infty} \bar{x}_n = \bar{x}^*$, where $\bar{x} = (m_{prop}, \dot{m}, p_e)$ is the design vector containing the total propellant mass, unadjusted propellant mass, mass flow rate, nozzle exit pressure, total tankage length, airframe diameter, airframe total length, GLOW, ballast mass, conical component of nosecone length, fin root chord, fin tip chord, fin sweep angle, fin span, and fin thickness. This information is necessary for the evaluation of the constraint functions, $h_{barrier} = 108401m < h < 151401m$, and $g_{penalty} = (F \leq 6kN, LS \geq 22m/s, \frac{a_{max}}{g_0} \leq 15g's, TWR \geq 2, L/D \leq 21, \frac{p_e}{p_a} \geq 0.35)$. $h_{barrier}$ is the strict apogee constraint, and the looser penalty constraints are: Thrust (F)—the Electric Feed System (EFS) that deals with pressurizing before propellant injection is not feasible for powerful engines, Launch Speed (LS)—ensuring stable take-off, Thrust to Weight Ratio (TWR), Length to Diameter Ratio (L/D), maximum acceleration, and nozzle over-expansion.

The unaltered optimization code produces an .ork rocket file for further testing in OpenRocket, as seen in Figure 1.

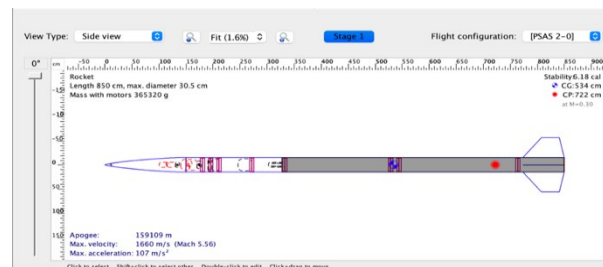


Figure 1. Example generated rocket.

It is then possible to run the simulation with settings emulating the launch site (WGS84 ellipsoid for Geodetic calculations), pictured in Figure 2.

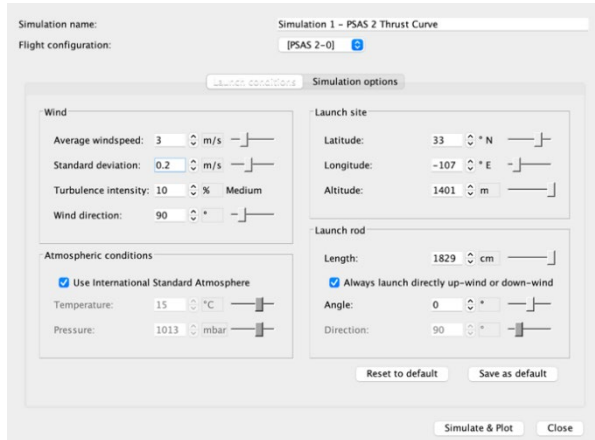


Figure 2. Settings to emulate the launch site.

These calculations produce a launch data graphic, pictured in Figure 3.

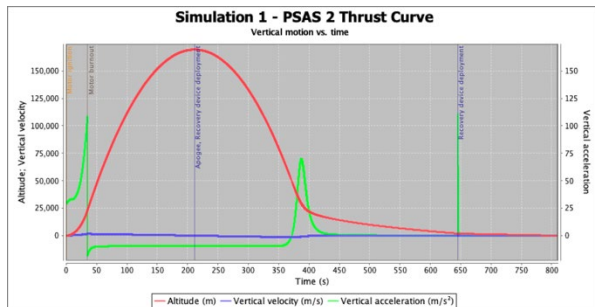


Figure 3. OpenRocket launch data graphic.

Review of uncertainty-based multidisciplinary design optimization methods for aerospace vehicles (Yao et al.) covers Uncertainty-Based Multidisciplinary Design Optimization (UMDO) theory and the cutting edge methods of that time. Throughout the lifecycle of the aerospace vehicle (design, manufacture, operation, disposal/repurposing), there exist many uncertainties related to the vehicle system itself, along with environmental and operational conditions. Before describing the UMDO procedure, several important definitions are given: uncertainty—incompleteness in knowledge and inherent variability of the system and

operational environment; robustness—measure of insensitivity to variations in both the system and environment; reliability—likelihood of a component/system to perform intended function for a given period of time under the determined operating conditions; deterministic design optimization—process of obtaining optimal designs with all variables, models, parameters and simulations involved being deterministic; robust design optimization (RDO)—optimizing design such that it is insensitive to many variations; and reliability-based design optimization (RBDO)—obtaining optimal design while meeting reliability constraints. The combination of these last two, RDO and RBDO, is the basis for reliability-based robust design optimization (RBRDO): Find \mathbf{x} minimizing $\tilde{f}(\mathbf{x}, \mathbf{p}) = F(\mu_f(\mathbf{x}, \mathbf{p}), \sigma_f(\mathbf{x}, \mathbf{p}))$ subject to (s.t.) $P[\mathbf{g}(\mathbf{x}, \mathbf{p}) \leq 0] \geq \mathbf{R}$, $\mathbf{x}^L \leq \mathbf{x} \leq \mathbf{x}^U$, where \mathbf{x} represents the design variable vector, \mathbf{p} represents the system constant parameter vector, \mathbf{x}^L and \mathbf{x}^U define the boundaries of the design space, μ_f and σ_f are the mean and standard deviation of the original optimization objective function, F is the reformulated optimization function with respect to μ_f and σ_f , \mathbf{g} is the unequal constraint vector, P is the probability of the statement in brackets to be true, and \mathbf{R} is the reliability vector related to this. Yao et al. provide illustrations related to RDO and RBDO, seen in Figures 4 and 5.

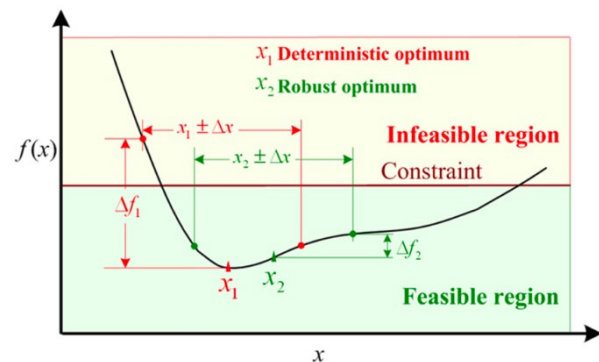


Figure 4. Graphical illustration of RDO.

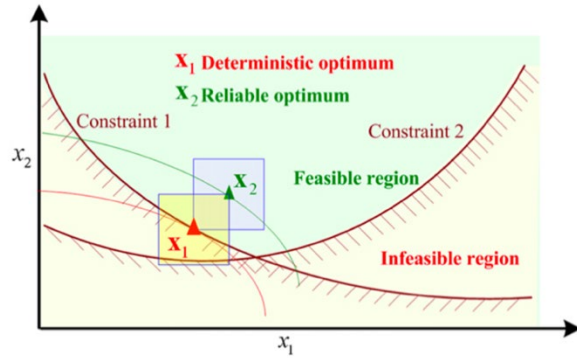


Figure 5. Graphical illustration of RBDO.

The actual UMDO procedure organizes the elements involved in uncertainty-based design optimization: system optimization, system analysis, disciplinary analysis, and uncertainty analysis. The key to realizing UMDO for a large, complex system is efficiently arranging these elements into an execution sequence so that it may be implemented on a computer; the coupling relationship related to disciplinary analysis and computationally intensive system analysis make for a very time-consuming procedure. The computational burden of UMDO can be understood by the following modification to the RBRDO formulation: Find \mathbf{x} minimizing $\tilde{f}(\mathbf{x}, \mathbf{p}, \mathbf{y}) = F(\mu_f(\mathbf{x}, \mathbf{p}, \mathbf{y}), \sigma_f(\mathbf{x}, \mathbf{p}, \mathbf{y}))$ s.t. $P[g_i(\mathbf{x}, \mathbf{p}, \mathbf{y}) \leq 0] \geq R_i, i = 1, 2, \dots, n_g, \mathbf{x}^L \leq \mathbf{x} \leq \mathbf{x}^U$. \mathbf{y} represents the intermediate state variables of the multidisciplinary analysis. We denote the output vector of disciplinary analysis i as \mathbf{y}_i , the coupling state vector output from disciplinary analysis i and input into disciplinary analysis j as \mathbf{y}_{ij} , the complete set of output vectors from discipline i coupled with other disciplines \mathbf{y}_i , and the complete set of coupling state vectors input into disciplinary analysis i as \mathbf{y}_i . With these conventions, we have $\mathbf{y} = [\mathbf{y}_i, i = 1, 2, \dots, n_D]$, $\mathbf{y}_i = [\mathbf{y}_{ji}, j = 1, 2, \dots, n_D, j \neq i]$, $\mathbf{y}_i = \mathbf{y}_i(\mathbf{x}_i, \mathbf{p}, \mathbf{y}_i)$ and $\mathbf{y}_i = [\mathbf{y}_{ij}, j = 1, 2, \dots, n_D, j \neq i]$. \mathbf{x}_i is the local design variable vector of discipline i , and \mathbf{p} is the system parameter vector. The paper provides a figure with information related to the coupling relationship for a three-discipline system, pictured in Figure 6.

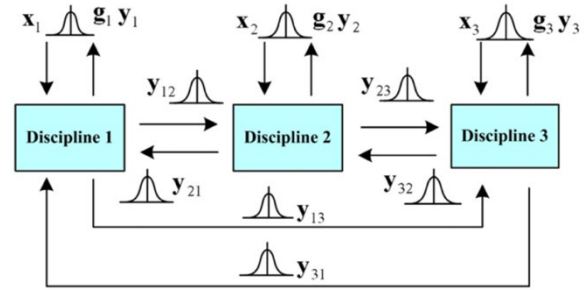


Figure 6. The coupling relationship of a three-discipline UMDO problem.

Yao et al. also provide an illustration of the conventional double-loop UMDO procedure, pictured in Figure 7.

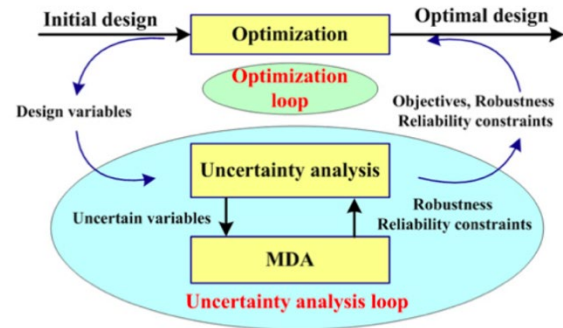


Figure 7. The conventional double-loop UMDO procedure.

I set out to review the existing open-source optimization code to analyze the dependencies and components of these procedures such that I would be able to isolate areas for potential improvements. In making modifications, I set out to compare simulated trajectory results and the optimized design vectors. The following is a list of planned improvements:

1. The majority of the Aerodynamics model is based on OpenRocket's source code, which is an oversimplification of reality. The first instance of a possible improvement to the Jupyter Notebook detailing the aerodynamics model is related to the fin-body interference coefficient. This can be improved using MIL-HDBK-762 (Handbook).
2. The optimization program generates designs based on a template OpenRocket

file. It will be necessary to update this to the latest airframe design, as the design fed into the optimizer is still based on the airframe of a previous iteration.

3. Implement fin “staging”; this will be done by dropping a large fin can. Essentially, larger fins enable a reduction in the required launch velocity, and, therefore, the engine size may be reduced. Dropping the can mid-flight will reduce the drag due to large fins. I will develop a method of simulating this effect.
4. Add to MDO capability via reading-in a database of aerodynamic coefficients created by CFD.
5. Improve the “UI” such that those unfamiliar with the code may set parameters and understand the process. Work on documentation and comments in relation to better user interaction.
6. Add structural analysis output such as weight, stresses, acceleration, acceleration in propellants, axial load down the rocket, and heatmap to show where the axial load is the highest.
7. If efforts to reduce engine weight have failed and we need a large engine (on the order of 10 kN), the use two 5 kN engines or four 2.5 kN engines would be optimal. This would reduce chamber pressure; additionally, lower-thrust engines are more feasible to build.
8. Compare efficiency/quality (merit function evaluation) of optimization approaches such as global optimization using RBFOpt, iterative Nelder-Mead, and Simplicial Homology Global Optimization (SHGO).

3. Results

3.1. Aerodynamics

The majority of the Aerodynamics model is based on source code from OpenRocket, which does not

account for the additional complexity of reality. The first improvement I made in relation to this was to adjust the fin-body interference coefficient using MIL-HDBK-762. Using the slender-body theory approach (where the slenderness of the modelled body is used to create an approximation to the field surrounding it), the ratio of the fin normal force gradient—the resulting corrective force perpendicular to the z-axis of the rocket—in the presence of a cylindrical body compared to that of an isolated fin is given by $K_{F(b)} = \frac{\frac{2}{\pi}}{(1-\frac{d}{b})^2} \left(\left(1 + \frac{d^4}{b^4} \right) \left(\frac{1}{2} \arctan \left[\frac{1}{2} \left(\frac{b}{r} - \frac{d}{b} \right) \right] + \frac{\pi}{4} \right) - \frac{d^2}{b^2} \left[\left(\frac{b}{d} - \frac{d}{b} \right) + 2 \arctan \left(\frac{d}{b} \right) \right] \right)$, where r is half the fin span (b) and d is the body diameter, as pictured in Figure 8.

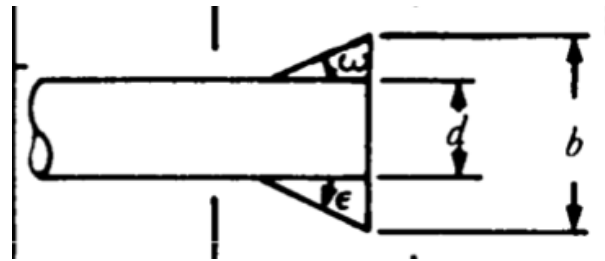


Figure 8. Fin span and body diameter of LV4.

The trajectory simulation component of the open-source code outputs the angle of attack—the difference between the rocket’s z-axis and relative velocity vector—of the vehicle as a function of time, seen in Figure 9.

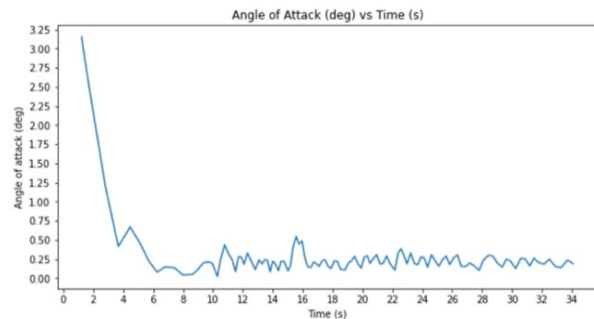


Figure 9. Angle of attack as a function of time.

The optimized design vector before and after this modification is represented in Figure 10.

```

6/06/2021 21:41:02
DESIGN VECTOR
-----
design total propellant mass           = 242.0959 kg
design unadjusted propellant mass      = 237.0335 kg
design mass flow rate                  = 6.8475 kg/s
design nozzle exit pressure             = 106525.5088 Pa
total tankage length (after adjustment) = 4.0814 m
design airframe diameter                = 0.3048 m.
design airframe total length           = 8.6464 m.
design GLOW                            = 393.9780 kg
design ballast mass                    = 2.0000 kg
conical part of nosecone length        = 1.0923 m
design fin root chord                  = 0.7620 m
design fin tip chord                   = 0.3302 m
design fin sweep angle                 = 40.0000 deg
design fin span                        = 0.4064 m
design fin thickness                    = 3.1750 mm

```

```

3/04/2022 15:57:13
DESIGN VECTOR
-----
design total propellant mass           = 246.6801 kg
design unadjusted propellant mass      = 241.5327 kg
design mass flow rate                  = 6.7373 kg/s
design nozzle exit pressure             = 167633.7555 Pa
total tankage length (after adjustment) = 4.1567 m
design airframe diameter                = 0.3048 m.
design airframe total length           = 8.7216 m.
design GLOW                            = 402.6394 kg
design ballast mass                    = 2.0000 kg
conical part of nosecone length        = 1.0923 m
design fin root chord                  = 0.7620 m
design fin tip chord                   = 0.3302 m
design fin sweep angle                 = 40.0000 deg
design fin span                        = 0.4064 m
design fin thickness                    = 3.1750 mm

```

Figure 10. Optimized design vector before and after fin-body interference modification.

The increased total propellant mass and gross lift-off weight indicate that increased resistance to the fin normal force is required. The higher nozzle exit pressure is related to the optimization program minimizing nozzle over-expansion (Monte).

An over/under-expanded nozzle is one in which the exit pressure is greater or lower than the atmospheric pressure. The combustion chamber generates high pressure, high temperature gas, and the ideal nozzle (shape and length optimized) converts this thermal energy into thrust as in Figure 11. An over-expanded nozzle is one in which the atmospheric pressure is greater than the exit pressure, which causes a pinching effect and decreases the efficiency of the nozzle as sections of the nozzle inner wall are not used to produce thrust. Figure 12 demonstrates an over-expanded nozzle. Under-expansion is the opposite: the atmospheric pressure is less than the nozzle exit pressure, which causes the flow to fan out after exiting the nozzle and results in inefficiency, as the

expansion is not fully converted into thrust by the nozzle inner wall. Figure 13 demonstrates an under-expanded nozzle.

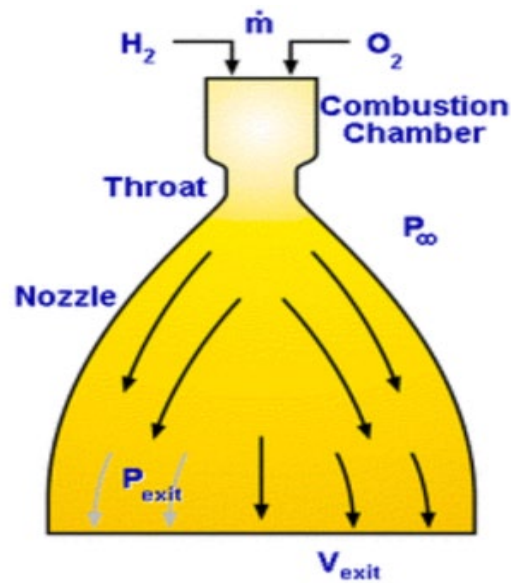


Figure 11. Nozzle and combustion chamber of LV4.

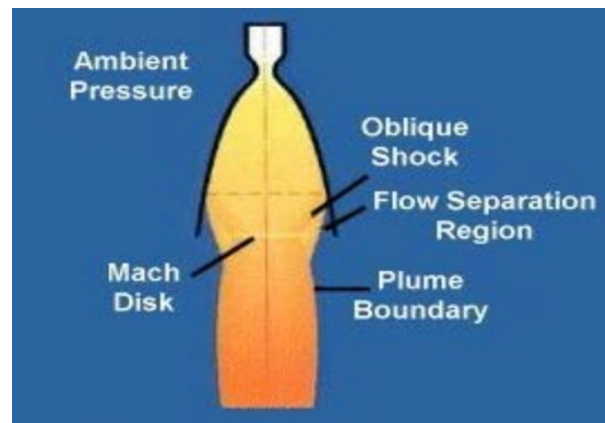


Figure 12. Over-expanded nozzle of LV4.

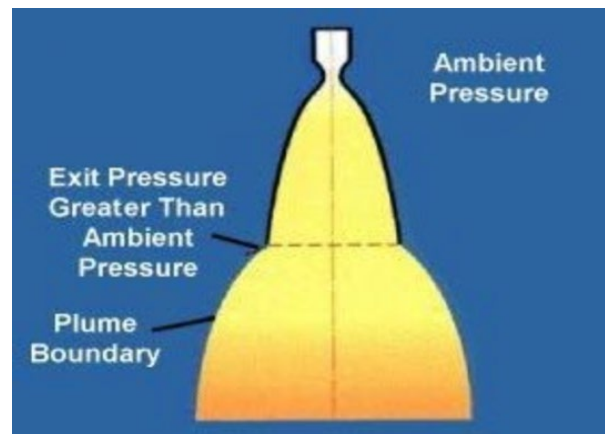


Figure 13. Under-expanded nozzle of LV4.

Ideally, we would like nozzle exit pressure to equal atmospheric pressure, and minimizing over-expansion is our best option. The higher exit pressure after increasing the accuracy of the fin-body interference coefficient indicates that the atmospheric pressure is higher, likely due to an increased fin normal force gradient.

In relation to enabling the MDO to read CFD data, I obtained a demo aerodynamics database—shown in Figure 14—with the goal of building an interpolation space in the variables.

| | |
|---|--|
| 1 | Mach, qbar, pitch, yaw, roll, Cx, Cy, Cz, Cl, Cm, Cn |
| 2 | 0.100, 631, 0.0, 0.0, 0.0, 0.381, 0.0, 0.0, 0.0, 0.0, 0.0 |
| 3 | 0.523, 15642, 0.0, 0.0, 0.0, 0.360, 0.0, 0.0, 0.0, 0.0, 0.0 |
| 4 | 0.963, 45734, 0.0, 0.0, 0.0, 0.451, 0.0, 0.0, 0.0, 0.0, 0.0 |
| 5 | 2.000, 110648, 0.0, 0.0, 0.0, 0.351, 0.0, 0.0, 0.0, 0.0, 0.0 |
| 6 | 2.850, 126219, 0.0, 0.0, 0.0, 0.294, 0.0, 0.0, 0.0, 0.0, 0.0 |
| 7 | 4.700, 85887, 0.0, 0.0, 0.0, 0.238, 0.0, 0.0, 0.0, 0.0, 0.0 |

Figure 14. Aerodynamic coefficients database.

I created a new notebook to complete this task and used the SciPy interpolate module (*Scipy.interpolate.Interp1d* — *SciPy v1.8.1 Manual*) along with the built-in Python CSV module. Figure 15 displays the first from-scratch code contribution I made.

```
import csv
import numpy as np
import matplotlib.pyplot as plt
from scipy import interpolate

matrix = {}
Dict = {}

with open('aero_database_demo.csv') as csv_file:
    csv_reader = csv.reader(csv_file, delimiter=',')
    for item in csv_reader:
        matrix.append(item)
        for k in range(len(matrix[0])):
            values = []
            for j in range(len(matrix)-1):
                value = float(matrix[j+1][k].strip())
                values.append(value)
            key = matrix[0][k].strip()
            Dict.update({key: values})

variables = Dict.keys()
print(variables)

dict_keys(['Mach', 'qbar', 'pitch', 'yaw', 'roll', 'Cx', 'Cy', 'Cz', 'Cl', 'Cm', 'Cn'])

zero = float(0)
for item in variables:
    Dict[item].append(zero)
    Dict[item].sort()
```

Figure 15. Code for processing database of Aerodynamic coefficients.

I initialize a list “matrix” to store the data along with a dictionary “Dict” to index into a variable’s list of values. Using the csv module, we read in the data and construct a 2-dimensional matrix. We then use a nested structure to

construct each variable’s list of values, with which we populate the dictionary. We are now ready to perform interpolation, as shown in Figure 16.

qbar

```
x = Dict['Mach']
xnew = np.arange(0, max(Dict['Mach']), 1e-7)
y = Dict['qbar']
f = interpolate.interp1d(x, y, kind = 'cubic')
ynew = f(xnew) # use interpolation function returned by `interp1d`
plt.plot(x, y, 'o', xnew, ynew, '-')
plt.xlabel('Mach')
plt.ylabel('qbar')
plt.show()
```

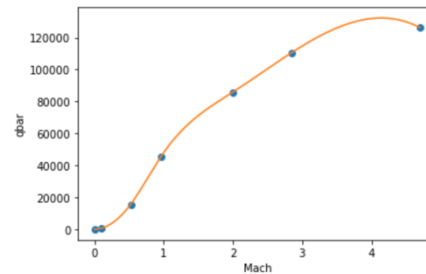


Figure 16. Cubic interpolation in the qbar variable.

We use the “interp1d” function to approximate a continuous function given our discrete data points. Figure 17 displays another example, this time with linear interpolation.

Cx

```
x = Dict['Mach']
xnew = np.arange(0, max(Dict['Mach']), 1e-7)
y = Dict['Cx']
f = interpolate.interp1d(x, y, kind = 'linear')
ynew = f(xnew) # use interpolation function returned by `interp1d`
plt.plot(x, y, 'o', xnew, ynew, '-')
plt.xlabel('Mach')
plt.ylabel('Cx')
plt.show()
```

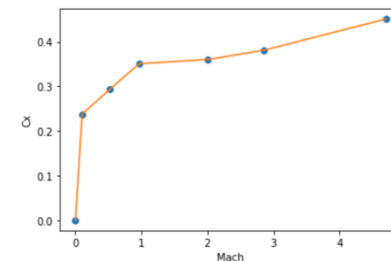


Figure 17. Linear interpolation in the Cx variable.

3.2. Optimization Method Efficiency/Quality Analysis

The three options for optimization that I considered were global optimization using

RBFOpt (black-box optimization), scipy.optimize's Nelder-Mead minimization, and Simplicial Homology Global Optimization (SHGO). It is important to note that our merit function is a combination of an objective function and a penalty function. This means that the constraints are captured by the penalty component and are not passed into the optimization methods directly. Therefore, we have in each case an unconstrained global optimization which approximates a constrained optimization.

The Nelder-Mead algorithm is designed to minimize a non-linear function $f: \mathbf{R}^n \rightarrow \mathbf{R}$ using function values at a few points in \mathbf{R}^n . It can be viewed as a simplex-based search algorithm. A simplex in \mathbf{R}^n is defined as the convex hull of $n + 1$ vertices. For example, a simplex in \mathbf{R}^2 is a triangle, while \mathbf{R}^3 would be a tetrahedron, shown in Figure 18.

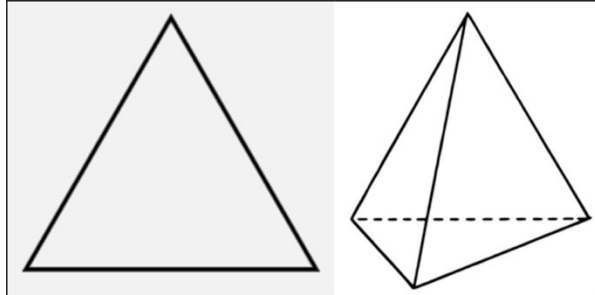


Figure 18. Simplexes in two- and three-dimensional space.

The method begins with a set of points $x_0, \dots, x_n \in \mathbf{R}^n$, which are the vertices of our simplex, and their merit function evaluations. The algorithm will then perform a series of transformations on the working simplex with the goal of decreasing the merit function evaluation at the vertices. This process is terminated when the absolute errors in the optimal design vector and its function evaluation are sufficiently small (*Minimize(Method='Nelder-Mead')* — *SciPy v1.8.0 Manual*). A simplification of the algorithm is the following:

1. Construct initial working simplex S .

2. Repeat until termination test is satisfied.
 - a. Calculate termination test information (absolute error).
 - b. If termination test is satisfied, transform the working simplex.
3. Return the best vertex of the current simplex S and the merit function evaluation.

We can construct the initial simplex by generating $n + 1$ vertices (x_0, \dots, x_n) around some input point in \mathbf{R}^n . For practical purposes, we use x_0 so that the algorithm may be restarted. The remaining n vertices are then generated to obtain a regular simplex, with all edges having the same length.

A key component is the simplex transformation algorithm, which consists of three stages:

1. Ordering to determine the worst (h), second-worst (s), and best (l) vertices in the current working simplex: $f_h = \max_j f_j$, $f_s = \max_{j \neq h} f_j$, $f_l = \min_{j \neq h} f_j$.
2. Calculation of the centroid of the best side, which is opposite the h-vertex ($c := \frac{1}{n} \sum_{j \neq h} x_j$).
3. Computation of the new working simplex via transforming the current.

We attempt to replace the worst vertex using reflection, contraction or expansion with respect to the best side. The test points lie on the line from the worst point (x_h) to the centroid of the best side, as previously calculated. At most, two such points are calculated in each iteration. If successful, this accepted point becomes the new vertex of our working simplex. Otherwise, we shrink the simplex towards the best vertex (x_l), and it is necessary to compute n new vertices.

On testing the Nelder-Mead approach, I reduced the termination conditions to an absolute difference between optimal design vectors of 1 and an absolute difference between

merit function evaluations of 0.1. The results indicate that this will produce a locally feasible design; however, this is not ideal for the global optimization that we desire. Combining this with SHGO should improve results. The output of this is shown in Figure 19.

```
Iteration 1:
Optimization terminated successfully.
    Current function value: 0.458370
    Iterations: 278
    Function evaluations: 705
    Arithmetic errors (from violations of acceptable altitude window): 0
Propellant mass (kg): 223.0627674561624
Mass flow rate (kg/s): 5.084690802101526
Exit pressure (Pa): 111199.05113706988
Peak Altitude (km): 98.9836442931816
```

Figure 19. Iterative Nelder-Mead optimization output.

We can see here that the peak altitude is less than desired. Overall, this approach is time-intensive, given a more stringent termination condition, and will at best produce locally feasible designs. The limited design space exploration of the Nelder-Mead algorithm can be understood via Figure 20.

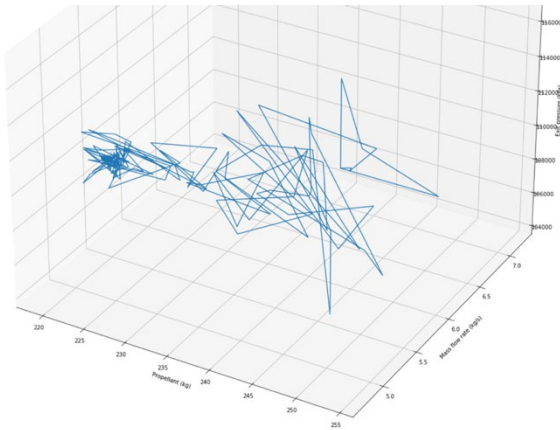


Figure 20. Iterative Nelder-Mead design space exploration.

The RBOpt (*Coin-or/Rbfopt*) global optimization method provides excellent coverage of the design space and runs to completion in under two hours. To perform this optimization, we construct a black box using the `RbfoptUserBlackBox` class and execute `RbfoptAlgorithm` on it. The values comprising the two arrays in the definition of the black box were set based on a feasible range for the design variables. Figure 21 displays a snippet of our code.

```
bb = rbfopt.RbfoptUserBlackBox(len(init_array),
    np.array([75, 1.5, 86346/4, 805000/2.5, 805000/2.5, 344738*1.5]),
    np.array([375, 7, 86346*2.5, 2.068e6, 2.068e6, 4.137e6]),
    np.array(['R']*len(init_array)), f)
settings = rbfopt.RbfoptSettings(minlp_solver_path="bonmin_path",
    nlp_solver_path=paths["ipopt_path"],
    max_evaluations=800, eps_impr=1.0e-4)
alg = rbfopt.RbfoptAlgorithm(settings, bb)
val, x, itercount, evalcount, fast_evalcount = alg.optimize()
```

Figure 21. RBOpt Global Optimization code snippet.

This design variable range works in conjunction with Bonmin (*Bonmin*) (Basic Open-source Nonlinear Mixed Integer programming) to find a design vector that minimizes the merit function. With this approach, the majority of our constraints are satisfied, as seen in Figure 22.

```
CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0) = 5.2142 deg
L/D ratio (c.f. < 25.0) = 27.6179
fin flutter ratio (c.f. > 1.0) = 27.2560
Sommerfeld criterion (c.f. pe/pa >= 0.35) = 1.6490
max acceleration (c.f. < 15.0) = 6.2303 gs
TWR at lift off (c.f. > 2.0) = 1.9012
Lowest stability margin caliber (c.f. > 2.0) = 2.9854
speed when leaving launch rail (c.f. > 22.0) = 25.9781 m/s
altitude at apogee (c.f. > 105.0) = 97.1917 km
LEETS LOX velocity (c.f. < 9.144) = 5.5099 m/s
LEETS IPA velocity (c.f. < 9.144) = 4.6270 m/s
design thrust (ground level) (c.f. < 10000) = 10653.9372 N
```

Figure 22. RBOpt Global Optimization Constraint Satisfaction.

Simplicial Homology Global Optimization (SHGO), in conjunction with Nelder-Mead minimization, provides good results with a completion time of about 2 hours. The theoretical advantages of SHGO are guaranteed when the objective function is Lipschitz smooth (objective function is continuous, convex, and smooth); however, if this is not the case, the algorithm will converge to the global optimum if the default “simplicial” sampling method is used (*Scipy.Optimize.Shgo — SciPy v1.8.0 Manual*). SHGO is a general-purpose global optimization algorithm that approximates the homology groups of a complex built on a hypersurface that is homeomorphic (similar in form) to a complex on the objective function. This facilitates approximations of locally convex subdomains in the search space (multidimensional space consisting of design vector parameters and their constraints) and provides an excellent visual tool for characterising and solving higher-dimensional black box optimization problems. The complex is created using sampling points

within the feasible search space as vertices. The algorithm is best suited to finding all local minima of an objective function with a computationally expensive evaluation (such as ours, which involves simulating the trajectory of the design).

Using the sampled points of an objective function as vertices, this method constructs a simplicial complex. The resulting directed subgraph contains the set of all 1-chains from the elements of $\mathcal{H}^1 \in \mathcal{H}$ and enables the finding of minimizer pools (Endres et al.) Sperner's lemma enables us to approximate the domains of stationary points for our objective function in the feasible search space, denoted by Ω . The homology groups produced from the construction of \mathcal{H} will be invariant given an adequate sampling set. It follows that for the given sampling set of vertices $\mathcal{H}^0 \in \mathcal{H}$, we are guaranteed to extract the optimal minimiser pool. The algorithm has four steps:

1. Sampling point generation of N vertices in the search space from which 0-chains of \mathcal{H}^0 are constructed.
2. Triangulation of the vertices to construct the directed simplicial complex \mathcal{H} .
3. Construction of the minimiser pool using Sperner's lemma.
4. Local minimization using the starting points defined in the minimiser pool (Nelder-Mead method).

Given a set of sampling points \mathcal{P} , we wish to describe a discrete mapping $h: \mathcal{P} \rightarrow \mathcal{H}$ that will provide a simplicial approximation for the surface of the merit function. To begin, we need to formally define the set of vertices forming the 0-chains of the simplicial complex and the edges forming the 1-chains of \mathcal{H} . The following are useful definitions:

1. χ is the set of sampling points created by a sampling sequence in a bounded

hyperrectangle (rectangle generalized to higher dimensions).

2. The set $\mathcal{P} = [\mathbf{x} \in \chi | g(\mathbf{x}) \geq 0]$ describes a set of points within the feasible set Ω .
3. Given an objective function f, \mathcal{F} represents the set of scalar outputs mapped by the objective function $f: \mathcal{P} \rightarrow \mathcal{F}$ in relation to a sampling set $\mathcal{P} \subseteq \Omega \subseteq \mathbb{R}^n$.
4. If \mathcal{H} is a directed simplicial complex, then $\mathcal{H}^0 := \mathcal{P}$ is the set of all vertices of \mathcal{H} .
5. Given a set of vertices \mathcal{H}^0 , we construct the simplicial complex \mathcal{H} by a triangulation connecting every vertex in \mathcal{H}^0 . This supplies a set of undirected edges E .
6. \mathcal{H}^1 is a set constructed by directing every edge in E . This is done by selecting a vertex $v_i \in \mathcal{H}^0$ and connecting to another vertex v_j by an edge within E . This edge is directed as $v_i v_j$ from v_i to v_j if and only if the merit function evaluation at the former is lesser than the latter. It is directed as $v_j v_i$ from v_j to v_i if and only if the merit function evaluation at the former is greater than the latter. In these cases, we have $\partial(v_i v_j) = v_j - v_i$ and $\partial(v_j v_i) = v_i - v_j$. The case in which $f(v_i) = f(v_j)$, with neither v_i nor v_j already being a minimizer, we use the rule that "the incidence direction of the connecting edge is always directed towards the vertex that was generated earliest by the sampling point sequence." If v_i is not connected to another vertex v_k , then our convention will be to leave $v_i v_k$ undefined, with $\partial(v_i v_k) = 0$. The higher dimensional simplices $\mathcal{H}^k, k = 2, 3, \dots, n+1$ may be directed in an arbitrary direction to complete the construction of the complex $h: \mathcal{P} \rightarrow \mathcal{H}$. This will be used to find the minimiser pool for the local minimization starting

points required by the algorithm.

7. v_i is a minimiser if and only if all edges connected to v_i are directed away from v_i ; formally, that is $\partial(v_i v_j) = (v_j - v_i) \vee 0 \forall v_j \in \mathcal{H}^0$. The set of all minimisers is the minimiser pool \mathcal{M} .
8. The star of a vertex v_i [$st(v_i)$] is the set of all points Q s.t. every simplex containing Q contains v_i .
9. The k -chain $\mathcal{C}(\mathcal{H}^k)$, $k = n + 1$ of simplices in $st(v_i)$ results in a boundary cycle $\partial(\mathcal{C}(\mathcal{H}^{n+1}))$ with $\partial(\partial(\mathcal{C}(\mathcal{H}^{n+1}))) = \emptyset$. The bounds of the domain defined by s.t. (v_i) form the faces of $\partial(\mathcal{H}^{n+1})$.

To place these constructions in a practical context, we minimize the Ursem01 function in two dimensions, which is defined as:

$$\min f(\mathbf{x}) = -\sin(2x_1 - 0.5\pi) - 3\cos(x_2) - 0.5x_1, x \in \Omega = [0, 9] \times [-2.5, 2.5]$$

A plot of this function with its three local minima is shown in Figure 23.

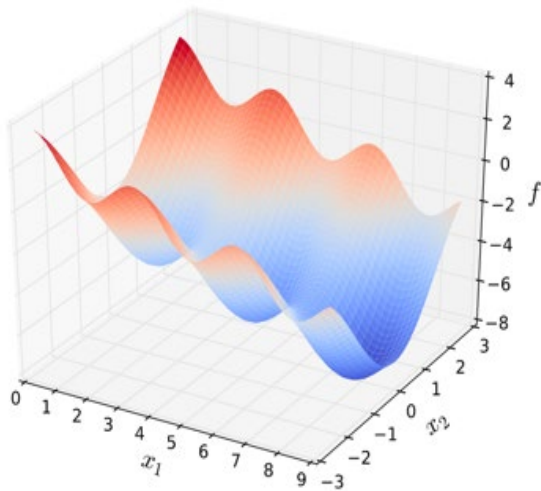


Figure 23. The Ursem01 Function.

The set \mathcal{P} contains $N = 15$ sampling points from the 2-dimensional Sobol sequence. Figure 24 contains a mapping of the objective function values.

$$f : \begin{bmatrix} v_0 = (0.0, -2.5) \\ v_1 = (4.6, 0.0) \\ v_2 = (6.9, -1.25) \\ v_3 = (2.3, 1.25) \\ v_4 = (3.45, -0.625) \\ v_5 = (8.05, 1.875) \\ v_6 = (5.75, -1.875) \\ v_7 = (1.15, 0.625) \\ v_8 = (1.725, -0.9375) \\ v_9 = (6.325, 1.5625) \\ v_{10} = (8.625, -2.1875) \\ v_{11} = (4.025, 0.3125) \\ v_{12} = (2.875, -1.5625) \\ v_{13} = (7.475, 0.9375) \\ v_{14} = (5.175, -0.3125) \end{bmatrix} \rightarrow \begin{bmatrix} f_0 = 3.403 \\ f_1 = -6.275 \\ f_2 = -4.0651 \\ f_3 = -2.208 \\ f_4 = -3.3429 \\ f_5 = -4.051 \\ f_6 = -1.493 \\ f_7 = -3.674 \\ f_8 = -3.591 \\ f_9 = -2.191 \\ f_{10} = -2.606 \\ f_{11} = -5.062 \\ f_{12} = -0.601 \\ f_{13} = -6.239 \\ f_{14} = -6.044 \end{bmatrix}$$

Figure 24. Objective function values using sampling points from Sobol sequence.

From Definition 4 above, we have \mathcal{H}^0 from \mathcal{P} . Definition 5 enables us to construct \mathcal{H} using Delaunay triangulation to find a set of connected edges. The edges are then directed according to Definition 6. Definition 7 enables us to find the minimiser set, which in this case is $\mathcal{M} = \{v_1, v_7, v_{13}\}$. Figure 25 is the resulting structure, which highlights the domain of s.t. (v_1) .

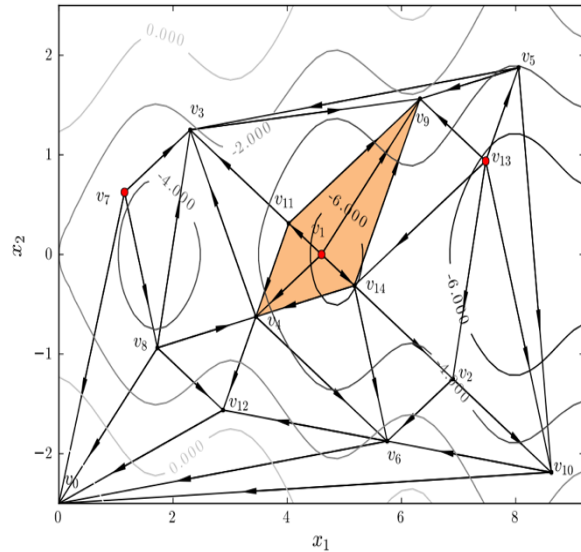


Figure 25. A directed complex \mathcal{H} —simplicial approximation for an objective function.

Increasing the sampling size to $N = 150$ and repeating the procedure produces the complex in Figure 26.

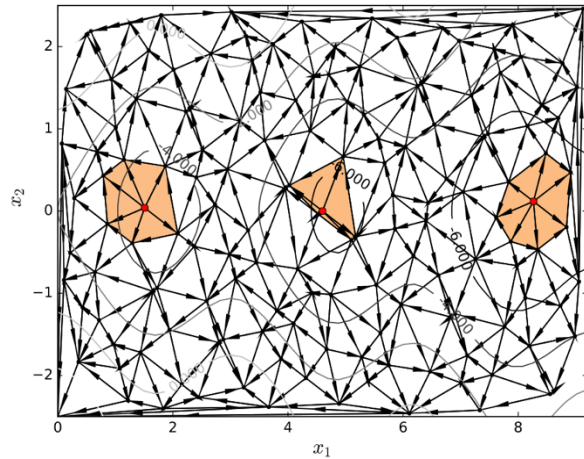


Figure 26. A directed complex \mathcal{H} —a simplicial approximation for an objective function with 150 vertices.

This has different minimiser vertices that are better approximations to the local minima, but $|\mathcal{M}|$ is unchanged. This points to the SHGO property: if the number of initial sampling points is adequate, $|\mathcal{M}|$ ceases to grow with increasing N , which provides a heuristic for the number of sampling points needed to approximately map the local minima of a merit function.

3.3. User Interface and Documentation Improvements

In relation to making the workings of the code more understandable, I added the following prior to the code block containing the three main techniques: The optimization approaches are RBFOpt Global Optimization, Iterative Nelder-Mead, and Simplicial Homology Global Optimization using Nelder-Mead at the local minima. RBFOpt produces results in about 2 hours, depending on your machine. The two array arguments passed to the RbfoptUserBlackBox class define the bounds of the black box and correspond to minimum and maximum feasible values for the design vector. Iterative Nelder-Mead does take a while; however, in the iterate function in the above code block, you may change the “xatol” and “fatol” parameters to relax the termination condition. These correspond to the absolute error in the

design vector and its merit function evaluation between iterations such that the optimization will terminate. Simplicial Homology is my preferred method as it finds approximations to local minima and then uses iterative Nelder-Mead at each of these to find the global minimum. This method is theoretically guaranteed to find the global minimum when using the ‘simplicial’ sampling method. However, for a merit function as complex as ours (involving trajectory simulation), it is inefficient. The “sobol” sampling method will approximate the global minimum with an execution time of about 2 hours. I have also added comments to the code related to setting (black box/design vector) boundaries.

3.4. Initial Design Modifications

In coordination with Hayden Reinhold from the PSAS airframe team, I have updated the initial template.ork OpenRocket file to approximate the current design. This involved modifying component weights and lengths, along with using an approximate thickness to model our isogrid plate bulkheads as having uniform density, demonstrated in Figure 27.

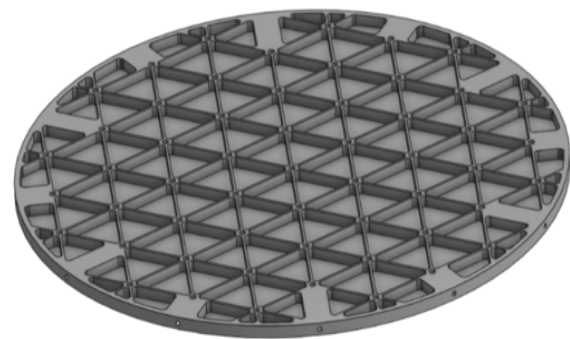


Figure 27. Isogrid plate bulkhead.

The updated initial design fed into the optimizer produced the diagram found in Figure 28.

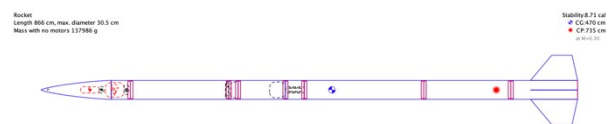


Figure 28. Updated initial design.

The main changes were made to the weight/length of Nosecone, Electrical Recovery System (ERS), N2 tank/Reaction Control System (RCS), Avionics/Camera module, Liquid Oxygen (LOX) tank, and fin can. A SHGO simulation with this updated model resulted in global coverage of the design space, as in Figure 29.

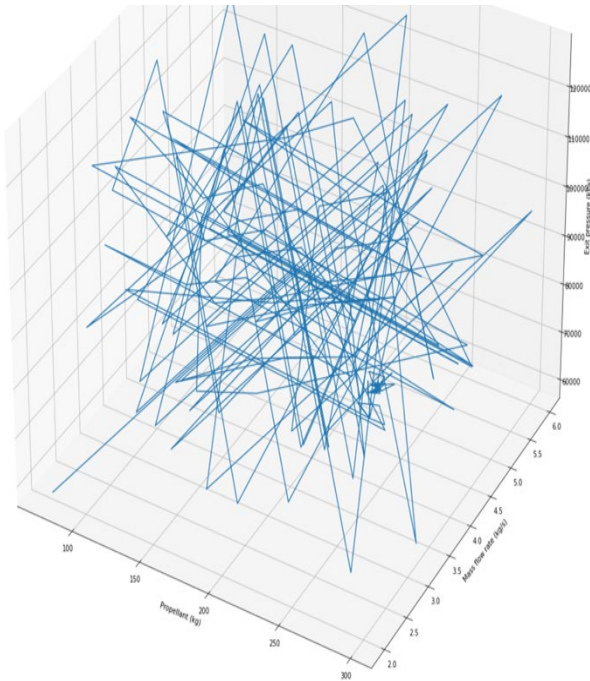


Figure 29. SHGO coverage of design space with updated design.

We met the majority of our constraints; however, manifesting a 10.6 kN engine poses a problem, displayed in Figure 30.

```

CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0)           = 5.2807 deg
L/D ratio (c.f. < 25.0)                       = 27.2469
fin flutter ratio (c.f. > 1.0)                 = 26.5080
Sommerfield criterion (c.f. pe/pa >= 0.35)    = 0.7082
max acceleration (c.f. < 15.0)                = 6.4626 gs
TWR at lift off (c.f. > 2.0)                  = 1.8866
Lowest stability margin caliber (c.f. > 2.0)   = 2.2576
speed when leaving launch rail (c.f. > 22.0)  = 25.7842 m/s
altitude at apogee (c.f. > 105.0)            = 95.6293 km
LFETS LOX velocity (c.f. < 9.144)            = 5.5395 m/s
LFETS IPA velocity (c.f. < 9.144)            = 4.6314 m/s
design thrust (ground level) (c.f. < 10000)   = 10580.0105 N

```

Figure 30. SHGO constraint satisfaction with updated design.

Our apogee estimate is slightly conservative, so 95.6 km is excellent. Trajectory information indicates a successful launch is possible with the design in Figure 31.

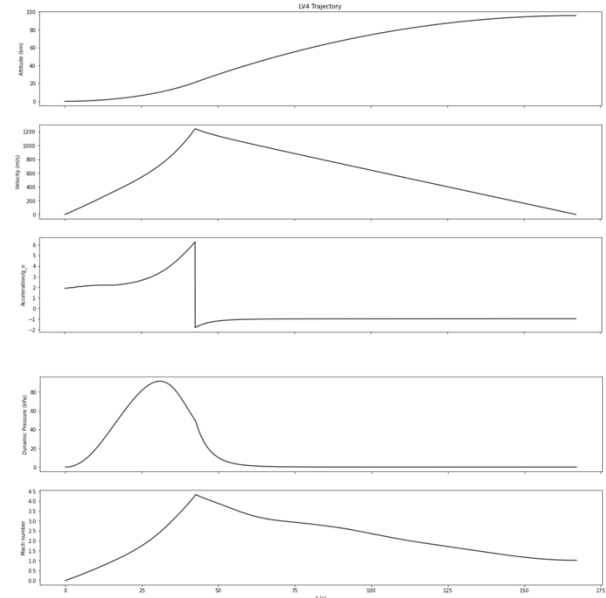
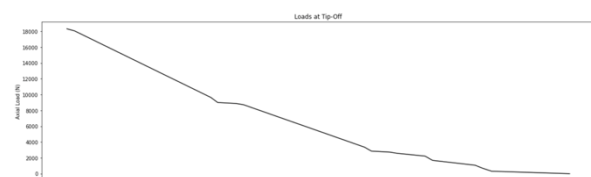


Figure 31. LV4 Trajectory Information with SHGO Approach.

3.5. Structural Analysis Output

Related to the goal of improving the MDO via providing structural analysis output, I added a new notebook that ported relevant code from the structural model notebook. This code contains a structural analysis function that calculates the axial and lateral loads along with bending moments at launch (tip-off), maximum aerodynamic pressure (max Q), and before and after engine burnout. The axial forces consist of friction along the body, parasitic drags related to each passthru module, and drag coefficient contributions. Lateral load is calculated via summing normal forces, and the bending moment is calculated considering the shear at the top of each component along with the lateral load at the middle. Using the structural plot function in the Display_Information notebook, the main MDO notebook now outputs the graphs seen in Figure 32.



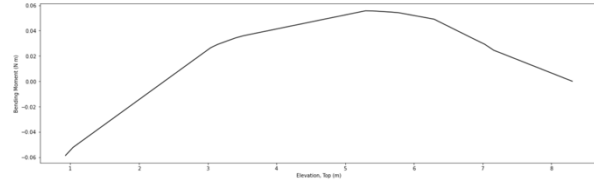
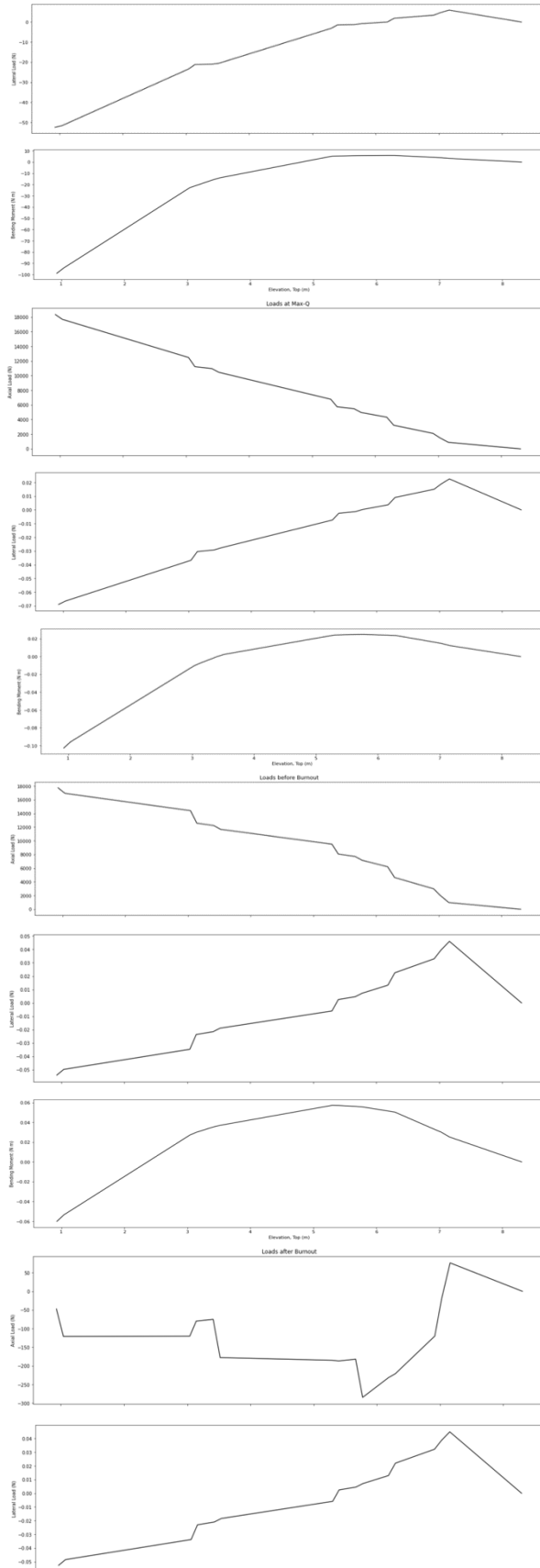


Figure 32. Structural analysis information added to MDOOutput.

3.6. Other Modifications

In order to make weight reductions easier, Peter McCloud (a scientist affiliated with NASA Aerothermodynamics) suggested that a pie chart with the mass breakdown be added to the MDO output. Figure 33 displays a code snippet and Figure 34 the result.

Mass breakdown: Propellant, Propulsion Modules, Pressurant (N₂) and Airframe

```
labels = ['Propellant', 'Pressurant(N2)', 'Propulsion', 'Airframe', 'Other']
propellant = sim_m_prop[0]
pressurant = sim_m_prop[1]
propulsion = 4.24 # from post-flight mass budget
airframe_diameter = sim_m_prop[2]
airframe_length = sim_m_prop[3]
volume = ((np.pi * ((airframe_diameter/2) ** 2) * airframe_length)
          + (np.pi * ((airframe_diameter/2) - AIRFRAME_THICKNESS) ** 2) * airframe_length))
total = sim_m_prop[4]
other = total - (propellant + pressurant + propulsion + airframe)
sizes = [(propellant/total) * 100, (pressurant/total) * 100, (propulsion/total) * 100, (airframe/total) * 100, (other/total) * 100]
explode = (0, 0.1, 0.12, 0, 0)

fig, ax1 = plt.subplots()
ax1.pie(sizes, explode=explode, labels=labels, autopct='%1.1f%%',
        shadow=True, startangle=90)
ax1.axis('equal') # Equal aspect ratio ensures that pie is drawn as a circle.

plt.show()
```

Figure 33. Mass breakdown code added.

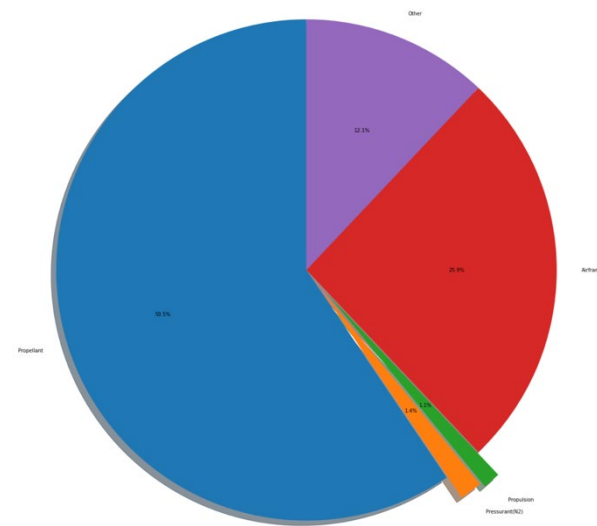


Figure 34. Mass breakdown pie chart.

The only non-trivial component of this is calculating the airframe mass. The volume of the tube was first calculated given the existing airframe length, diameter, and thickness

variables. Given the 2700 kg/m^3 density of 6061-T6 aluminum, the mass is calculated. The pie chart was constructed with reference to the matplotlib documentation (*Basic Pie Chart – Matplotlib 3.5.2 Documentation*).

Another issue is related to the engine thrust constraint. It is not feasible for the engine to have a thrust much greater than 6 kN. Since the thrust constraint is lenient, I experimented with setting the CONS_THRUST parameter to 5.5 kN. Figure 35 contains the results using Simplicial Homology with the simplicial sampling method (guaranteed optimality) and COBYLA local minimization.

```

CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0)          = 6.4060 deg
L/D ratio (c.f. < 25.0)                     = 31.9445
fin flutter ratio (c.f. > 1.0)               = 33.6321
Sommerfield criterion (c.f. pe/pa >= 0.35)   = 0.6618
max acceleration (c.f. < 15.0)              = 6.9777 gs
TWR at lift off (c.f. > 2.0)                 = 1.1000
Lowest stability margin caliber (c.f. > 2.0)  = 4.0010
speed when leaving launch rail (c.f. > 22.0) = 20.0737 m/s
altitude at apogee (c.f. > 105.0)           = 90.2172 km
LFETS LOX velocity (c.f. < 9.144)           = 5.5849 m/s
LFETS IPA velocity (c.f. < 9.144)           = 4.7673 m/s
design thrust (ground level) (c.f. < 5500)   = 9192.0443 N

```

Figure 35. Constraint satisfaction with 5.5 kN engine thrust constraint.

The result is a roughly 9 kN engine with 90 km apogee. Reducing the constraint to 5.4 kN, I found that the optimal apogee was a scant 14 km. The sweet spot for the constraint is 5.49698 kN, which produces an apogee of 83 km with an engine thrust of 9 kN, shown in Figure 36.

```

CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0)          = 6.4671 deg
L/D ratio (c.f. < 25.0)                     = 31.9447
fin flutter ratio (c.f. > 1.0)               = 34.5250
Sommerfield criterion (c.f. pe/pa >= 0.35)   = 0.6618
max acceleration (c.f. < 15.0)              = 6.8493 gs
TWR at lift off (c.f. > 2.0)                 = 1.0711
Lowest stability margin caliber (c.f. > 2.0)  = 3.9664
speed when leaving launch rail (c.f. > 22.0) = 19.8191 m/s
altitude at apogee (c.f. > 105.0)           = 83.6215 km
LFETS LOX velocity (c.f. < 9.144)           = 5.5057 m/s
LFETS IPA velocity (c.f. < 9.144)           = 4.6997 m/s
design thrust (ground level) (c.f. < 5496.98) = 9065.8888 N

```

Figure 36. Constraint satisfaction with optimized engine thrust constraint.

Building a launch rail greater than 10 meters is difficult; therefore, I ran the simulation with the LAUNCH_TOWER parameter set to 9.8 m, shown in Figure 37.

```

Launch Parameters
# Launch constants
# Vertical Launch Area at Spaceport America
LAUNCH_SITE_ALT = 1381 # m, altitude of launch site above sea level, from freemaptools.com/elevation-finder.htm
LAUNCH_TOWER    = 9.8 # launch rail height in m
LAUNCH_SITE_LOC = 132.940643717444, -106.92178220379703 # dec deg N, E from google maps
AS_PERTURB      = 158.19822500605724
EL_PERTURB      = 0.3421796303215663

```

Figure 37. Launch Parameters with reduced launch rail length.

The optimal CONS_THRUST parameter in this case is somewhere between 5599.6 and 5599.7. Figure 38 displays the results for those two options.

```

CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0)          = 4.9819 deg
L/D ratio (c.f. < 25.0)                     = 19.2188
fin flutter ratio (c.f. > 1.0)               = 28.9802
Sommerfield criterion (c.f. pe/pa >= 0.35)   = 1.4887
max acceleration (c.f. < 15.0)              = 3.2883 gs
TWR at lift off (c.f. > 2.0)                 = 2.0768
Lowest stability margin caliber (c.f. > 2.0)  = 3.2218
speed when leaving launch rail (c.f. > 22.0) = 20.0714 m/s
altitude at apogee (c.f. > 105.0)           = 14.2009 km
LFETS LOX velocity (c.f. < 9.144)           = 3.2942 m/s
LFETS IPA velocity (c.f. < 9.144)           = 2.8119 m/s
design thrust (ground level) (c.f. < 5599.6) = 5664.9528 N

CONSTRAINTS
-----
Largest angle of attack (c.f. < 8.0)          = 6.6632 deg
L/D ratio (c.f. < 25.0)                     = 31.9341
fin flutter ratio (c.f. > 1.0)               = 33.4302
Sommerfield criterion (c.f. pe/pa >= 0.35)   = 0.6618
max acceleration (c.f. < 15.0)              = 7.2042 gs
TWR at lift off (c.f. > 2.0)                 = 1.2110
Lowest stability margin caliber (c.f. > 2.0)  = 3.8711
speed when leaving launch rail (c.f. > 22.0) = 15.3504 m/s
altitude at apogee (c.f. > 105.0)           = 77.8307 km
LFETS LOX velocity (c.f. < 9.144)           = 5.8874 m/s
LFETS IPA velocity (c.f. < 9.144)           = 5.0255 m/s
design thrust (ground level) (c.f. < 5599.7) = 9672.8167 N

```

Figure 38. Constraint satisfaction to find sweet spot of CONS_THRUST parameter.

The apogee is dismal for the first and the engine thrust is too high for the second. With a 9.8 m launch rail, along with the CONS_THRUST parameter set to 5599.67, we have an apogee of roughly 83 km and engine power of 9.8 kN. The result is still too powerful of an engine, so we need to experiment with the initial fin parameters to reduce the required thrust. We will investigate the velocity off the launch rail related to the engine thrust. The “event_manager” function shown in Figure 39 contains the desired parameter and Figure 40 shows the related launch velocity analysis code.

```

if (not rkt.off_tower and np.linalg.norm(new[1] - state_list[0][0][1]) >= LAUNCH_TOWER and
    np.linalg.norm(state[1] - state_list[0][0][1]) < LAUNCH_TOWER) or rkt.tip_off_steps != 0:
    if rkt.tip_off_steps == 0:
        rkt.off_tower = True
        rkt.tower_index = len(state_list)
        rkt.launch_speed = np.linalg.norm(state[3])

```

Figure 39. Velocity off launch rail (rkt.launch_speed parameter).

```

run OpenRocket_Interface.ipynb

init_array = [M_PROP, MDOT, P_S, LOX_TANK_P, IPA_TANK_P, ENG_PC]
ipawt, w_ratio, p_ch, Td, MM_gamma, _ = propellant_optimizer(init_array[0])
sim_trajectory(False, 0, 0, 0, 0, 0, 0, init_array[0], init_array[1],
               THROTTLE_WINDOW, MIN_THROTTLE,
               RCS_MDOT, P_S, RCS_PC, PC)
BURNLIST = Td * 0.3302 + 0.6981377007977318 * 0.4044 + 0.003175, COM_NOER_L, #enter larger tin parameters
            init_array[3], init_array[4], RIDT, NUM_RADS_OURNS,
            ASFWF, IN_RAD, ipawt, w_ratio, init_array[5], Td, gamma, MM,
            [0, 0, AL_PERTURB, EL_PERTURB, True, 0, 0, 0, 0, 0, True],
            0.025, False, 0.045, False, False)

[-2.14689896e-04 1.22471226e-04 3.49119566e+00]

print(sim.LVL_launch_speed, "m/s")
print(min.thrust[0], "N")

23.47499314736307 m/s
14134.541128133678 N

```

Figure 40. Launch velocity analysis code.

With the standard fins and unoptimized initial design vector, we have a launch velocity of 23.47 m/s and engine thrust of 14 kN. We would like to reduce the engine thrust to around 10 kN, which means the optimized design should be < 7 kN. The plan was to drop a rectangular fin can, meaning that only the fin root and tip chord lengths would be changed. Increasing the fin root and tip chords by 8 m, the velocity off the launch rail decreases to 19.3 m/s; however, the engine thrust remains unchanged at 14 kN.

3.7. Fin Staging/Optimization

Fin geometry is defined by the root, tip, sweep angle, semispan, and thickness, as in Figure 41.

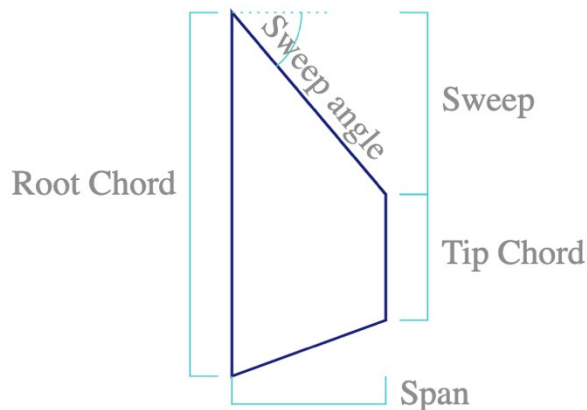


Figure 41. Typical Fin Nomenclature (Barrowman Package – Barrowman 0.0.1 Documentation).

To simulate dropping a fin can mid-flight, we create a second rocket object with new fin parameters. The idea here is to reduce the required engine thrust by starting out with larger fins, and then the smaller fins will reduce drag in the upper atmosphere. The function pictured in Figure 42 performs fin resizing.

```
def fin_resizing(LV4, root, tip, sweep, span, thickness, mass_red):
    new_rocket = LV4
    new_rocket.fin.root = root
    new_rocket.fin.tip = tip
    new_rocket.fin.sweep_angle = sweep
    new_rocket.fin.semispan = span
    new_rocket.fin.thickness = thickness
    new_rocket.mass = new_rocket.mass - mass_red
    return new_rocket
```

Figure 42. Fin resizing function.

In the trajectory simulation notebook, I have modified the `event_manager`, `time_step`, `integration`, and `trajectory` functions to accommodate fin staging, in particular the code seen in Figure 43.

```
if fin_staging and (state[1][2] >= stage_drop_ECFB):
    rkt = fin_resizing(rkt, root, tip, sweep, span, thickness, mass_red)
```

Figure 43. Fin staging condition in event manager function.

The stage_drop_ECEF—Earth-centred, Earth-fixed coordinate system (‘Earth-Centred, Earth-Fixed Coordinate System’)—parameter determines the altitude at which we drop the fin can module. To convert from altitude to ECEF, the function pictured in Figure 44 is used.

```
def altitude_to_ECEF(alt):  
    return (alt + 6.371e3)  
  
drop ECEF = altitude to ECEF(50) # enter drop altitude here
```

Figure 44. Altitude to ECEF for entry in trajectory function.

The trajectory function now includes parameters related to fin staging, seen in Figure 45.

```
def trajectory(fin_staging, stage_drop_ECEF, stage_root, stage_tip, stage_sweep, stage_span, stage_thickness,
              mass_red, prop, mdot, p_e,
              throttle_window, min_throttle,
              rcs_mdot, rcs_p_e, rcs_p_ch,
              ballast, root, tip, sweep, span, thickness, con_nose_l,
              tank_p_o, tank_p_f, rib_t, num_radl_dvns,
              airfrm_in_rad, ipa_wt, of_p_ch, f_ch, ke, mm, perturbations,
              dt, adaptive_False, tol=0.005, descend=False, FEMSE, early_return=False, recovery=False):
```

Figure 45. Trajectory function arguments.

Figure 46 displays the documentation added to the main MDO notebook.

Fin Staging - the first 8 arguments of the trajectory function are:

- 1) The boolean variable `fin_staging`, indicating whether or not you would like to simulate this
- 2) `stage_drop_ECEF`, enter drop altitude in kilometers into `altitude_to_ECEF` function
- 3) `stage_root`, root chord of new fin
- 4) `stage_tip`, tip chord " "
- 5) `stage_sweep`, sweep angle " "
- 6) `stage_span`, semispan " "
- 7) `stage_thickness`, thickness " "
- 8) `mass_red`, mass of initial larger fin can

Figure 46. Fin staging simulation instructions.

To test the code, we drop the ECEF at 50 km and leave the fin parameters unchanged, with zero mass reduction, as seen in Figure 47.

```
trajectory(True, drop_ECEF, 0.762, 0.3302, 0.6981317007977318, 0.4064, 0.003175, 0
```

Figure 47. Fin staging test arguments.

The simulation produces the same output as was produced prior to adding this functionality, indicating that the code is sound.

To find the ideal altitude for dropping the larger fin can, we must find the point at which the smaller fins are passively stable. McCloud suggested that this be done when the ratio of the center of pressure to the center of mass is around 2. The stability_margin in the MDO calculates this information, shown in Figure 48.

```
stability_margin = (rkt.CoM[2] - update[1][5][6]) / rkt.diameter
```

Figure 48. Center of mass vs. center of pressure metric.

Figure 49 contains the code to find the ideal drop time.

Stability Margin: Find ideal drop time

```
# given 0.025 time step calculate the time at which we should drop the fins
def find_drop_time(stability_list):
    closeness = []
    for item in stability_list:
        closeness.append(abs(item - 2.0))
    index = closeness.index(min(closeness))
    return (index * 0.025)
```

Figure 49. Time after launch to drop the fin can.

Now, the MDO has a component that simulates performance with the smaller fins (post dropping) to find the altitude at which they are passively stable, as seen in Figure 50.

```
smaller_fin_sim = trajectory(False, 0, 0, 0, 0, 0, 0, x[0], x[1], x[2],
    THROTTLE_WINDOW, MIN_THROTTLE,
    RCS_MDOT, RCS_P_E, RCS_P_CH,
    BALLAST, 0.762, 0.3302, 0.6981317007977318, 0.4064, 0.003175, CON_NOSE_L,
    x[3], x[4], RIB_T, NUM_RADL_DVSNS,
    AIRFRM_IN_RAD, ipa_wt, of_ratio, x[5], Tc, gamma, MW,
    [0, 0, AE_PERTURB, EL_PERTURB, True, 0, 0, 0, 0, 0, 0, True],
    0.025, False, 0.045, False, False)

drop_time = find_drop_time(smaller_fin_sim.stability_margin)
time_diff = []
for item in smaller_fin_sim.t:
    time_diff.append(abs(item - drop_time))
min_index = time_diff.index(min(time_diff))

def altitude_to_ECEF(alt):
    return (alt + 6.371e3)

drop_ECEF = altitude_to_ECEF(smaller_fin_sim.alt[min_index])
```

Figure 50. Finding the ideal drop altitude.

The code shown in Figure 51 prints the altitude at which the fins are dropped, as well as the Mach number at that point.

```
time_diff_2 = []
for item in sim.t:
    time_diff_2.append(abs(item - drop_time))
min_index_2 = time_diff_2.index(min(time_diff_2))
print("Fin drop altitude: ", smaller_fin_sim.alt[min_index_2]/1000, "km")
print("Mach number upon fin dropping: ", sim.Ma[min_index_2])
```

Optimization done!

```
[-1.79217336e-04  1.02235629e-04  3.99217627e+00]
[-1.79217336e-04  1.02235629e-04  3.99217627e+00]
Fin drop altitude:  0.007434751872904598 km
Mach number upon fin dropping:  0.02662397778539716
```

Figure 51. Displaying fin drop altitude and the Mach number at that point.

In Figure 52, a plot of the stability margin versus time has been added in order to double-check the fin drop logic and find ideal fin sizing. This process, shown in Figure 53, involved modifications to the Trajectory_Simulation, Display_Information, and MDO notebooks, as the rocket_plot function required an additional parameter “stability” for the stability margin list.

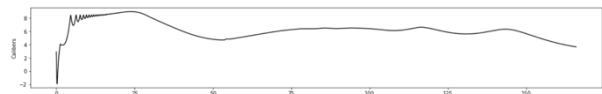


Figure 52. Calibers vs Time plot in MDO Notebook.

```
def rocket_plot(t, alt, v, a, F, q, Ma, stability,
ax7.plot(t[start:end], stability[start:end], 'k')
ax7.yaxis.major_locator.set_params(nbins=10)
ax7.set_ylabel("Calibers")
ax7.set_xlabel("t (s)")
```

Figure 53. Modifications to Display_Information enabling stability (calibers) vs. time plot.

The initial fluctuation (especially that of the negative section of the graph) does not seem to be physical; rather, when the wind is turned on in the trajectory simulation, and before the rocket has left the launch rail, there is an interval during which the wind velocity dominates the rocket's velocity, meaning that the angle of attack is ~ 45 degrees or more. This interferes with the update [1][5][6] (indexing into multidimensional array) parameter in Fig. 48, which is the center of pressure and the seventh element of the array returned by the aero function in the Aerodynamics_Model notebook, as in Figure 54.

```
return np.array([force_body, torque_body, v0, dyn_press, Ma, alpha, CoP[2])
```

Figure 54. Array returned by the aero function in the Aerodynamics Model.

This explanation has been verified by turning off the wind and viewing the stability plot, seen in Figure 55.

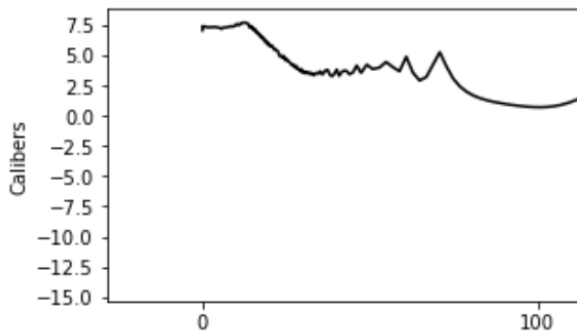


Figure 55. Stability plot with wind turned off (now strictly positive).

A plot of the first five seconds of the stability metric was added, given the fluctuating behaviour, with a line indicating the time at which the rocket has left the launch rail, as in Figure 56.

```
def Init_Stability(sim):
    off_rail = sim.t[sim.tower_index]
    plt.plot(sim.t[0:200], sim.stability_margin[0:200], 'k')
    plt.axvline(x=off_rail)
    plt.ylabel("Calibers")
    plt.xlabel("t (s)")
    plt.show()
    return None
```

Figure 56A. Stability metric code.

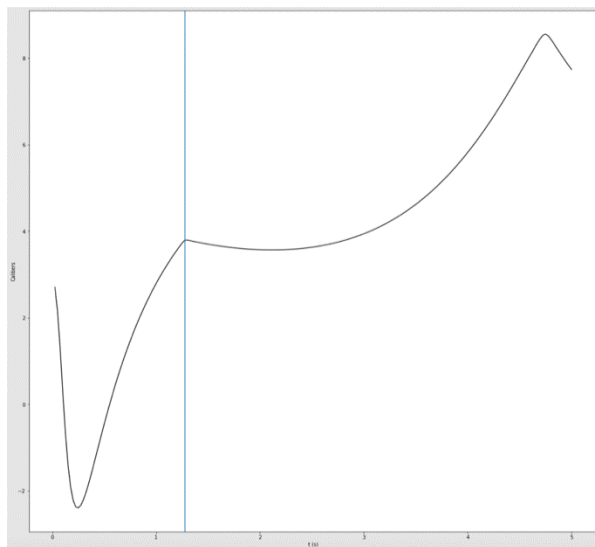


Figure 56B. Stability metric: first five seconds post-launch.

Given that the stability is quite high without fin staging, I reduced the fin root and tip chords

by 0.2 m. The result, shown in Figure 57, is a minimum just above 2.

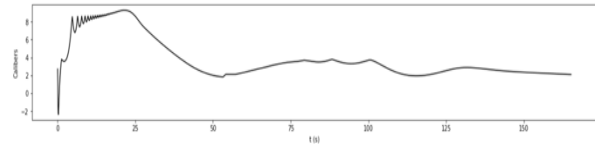


Figure 57. Calibers vs. time with reduced fin length.

On adding the fin root and tip chords to the design vector along with boundaries for these values incentivizing a larger root than tip chord, SHGO produces the design parameters pictured in Figure 58.

```
DESIGN VECTOR
-----
design total propellant mass           = 306.5331 kg
design unadjusted propellant mass      = 299.9971 kg
design mass flow rate                  = 5.4960 kg/s
design nozzle exit pressure             = 57563.9675 Pa
total tankage length (after adjustment) = 5.1717 m
design airframe diameter                = 0.3048 m.
design airframe total length           = 9.7366 m.
design GLOW                            = 445.9791 kg
design ballast mass                    = 2.0000 kg
conical part of nosecone length        = 1.0923 m
design fin root chord                  = 0.6531 m
design fin tip chord                   = 0.4723 m
design fin sweep angle                 = 40.0000 deg
design fin span                        = 0.4064 m
design fin thickness                   = 3.1750 mm
```

Figure 58. Optimized fin root and tip chords.

The stability was still quite high for this iteration, so McCloud recommended that the semispan be added to the design vector, shown in Figure 59.

```
[M_PROP, MDOT, P_E, LOX_TANK_P, IPA_TANK_P, ENG_P_CH, FIN_ROOT, FIN_TIP, FIN_SEMISPAN]
```

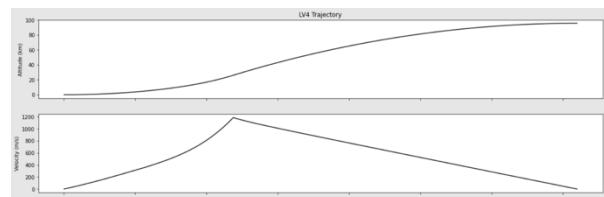
Figure 59. Modified design vector variables.

Figure 60 displays the boundaries given to SHGO.

```
shgo(f, bounds=[*zip([75,2,86346/1.5, 805000/2,805000/2, 344738*1.5, 0.8, 0.5, 0.15],
[300,6,86346*1.5,2.068e6, 2.068e6, 4.137e6, 1.8, 0.9, 0.9]])]
```

Figure 60. Boundaries on design vector values given to SHGO.

Figure 61A–C contains the results.



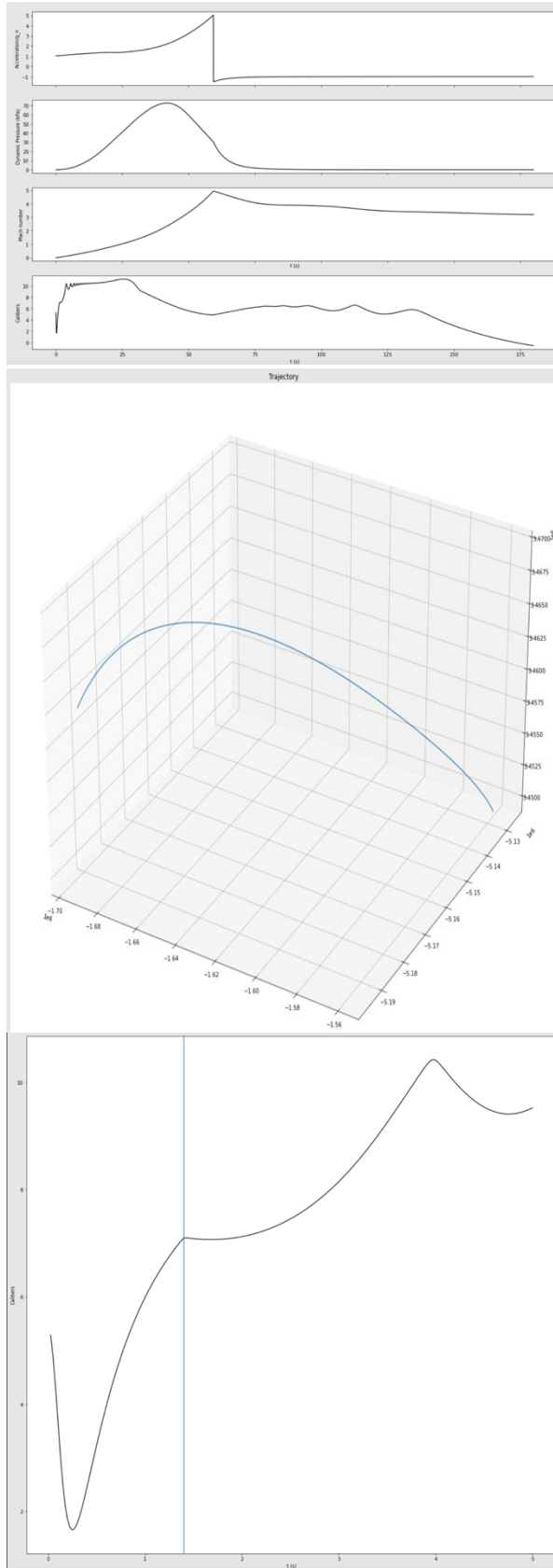


Figure 61A. Trajectory and stability metric: optimized fins.

DESIGN VECTOR

| | |
|---|-----------------|
| design total propellant mass | = 306.2610 kg |
| design unadjusted propellant mass | = 299.7172 kg |
| design mass flow rate | = 4.9497 kg/s |
| design nozzle exit pressure | = 57563.9985 Pa |
| total tankage length (after adjustment) | = 5.1669 m |
| design airframe diameter | = 0.3048 m. |
| design airframe total length | = 9.7318 m. |
| design GLOW | = 445.9012 kg |
| design ballast mass | = 2.0000 kg |
| conical part of nosecone length | = 1.0923 m |
| design fin root chord | = 0.5145 m |
| design fin tip chord | = 0.1640 m |
| design fin sweep angle | = 40.0000 deg |
| design fin span | = 0.6942 m |
| design fin thickness | = 3.1750 mm |

Figure 61B. Design vector: optimized fins.

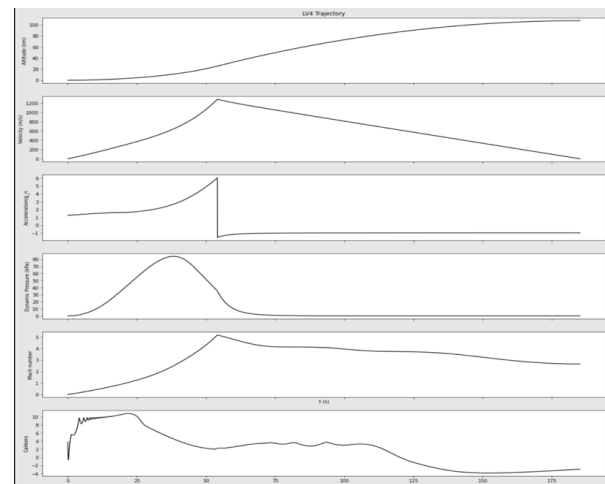
CONSTRAINTS

| | |
|---|---------------|
| Largest angle of attack (c.f. < 8.0) | = 6.9743 deg |
| L/D ratio (c.f. < 25.0) | = 31.9285 |
| fin flutter ratio (c.f. > 1.0) | = 19.1983 |
| Sommerfield criterion (c.f. $pe/pa \geq 0.35$) | = 0.6618 |
| max acceleration (c.f. < 15.0) | = 6.7540 gs |
| TWR at lift off (c.f. > 2.0) | = 1.0464 |
| Lowest stability margin caliber (c.f. > 2.0) | = 4.8811 |
| speed when leaving launch rail (c.f. > 22.0) | = 14.3173 m/s |
| altitude at apogee (c.f. > 105.0) | = 95.5472 km |
| LFETS LOX velocity (c.f. < 9.144) | = 5.4400 m/s |
| LFETS IPA velocity (c.f. < 9.144) | = 4.6436 m/s |
| design thrust (ground level) (c.f. < 5800) | = 8961.1662 N |

Figure 61C. Constraint satisfaction information indicating acceptable apogee with 9 kN engine: optimized fins.

Here, we achieve feasible fins and a 95 km apogee with a 9 kN engine. The root and tip chords are relatively small, making for a reasonable altitude (less drag), and the larger span corresponds to greater stability, which contributes to a reduced engine thrust.

The minimum stability is still quite high, so we scale down the optimized fin parameters to 80%, reducing the fin area. The result is an apogee of 107 km with a 9.8 kN engine, seen in Figure 62.



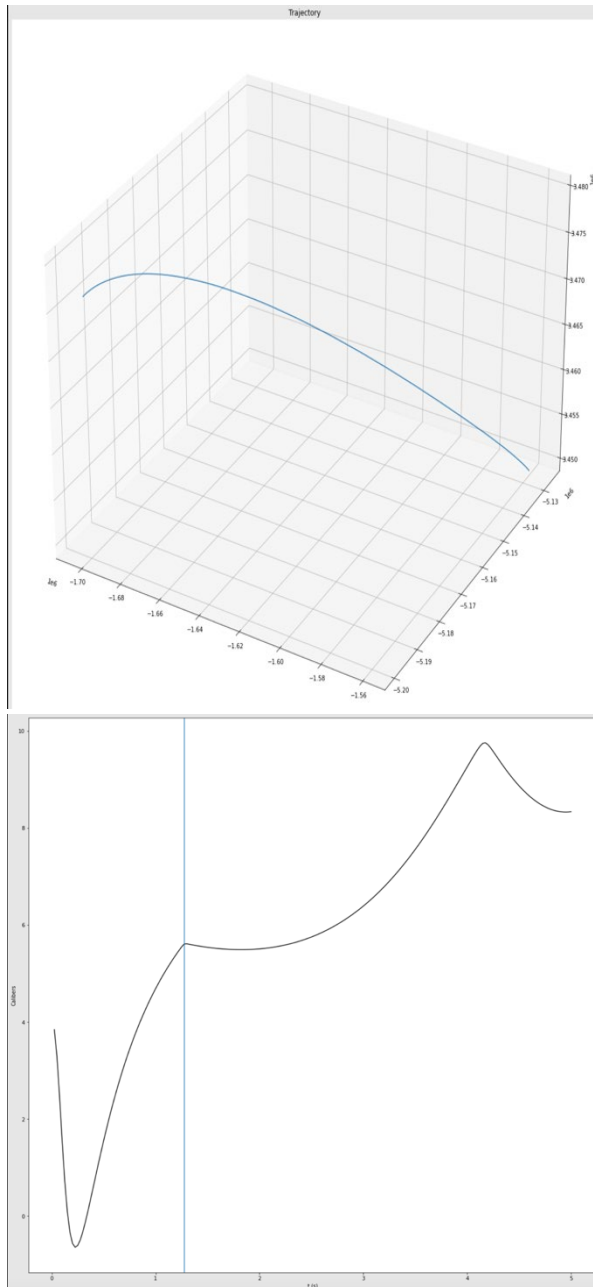


Figure 62A. Trajectory and stability metric: optimized fins scaled down to 80%.

DESIGN VECTOR

| | |
|---|-----------------|
| design total propellant mass | = 306.2930 kg |
| design unadjusted propellant mass | = 299.7606 kg |
| design mass flow rate | = 5.4331 kg/s |
| design nozzle exit pressure | = 57563.9918 Pa |
| total tankage length (after adjustment) | = 5.1676 m |
| design airframe diameter | = 0.3048 m. |
| design airframe total length | = 9.7326 m. |
| design GLOW | = 442.9361 kg |
| design ballast mass | = 2.0000 kg |
| conical part of nosecone length | = 1.0923 m |
| design fin root chord | = 0.4116 m |
| design fin tip chord | = 0.1312 m |
| design fin sweep angle | = 40.0000 deg |
| design fin span | = 0.5554 m |
| design fin thickness | = 3.1750 mm |

CONSTRAINTS

| | |
|---|---------------|
| Largest angle of attack (c.f. < 8.0) | = 6.4908 deg |
| L/D ratio (c.f. < 25.0) | = 31.9310 |
| fin flutter ratio (c.f. > 1.0) | = 24.5095 |
| Sommerfield criterion (c.f. $pe/pa \geq 0.35$) | = 0.6618 |
| max acceleration (c.f. < 15.0) | = 7.6165 gs |
| TWR at lift off (c.f. > 2.0) | = 2.2574 |
| Lowest stability margin caliber (c.f. > 2.0) | = 2.0206 |
| speed when leaving launch rail (c.f. > 22.0) | = 15.5879 m/s |
| altitude at apogee (c.f. > 105.0) | = 107.6219 km |
| LFETS LOX velocity (c.f. < 9.144) | = 5.9712 m/s |
| LFETS IPA velocity (c.f. < 9.144) | = 5.0971 m/s |
| design thrust (ground level) (c.f. < 5599.67) | = 9805.8223 N |

Figure 62B. Design vector and constraint satisfaction information indicating ideal apogee with 9.8 kN engine: optimized fins scaled down to 80%.

This is the ideal design. The 9.8 kN thrust may be realized by using two 5 kN engines. What remains unexplained is the 120 km vehicle drift (calculated by considering the coordinates at launch and apogee, as in Figure 63).

ADDITIONAL INFORMATION

started at (lat, long, height): (32.94066362617013, -106.92170468292086, 1385.0087711460915)
ended at (lat, long, height): (32.607725193057234, -108.13965149845598, 108890.64253619876)

Figure 63. Coordinates at launch and apogee.

Setting the wind parameter to False in the trajectory function increases drift to 121 km, which means there is either an error in the MDO or the wind does not contribute to the drift. Therefore, I have added a plot of the angle of attack from when the rocket leaves the launch rail to just before engine burnout, pictured in Figure 64.

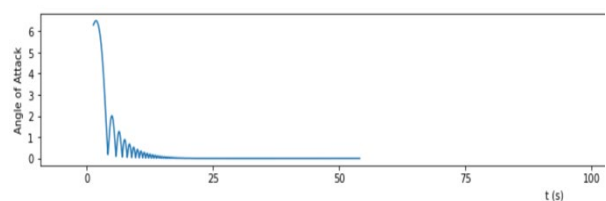


Figure 64. Angle of attack from leaving the launch rail to just before engine burnout.

Pictured is a non-zero angle of attack; however, it is not significant enough to constitute a 120 km drift. One potential hypothesis is that the drift is due to the combination of the Coriolis acceleration and the wind; however, upon setting these variables to zero and false, respectively, the drift actually increased to 126 km, which means that there must be some computational error in the MDO notebook.

4. Conclusion

In this work, I set out to improve and extend the existing open-source Multidisciplinary Design Optimization (MDO) simulation code. I evaluated different optimization approaches such as standard global optimization with RBFOpt, Nelder-Mead with different local minimization approaches, and Simplicial Homology Global Optimization. I found the SHGO approach to be the most effective and converged on the ideal design vector upon including fin parameters and scaling down given stability margin information. The 120 km vehicle drift was caused by some computational error in the notebook. This has been confirmed by running trajectory simulations with the design variables returned by the MDO, which indicate that the wind is the cause of the large vehicle drift. Further debugging and testing are required. However, the convergence of that ideal design vector serves as a theoretical guidance to the PSAS engineering team going forward.

Acknowledgements

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Indigenous Voices Reshaping Cinema: Native American Representation in *Dances with Wolves* (1990) and *Montford: The Chickasaw Rancher* (2021)

Tom Farrenkopf*

Abstract

In 2015, film critic Angela Aleiss wrote that “*Dances with Wolves* created a watershed... no Western has had such a powerful impact.” More than thirty years have passed since the release of the film *Dances with Wolves* in 1990, and since then, there have been significant shifts in public opinion and government policies regarding Indigenous rights and representation. Sports franchises are parting ways with former idols, and the US government has allocated substantial financial resources for providing healthcare to Indigenous communities, among other endeavors. Against this shifting cultural backdrop, the present research project seeks to investigate how, if at all, the representation of Native Americans in the American film industry has changed since 1990. To address this inquiry, I adopt a comparative analysis approach, drawing on the films *Dances with Wolves* and *Montford: The Chickasaw Rancher* (2021). The two key areas of examination are the on-screen portrayal of stereotypical character types and the off-screen employment practices of production companies. Scholars and activists have argued that the cinematic representation of Native Americans has traditionally been confined to that of stereotypical characters, which has been deemed harmful to the Native American population's perceived identity. While both films employ such character types, the filmmakers of “*Montford*” utilize narrative techniques to mitigate, subvert, and identify these representations. With respect to hiring practices, a small increase in the number of Native Americans employed in roles involving creative control occurred over time. Overall, the most noteworthy and observable transformation within the American film industry has been the substantial rise in the number of film production companies owned and operated by Native Americans.

1. Introduction

“It gives me pleasure to announce to Congress that the benevolent policy of the Government, steadily pursued for nearly thirty years, in relation to the removal of the Indians beyond the white settlements is approaching to a happy consummation. Two important tribes have accepted the provision made for their removal at the last session of Congress, and it is

believed that their example will induce the remaining tribes also to seek the same obvious advantages...The present policy of the Government is but a continuation of the same progressive change by a milder process. The tribes which occupied the countries now constituting the Eastern States were annihilated or have melted away to make room for the whites...” —U.S. President Andrew Jackson, December 6, 1830.

*Tom Farrenkopf (tomf@uoregon.edu) graduated in 2023 with a Bachelor of Science in Cinema Studies, accompanied by a minor in Sociology. Their capstone undergraduate research project, titled “*Indigenous Voices Reshaping Cinema: Native American Representation in *Dances with Wolves* (1990) and *Montford: The Chickasaw Rancher* (2021),” explores the portrayal of Native Americans in film. Tom conducted this research under the guidance and mentorship of Dr. Ari Purnama, Assistant Professor of Cinema Studies. Building on their achievements, Tom has been accepted into the University of Southern California's School of Cinematic Arts, where they have been honored as a 2023 Shriram Fellow. With an ultimate ambition of attaining a doctorate in the cinematic arts, Tom aspires to contribute to academia as a professor of cinema studies.*

The comprehensive eradication of the Native American populace constituted, on certain occasions, an overt objective pursued by the United States government and its constituents, who sought to capitalize on governmental initiatives to displace Indigenous people, notably exemplified by the Homestead Act of 1862. During this period, myths of so-called unholy savages circulated amongst those involved with the westward expansion effort. From spoken word, transmitted through oral stories, this troublesome stereotype¹ became widely circulated through books, wild west shows, and eventually, full-length movies. From its inception, the American film industry has utilized these character types and continued to represent the Native American population in such a way that, as Jackson stated, “make[s] room for the whites.” In the early years of cinema, imagery of Native Americans was utilized for the monetary gains of white filmmakers. For instance, in *The Daughters of Dawn* (1921), director Norbert Myles employed an entirely Native American cast with nearly 300 actors (Franklin 2014). Nevertheless, the film maintains an overly romanticized portrayal of those Indigenous characters represented. Furthermore, Native Americans rarely received production offers outside of acting roles, and, as I will discuss later, this trend continues in contemporary filmmaking. However, over the last 31 years, a significant increase in Native American film production companies raises the following question: *How, if at all, has the American film industry altered its relationship with Native Americans between 1990 and 2021?*

In the study that follows, five main subareas of research will provide further examination of these topics. First, I describe a specific subset of Native American stereotypical representations in

order to lay the framework for evaluating *Dances with Wolves* and *Montford: The Chickasaw Rancher*. The stereotypes selected for examination relate to the representations portrayed in these films. Following the breakdown of these stereotypes, a two-part analysis—one for each film—will contribute to an examination of on-screen portrayals and highlight how these ideas are represented in each film. In the fourth section, an analysis of employment practices aims to understand how representation behind the camera may influence representation in front of the camera. Lastly, the final topic discussed in this research is why representation in film matters and how the continued utilization of historical stereotypes is potentially damaging to those Indigenous viewers who identify with these fictional ideas.

2. Methodology

Through a comparative examination of modern and historic films featuring Indigenous characters and themes, there appears to occur an observable and measurable change related to the degree of Indigenous representation. My research takes both qualitative and quantitative approaches to understanding whether and how Native American representation within the American film industry has changed.

To begin with, this paper utilizes a comparative analysis approach by examining two movies produced within the American film industry in order to understand what change has occurred and how. The films analyzed are *Dances with Wolves* (Costner 1990) and *Montford: The Chickasaw Rancher* (Frankowski 2021).

While national opinion and policy have continued to shift over time, the impact of films like *Dances with Wolves* has aided public awareness of Indigenous issues. The shift in general national awareness and governmental policies that followed the film constitutes the most significant reason for selecting this film. In 1991, after significant box office and industry-

¹ Onscreen portrayals of stereotypical characters are characterized as simplified and one-dimensional representations of individuals or groups that conform to fixed patterns based on attributes such as sex, race, religion, profession, or age.

wide success, *Dances with Wolves* was nominated for 12 Academy Awards and received seven. As described in a Native American online news source, Indian Country Today, a 2015 article by Dr. Angela Aleiss² states, “*Dances with Wolves* created a watershed... no western has had such a powerful impact.” While it cannot be definitively proven whether the film directly affected policymakers, the immediate years after its release saw significant policy changes. For instance, in 1993, U.S. President George H.W. Bush renamed Custer’s National Monument to Little Bighorn National Monument., in 2010, the Patient Protection and Affordable Care Act provided healthcare access for all registered members of the 574 federally recognized Indigenous tribes. Within this legislation, Native American households earning less than 300 percent of the federal poverty line were eligible to receive universal healthcare at no cost. These contemporary U.S. government policies represent a significant change in priorities from the former policies that worked up to and included the expulsion, “civilization,” and annihilation of the Native American population.

Montford: The Chickasaw Rancher is the second film selected for qualitative analysis. Intending to understand how the film industry has altered its relationship with Indigenous cultures over the last thirty-year period, I elected to examine a contemporary film that boasted its inclusion of more than 200 Native American cast and crew members. Additionally, the film’s production company is the Native-owned Chickasaw Nation Productions. In a preliminary assessment of this film, these factors stood out as distinctive when compared with other productions created within the American film industry.

An observable weakness of this research method is its limited scope. While this work is nowhere near an exhaustive examination of a larger cross-section of films, it opens the door to

future dialogue and investigation.

The second approach involves the statistical analysis of each film’s hiring practices. My analysis specifically examines those key roles with direct creative control over the film’s production, including positions both in front of and behind the camera. Since representation behind the camera may significantly affect the product created, this second approach identifies a crucial factor. Production companies require a substantial amount of labor on the opposite side of the camera and employ hundreds of workers to complete various tasks during the production process.

One way to categorize crew members is to divide them into two district groups, referenced by their place above or below a “line.” In this instance, the term “line” references the distinction between those who maintain creative control of the film’s ultimate product (above-the-line) and those completing tasks to fulfill the vision of filmmakers (below-the-line) (Clevé 2016, 6). For the purposes of this research, above-the-line positions include the following creative positions: director, writer, producer, casting director, cinematographer, and principal cast. It is significant to note this distinction because Chickasaw Nation Productions, the production company for *Montford: The Chickasaw Rancher*, states on their website that over 200 Native American cast and crew members worked on the film.¹ Additionally, I have analyzed publicly available information on each production team member, if available, to determine each member’s nationality or status as a recognized Native American or First Nation citizen of one of the 574 federally recognized tribes. This information is publicly available on an array of sites such as IMDB, individual portfolio sites, or film credits. For example, I accessed Robyn Elliot’s information through the Chickasaw Nation legislative department website. In the case of Lucy Tennessee Cole, a screenwriter for *Montford*, there is no publicly available information; thus, they represent an unknown

² Dr. Angela Aleiss is a professor of film studies and has published multiple books on Native American representation within the American film industry.

portion of this sample. To further break down these groups, I elected to look at the top ten acting roles from each film, as shown in their respective credit sequences. In conjunction with the six creative directing roles, I examined a total of 16 positions for *Dances with Wolves* and 17 for *Montford: The Chickasaw Rancher*.

Overall, this unit of measure is limited in that it maintains the U.S. government's power of determination and overlooks those who do not fall within the established classification. Of paramount importance to this research is the recognition that the publicly available information utilized for each individual, where applicable, strictly adheres to the classification of membership in a federally recognized tribe and is comprehensively included as such. This approach ensures the accuracy and validity of the data used in the study, thereby upholding the integrity and credibility of the findings. By meticulously adhering to the recognition of federal tribal affiliations, the research maintains a rigorous and principled stance, safeguarding against misrepresentations and misconceptions that may arise in the absence of such precise classification.

Through the utilization of these two approaches, my goal is to gain an understanding of Indigenous cinematic representation based on the qualities of each.

3. Framing Historical Stereotypes for Film Evaluations

To lay the foundation for the cases of stereotypical representation utilized in these films, I must first establish the framework of these ideas. To this end, I have elected to provide a brief overview of each stereotypical character type and provide background information from those scholars—in film or otherwise—that have contributed to these ideas. Throughout American film history, filmmakers have repeatedly utilized numerous oversimplified Native American

stereotypes that are problematic in their presentation. Several of these stereotypes are utilized in contemporary films. For example, in the Disney film *The Lone Ranger* (2013), Johnny Depp portrays a fictional Comanche character. The process of granting white actors a role outside of their race is known as “whitewashing,” or, in this case, acting in “redface.”

Before I lay the framework for these stereotypes, it is worth mentioning that the stereotypes presented in this project constitute but a fraction of the overall representations utilized within the American film industry. Furthermore, I find it significant to clearly state that these stereotypes were typically not created by the American film industry. More exactly, many of these ideas were initially created through literary works, photography, wild west shows, and various forms of oral tradition. In some cases, these stereotypes were constructed as colonizing tools utilized as justification for murder. However, it is through film and live shows that these stereotypes have gained a visual representation.

The principal error within these stereotypes is that they brand all Native Americans as the same one-dimensional characters. In one way or another, these stereotypes have been utilized to paint an inaccurate portrayal of the relationship between the white colonizers and Native Americans. As one scholar writes, “[w]hile Native American community members have tried to amend and correct them, these stereotypes still inform popular culture and curricula” (Raheja 2013, 222). While these stereotypical representations remain numerous in their presentation, this study will examine those examples that correlate with the two selected films.

In the book *Killing the Indian Maiden* (2009), M. Elise Marubbio extensively examines the representation of Native American women as portrayed in films. Within this book, Marubbio identifies a representative idea that they refer to as the Celluloid Princess. One of the most cited

and recognizable examples of this stereotype comes from Disney's animated film *Pocahontas* (1995). This stereotype is realized when a Native American woman falls in love with a member of a group of invading white colonizers and works to bridge the gap between the two groups. It is the sexualization of the exotic other that propels the white male character into a relationship with the Celluloid Princess (Marubbio 2009, 43), and it is the Celluloid Princess who suffers the most and commonly dies as a direct result of the relationship. In one way, this suffering is most often initiated after the two engage in an intimate affair and the white male is forced to end the relationship (Marubbio 2009, 43).

Another stereotypical idea—that Native warriors have been and are frequently engaged in all levels of criminal activities—has its roots in how white Euro-Americans viewed the Indigenous population and utilized their criminalization as justification for murder. Having permeated many aspects of American life, the idea of Native “warriors” is reflected in numerous entertainment industries. Specifically, within the American film industry, this idea is represented by the stereotypical characteristics of the bloodthirsty warrior/savage: “[t]he bloodthirsty warrior is a vicious, animalistic beast, attacking white men and kidnapping white children” (Boyd 2015, 106). These “savages” are presented as cold, heartless animals that possess only one goal: assailing the white man. The idea that “[e]specially in Western films, the bloodthirsty, war-crazed Indian has been Hollywood's stock and trade” (Rollins and O'Connor 2002, 33) highlights a prevailing stereotype prevalent in cinematic depictions of Indigenous peoples. The work of Rollins and O'Connor underscores the longstanding presence of such harmful stereotypes in the film industry and emphasizes the need for critical examination and revision of these portrayals to foster more authentic and respectful representations of Indigenous cultures.

Contrasting the idea of the Bloodthirsty

Warrior is that of the noble/spiritual Medicine Man. This character type is frequently depicted as the extreme opposite of the savage warrior and is characterized by their belief in working *with* the invading white colonizers. These magic-wielding characters are portrayed as serving no higher purpose than guiding the white character on their journey. This literary trick—presenting a noble Indigenous character—is counterbalanced with a version of the plain old savage (Rollins et al. 2009, 160). Often depicted as observing whiteness as a holy form of existence, these characters elect to align themselves with the white colonizer and represent the spiritual guiding force that seeks to unite the two groups of people. Through the teachings of the “esoteric secrets” of tribal life, the white warrior is often elevated spiritually and depicted as the savior of the tribe.

The image of the Stoic Indian has been observed in motion pictures since their inception and has remained a common stereotype. As Johanna Feier writes, “warring American Indians were noted for their sternness, which popular culture interpreted as a sign of stoicism and lack of emotion” (2011, 12). These silent, grim, humorless representations is, as Feier argues, a form of “dehumanization... because it presents them as... machines.” The stoic presentation of Native Americans is believed to have grown from the work of photographer Edward Curtis. Throughout his works, it is rare for his Native American subjects to display anything other than a vacant, emotionless expression. The Library of Congress houses thousands of his photos and has achieved significant circulation, perpetuating these mostly one-dimensional images. The character of Edward Curtis's work is important to note because some argue that his work influenced early cinema and how Native Americans were presented (Block & Red Corn 2011). And yet, though this stereotype misrepresents Native Americans, its usage persists.

Opposing the images of the Bloodthirsty Warrior, Native Americans are elsewhere

presented as weak and inferior human beings with limited resources with which to support themselves. Through a sympathetic view, the White Savior is frequently utilized as a form of protection from other white colonizers. Aligning himself with Native tribes, the White Savior comes to their aid when other colonizers determine that these tribes must be moved or eradicated. Furthermore, as previously discussed, the White Savior engages in an intimate relationship with the Celluloid Princess. In this way, the White Savior is entrusted by the tribespeople to bridge the gap between the imperial colonizers and the Native American tribes.

The Nabb Research Center's online exhibit on Native American Representation in Visual Media posits that the concept of the "White Savior Complex" asserts that in scenarios where non-white groups face oppression or perilous threats, the narrative depicts a white individual as the only figure capable of rescuing them from their adversities. This perpetuates the notion of white superiority and benevolence, positioning white characters as the ultimate saviors and reinforcing racial hierarchies. Such portrayals have been criticized for their reductionist and patronizing approach, as they marginalize and undermine the agency and resilience of marginalized communities, including Native Americans.

Another prevailing stereotype related to the white colonizer is the idea known as "going native." This term represents the idea of a white character leaving the safety of their community to completely assimilate into tribal life. Upon their assimilation into the tribe, characters who have "gone native" commonly believe they are experiencing a more divine or wholesome life. While many of the films that employ this stereotype depict the white character as consciously making this decision, outsiders are often convinced that characters who "went native" were kidnapped or forced into joining the tribe. As a result, the tribe is often attacked by outside forces, usually the U.S. Army or a white

militia. This further perpetuates the distinct attitude in the American film industry that Native Americans are inferior to white colonizers. Another aspect of this stereotype is realized when the tribespeople aid their new white member in attacking and/or repelling the advances of their previous society, usually to their own demise, highlighting the expendability of Indigenous characters.

The Half-Breed character constitutes another significant stereotype worth exploring. Typically depicted as an individual grappling with the challenge of reconciling their dual identities—being both white and Indigenous—the Half-Breed character faces animosity from both cultural groups due to their association with the other. They are often viewed with suspicion and distrust, considered untrustworthy, thieves, or disloyal by both communities.

On the other hand, some narratives also present the notion that these characters possess the finest qualities of both races, potentially embodying a blend of noble attributes. In the book "There Must Be a Lone Ranger," Jenni Calder encapsulates this stereotype by asserting that being a Half-Breed confers a distinct advantage over both Indigenous and white individuals. This implies that such characters are somehow positioned within an advantageous middle ground, suggesting that they possess unique strengths arising from both sides of their dual heritage.

This selection of Native American stereotypes commonly utilized in the American film industry was chosen for inclusion due to its connection to the films *Dances with Wolves* and *Montford: The Chickasaw Rancher*. This does not constitute an exhaustive list or description of the existing stereotypes associated with Indigeneity; however, it provides vital framing and context for the films' analysis. From here, I will build upon these ideas in order to explain how they are employed in cinema.

4. *Dances with Wolves* (1990)

Dances with Wolves, a 1990 film directed by Kevin Costner and based on Michael Blake's literary work of the same name, tells the story of Lieutenant John Dunbar, a decorated Civil War veteran who is sent to Fort Sedgewick at the edge of the North American frontier. Upon his arrival, Dunbar discovers the post abandoned. However, as he rehabilitates the fort, Dunbar encounters several members of the Lakota and remains cautious of their interactions. After Dunbar meets Stands With A Fist, a white woman who was raised by the Lakota, Kicking Bird, her adoptive father and a spiritual tribal leader, guides Dunbar on his journey to become fully embraced by the tribe. Dunbar's newfound freedom is threatened when new soldiers arrive and he is taken into custody for abandoning his post at Fort Sedgewick. The Lakota tribe comes to Dunbar's aid and rescues him, upon which Dunbar and Stands With A Fist decide to leave before the army arrives to avoid any further conflict.

After its release in 1990, *Dances with Wolves* rapidly became one of the best-known films of the period. Nominated for 12 Academy Awards, the film ultimately received seven, including best picture, and was the first Western to receive the honor since *Cimarron* (1931). At the time, film critic Tom Matthews wrote in *Boxoffice* magazine, "No doubt destined to do for the Native American what 'Roots' did for the African American slave, this movie is determined to challenge the cruel Indian stereotypes from Ford's day, and in the end, it gives us a rare, sympathetic look at a culture about to [be] annihilated." The film's so-called "sympathetic look" at Indigenous characters may even have gone as far as influencing national policy: on December 10, 1990, U.S. President George H.W. Bush renamed the former Custer National Monument as Little Bighorn National Monument in recognition of both the U.S. Army soldiers and Native Americans that fought at the battle of Little Bighorn. In *The Washington Post*, Paul Valentine wrote, "*Dances with Wolves*' has become an important psychological purgative for white

America. We have finally expelled from our imagery the traditional Hollywood Indian—the shiftless savage who can't hold his liquor—and replaced him with the more complex and authentic characters of Costner's story." And yet, while both Matthews and Valentine argue that the film distances itself from historically inaccurate stereotypes of the day, it remains filled with and built around these ideas, even if they ostensibly appear more "sympathetic." The remainder of this section will explore the generic stereotypes connected with each character in the film.

With few exceptions, *Dances with Wolves* is primarily presented through the perspective of Lieutenant John Dunbar—played by Kevin Costner—who is renamed *Dances with Wolves* once the tribe embraces him as a member. This use of perspective is noteworthy because it represents an invitation for the audience members to become spectators, if not participants, in the depicted representations. That said, Dunbar's character correlates with several previously discussed stereotypes; namely, Dunbar is representative of the White Savior. After working to open lines of communication with the Lakota tribe, Dunbar pursues the Lakota way of life. As the White Savior, Dunbar embraces the Lakota lifestyle, weds Stands With A Fist, and nearly abandons Fort Sedgewick altogether to live full-time with the Lakota tribe. By the end of the film, Dunbar speaks almost exclusively in the Lakota language and incorporates traditional Native American regalia into his daily dress. After returning to Fort Sedgewick to reclaim his journal, which narrativizes his entire experience, Dunbar is mistaken for a tribal member and attacked by the occupying U.S. soldiers. Upon regaining consciousness, Dunbar speaks to the soldiers in the Lakota language, representing his deeper transition into the Indigenous culture, or his "going native."

Dunbar, having secured his place within the tribe—as indicated by their willingness to send a war party to release him—believes the US military will continue to track him and hold him

responsible for the military crime of abandoning his post. Believing it is in the best interest of the tribe, Dunbar and Stands With A Fist leave the tribe behind in hopes of rejoining white society and convincing other colonizers to build a relationship with Native Americans. Dunbar's act of sacrifice, the utilization of his privileged position within white society, and his vehement desire to convince other white settlers to alter their view of Native Americans are further representative of the White Savior stereotype. Through adopting the perspective of John Dunbar, the audience is invited to participate in the "going native" process and celebrate Dunbar's "selfless" deeds as the White Savior.

Stands With A Fist, as portrayed by Mary McDonnell, represents at least two of the previously mentioned stereotypes: the Celluloid Princess and "going native." Viewers watch as Stands With A Fist, originally the child of white settlers, runs away during an attack on her family's settlement; it is assumed that all other family members are murdered during the attack. After surviving the attack, Stands With A Fist is discovered by Kicking Bird and taken in as a member of his family. As she begins to accept her dramatically changed living situation, Stands With A Fist adapts to her new family and the Lakota way of life. This adaptation includes the use of the Lakota language and limited use of the English language, as indicated by her struggle to communicate with John Dunbar during his first verbally communicative meeting with Kicking Bird. From the Euro-American perspective, Stands With A Fist also represents the "going native" stereotype. While this argument may receive opposition because it is assumed that Stands With A Fist does not actively elect to leave behind her white identity and join the Lakota for a more wholesome life, it can be reciprocally argued, then, that her character equally represents the Celluloid Princess. Through her juvenile defiance of an elderly tribe member, Stands With A Fist gained the respect of tribal members and earned her Lakota name. Through

Stands With A Fist's willingness to embrace her newly learned culture and the tribe's subsequent acceptance of her as a member of Kicking Bird and Black Shawl's family and of the tribe, in numerous ways, though she is racially white, Stands With A Fist represents a Lakota woman. In addition to representing the "going native" stereotype, her sympathy for and alignment with John Dunbar dually defines her character as the Celluloid Princess.

During the sequence of shots where Stands With A Fist's white family is murdered by Pawnee warriors, the stereotypical representation of the Bloodthirsty Warrior is placed on display. As a significant plot point, this attack represents the principal reason as to why Stands With A Fist becomes dispersed and is later discovered by Kicking Bird and raised as a member of the Lakota tribe. After telling the Pawnee warriors to flee the area, a warrior gathers a tomahawk from his waist and hurls it into the back of a fleeing settler. Subsequently, the warriors assault the remaining settlers, and it is assumed that all other remaining family members are killed. Later, the Pawnee warriors make four unique appearances throughout the film, with the central focus placed on Toughest Pawnee, portrayed by Wes Studi. These warriors are responsible for the attack and murder of Stands With A Fist's white family, the attack and murder of Timmons, the attack on the Lakota tribe, and the tracking of Native Americans as enlisted soldiers in the U.S. Army. Comparing the presentation of the Pawnee warriors with that of the Lakota tribe, the difference is substantial. The distinction between these two tribes allows the audience to maintain a sympathetic view of the Lakota and merciless anger toward the Pawnee warriors. Presenting these warriors in such a manner draws a connection to the Bloodthirsty Warrior stereotype; even if it is not levied toward the "primary" tribe in the film, the archetype still exists.

Kicking Bird, portrayed by Graham Greene, represents the inquisitive spiritual leader that

remains hopeful of opening lines of communication with the invading white settlers. Throughout the film—initially with the aid of *Stands With A Fist*—Kicking Bird meaningfully communicates with John Dunbar. After some time, the interactions between Kicking Bird and John Dunbar grow beyond their formal relationship and, after the marriage of Dunbar and *Stands With A Fist*, develop into a family bond. Serving the role of convincing the rest of the tribespeople of Dunbar's perceived significance, Kicking Bird's character remains a representation of the spiritual Medicine Man. Throughout the film, Kicking Bird focuses almost exclusively on his relationship with Dunbar and accompanies him throughout his journey, which ultimately leads to Dunbar's inclusion in the Lakota tribe.

Portrayed by Rodney Grant, *Wind In His Hair* makes a significant character transition throughout the story. Early in the film, *Wind In His Hair* is reluctant about the idea of communicating with the white soldier and coordinates an attack on Fort Sedgwick to steal Cisco, Dunbar's horse. About 47 minutes into the film, *Wind In His Hair* represents the stoic warrior archetype as he confronts Dunbar in an act of intimidation. Thrusting his weapon into the ground at Dunbar's feet, he yells "I am not afraid of you!" As the film progresses, the stoicism of *Wind In His Hair* wavers as he eventually embraces Dunbar as a member of the tribe. This transition causes *Wind In His Hair* to lead a war party against the U.S. Army soldiers as they transport Dunbar to stand trial for abandoning his post.

Lastly, it is significant to identify the balance is created by the portrayal of these stereotypes. Each discussed stereotype is either unequivocally representative of the idea, as with the Pawnee, who are portrayed as bloodthirsty and ruthless warriors, or attempts to undermine the stereotype through minor variations, as with *Stands With A Fist*, who takes on the role of Celluloid Princess, even though she is white.

These variations present the opportunity for additional conversations about how variant attributes—such as the character's race—may aid the overall subversion of stereotypes. However, although the identified characters do not fit neatly into each of the connected stereotypes, these representations, I argue, remain examples of these character types.

5. Montford: The Chickasaw Rancher (2021)

Inspired by the literary work of Neil Johnson and C. Neil Kingsly and based on the life of Montford Thomas Johnson, a Chickasaw cattle entrepreneur, *Montford: The Chickasaw Rancher* is a film adaptation of a book of the same name. The film focuses on several key periods during Montford's life and explores how each impacts the arc of his story. Initially, the film begins during a period of considerable hardship for Montford, his family, and his Indigenous neighbors during the civil war. With only a sole head of cattle left to his name, Montford must find a way to take care of his family. Following the downfall of the Confederate States of America, Montford, the protagonist, finds himself largely unscathed by the U.S. Army and is afforded the opportunity to expand his cattle empire. Although the state of Kansas did contribute troops to the Union cause, the film indicates that the Chickasaw Nation has chosen to align with the Confederacy as a consequence of a prior Union record of broken treaties. Throughout the film, there are several key moments when various attacks on Montford's home and ranch take place, including one by hired outlaws directed to complete the dirty work of Sargent Richter. After the capture of a beloved Indigenous friend, along with many others, Montford is faced with a mission of traveling to Florida in hopes of arguing for their release. Before his departure—and after the arrival of his English biological father, who had remained

absent for most of his life—Montford is forced to grapple with a paternal relationship he ardently opposes. Recognizing the value of his father's presence at the Florida fort, Montford allows his father to accompany him on his journey and embraces their newfound relationship.

Here, I identify and draw connections to several observable stereotypes in *Montford: The Chickasaw Rancher*. These include that of the Half-Breed, the White Savior, the Stoic Indian, and the Plains Indian. The remaining stereotypes explored in this essay—those of the Celluloid Princess, “going native,” the Bloodthirsty Warrior, and the spiritual Medicine Man—are not portrayed within this film. Rather, filmmakers utilized available screen time to develop the presented characters and avoided one-dimensional representations.

Having been passed down from generation to generation, the story of Montford Thomas Johnson, through the interpretation of Chickasaw Nation Productions, has now gained visual representation. This film represents a contemporary example of Native American filmmaking and appeared apt for comparative analysis due to the similarities it shares with *Dances with Wolves*. For example, both films are of the Western genre, situated within the Central Great Plains, and include significant interactions between U.S. soldiers and the Indigenous population. Furthermore, both films are set in similar periods, with *Montford* set in the 1840s and *Dances with Wolves* set in the 1860s. However, unlike *Dances with Wolves*, *Montford: The Chickasaw Rancher* is primarily told from the Native American point of view. The story of Montford Johnson is one that is regionally recognized and shared widely. The literary narrative upon which the film was based was initially published by Neil R. Johnson, Montford's grandson, in 1960, and a mere 1,000 copies of the book were printed at the time. Neil Johnson's grandson, C. Neil Kingsly, expanded on his grandfather's work and published a revised copy that has since been widely circulated. In 2020,

Johnson was inducted into the National Cowboy and Western Heritage Museum's Hall of Great Westerners, and the film was released a year later.

In *Montford: The Chickasaw Rancher*, my analysis of the cinematic portrayal of Native Americans indicates that some of the previously mentioned stereotypical representations are utilized. However, it also appears that the filmmakers were conscious of these forms of representation and addressed these stereotypes by calling them out directly. One such stereotype is that of the Half-Breed. While this stereotype is historically prevalent in many American films, in *Montford*, the Half-Breed identity accurately represents an aspect of Montford Johnson's identity, and filmmakers explicitly draw attention to its existence. Approximately 13 minutes into the movie, filmmakers directly acknowledge the Half-Breed stereotype through an interaction between Montford and Sargent Richter. Speaking to Lieutenant Richard Pratt, Sargent Richter indicates Montford, “This is the Half-Breed I told you about.” While Montford exhibits disgust for his English father, his character is not fraught with inner turmoil about his multicultural background. He embraces this identity, as it allows him to navigate both cultures effectively. These characteristics are observed through Montford's interactions with Lt. Pratt and Sgt. Richter at Fort Sill, and during his meeting with the Native American Chiefs before the cattle drive.

Next, an examination of Montford's father, Charles “Boggy” Johnson, reveals the White Savior stereotype. As the story goes, Charles Johnson abandoned his family while Montford and his sister Adelaide were still young. Despite this situation, Montford survived his youth and built a substantial cattle empire. Upon Boggy's controversial return to Kansas, the reunion between Boggy and his son is bitter, as Montford elected to merely regard him as the person who abandoned his family. Following the imprisonment of several Cheyenne men,

Montford, Boggy, and Montford's son, Edward Bryant Johnson, set out for Fort Marion in Saint Augustine, Florida in hopes of aiding in the release of the prisoners. During a conversation between Montford and Boggy prior to their departure, Boggy mentions a personal relationship with a U.S. Senator and the fact that the Senator "owes him substantially." To Montford's disgust, Boggy raises this notion again while aboard a train bound for Blue Springs. Upon their arrival to Fort Marion, Boggy takes over the conversation with Lt. Pratt and informs him of his relationship with both U.S. Senator Augustus Hill Garland of Arkansas and President Rutherford B. Hayes. After pleading their case to Lt. Pratt and receiving an empathetic rejection, the Johnsons walk beyond the gates of Fort Marion to find a local building in flames. With flames erupting, Montford, Boggy, and Sargent Richter run inside to help evacuate those in need. During this scene, Sargent Richter lures Montford into an enclosed room, locking him inside as the building continues to burn. Upon the realization that Montford remained in the burning building, Boggy dashes into the flames in hopes of retrieving his son. After locating Montford in the sealed room, Boggy throws him over his shoulder and transports him out, effectively saving his life. The following morning, after the building fire is safely distinguished with the aid of the imprisoned Cheyenne men, Senator Garland arrives at Fort Marion and works to release the prisoners. While it is unclear as to whether Senator Garland's presence affects the prisoners' status, Boggy utilizes all viable options to assist them. These two examples—saving Montford's life and the utilization of personal privilege in an attempt to free the Native American prisoners—are representative characteristics of the White Savior. While there is an argument in opposition to this idea—namely that Boggy is not a principal character—during his presence onscreen, he makes a concerted effort to symbolize the White Savior.

Throughout the movie, filmmakers were successful in their presentation of multi-dimensional Native American characters, incorporating an impressive level of emotional depth through both the script and the acting direction. There is a reasonable argument that the sternness Montford displays is representative of the Stoic Indian stereotype. However, I argue that the depth of his character withdraws him from this category. Montford's display of sternness is primarily shown during his interactions with those he views as disrespectful, perceived or otherwise. The two primary examples of Montford's stoicism are his interactions with Sargent Richter and those with his father. However, Montford's sternness is subverted by the inclusion of stories about his charitable giving and heroic deeds. When an unknown cousin shows up to the Johnson ranch with seven children in tow, Montford and his wife welcome the family into their home. Additionally, Montford travels to Florida in hopes of releasing his friends from a military prison and, while there, narrowly survives a fire after pulling people to safety. These examples show Montford's emotional depth and are the basis for the argument that invoking the Stoic Indian stereotype is an inaccurate—or, at least, incomplete—way to describe Montford's characterization in this film.

At the 45-minute mark, however, the film reintroduces the Stoic Indian stereotype during Montford's interaction with tribal Chiefs. In this particular 33-second shot sequence, one of the assembled Chiefs stoically responds to Montford's request to guide his cattle through their lands. Throughout the meeting, all seven Chiefs maintain the appearance of the Stoic Indian, reinforcing this stereotype. The rhythmic pace of the verbal communication of the responding Chief further accentuates the stoic demeanor. Although this approach may have been intended to streamline the narrative for clarity, it nevertheless perpetuates the Stoic Indian stereotype. This reductionist portrayal

oversimplifies the multifaceted nature of Indigenous cultures and communication styles, reducing it to a single, static representation. While the filmmakers may have intended to facilitate storytelling efficiency, the usage of the Stoic Indian stereotype in this sequence evokes an oversimplified depiction of Indigenous peoples, warranting critical examination and discussion.

Chickasaw, Cheyenne, Comanche, and Kiowa are just a few of the numerous Native American tribes filmmakers draw from throughout the film. In addition to Montford, a member of the Chickasaw, another noteworthy representation is that of his Cheyenne friend, Rising Wolf. Common to many films that utilize Native American representations is the Plains Indian stereotype. This aspect of the story is significant to recognize because, as Wishart states, “the Hollywood Indian from the 1920s through the 1980s was more likely to resemble a Plains Indian than any other, largely because the American audience quickly grew accustomed to the exotic look of Plains headdresses and breastplates” (Wishart 2011). Hailing from another tribe of the Great Plains, Rising Wolf makes several appearances throughout the film, wearing clothing like Montford, sans headdresses and breastplates.

While the Plains Indian approach will generate interest from viewers, its usage, like that of the Half-Breed stereotype, is historically accurate in the case of *Montford: The Chickasaw Rancher*. The current Chickasaw Nation reservation—located south of Oklahoma City, Oklahoma—and Johnson’s primary home—located in Council Grove, Kansas—fall within the Great Plains region of the United States. Furthermore, all tribes depicted in this film, whether directly or through dialogue, are understood to have lived within the Great Plains area. The historical accuracy of these inclusions is thus important to the subversion of the Plains Indian stereotype.

6. Employment Practices and the Line

Through the evaluation of each film’s cinematic portrayal of Native Americans, there is reason to believe that some change has occurred within the American film industry over the intermediate 31-year period. One circumstance that may have influenced this shift is off-screen representation, as representation matters in all aspects of media production.

To this end, *Dances with Wolves* employed no Indigenous crew members to fill the above-the-line positions. However, in front of the camera, half of all principal roles in *Dances with Wolves* were portrayed by Native American or First Nation actors. In total, 31.25 percent of the above-the-line positions in this film were filled by Native American and First Nation actors, though they remained limited to on-screen positions. Meanwhile, 100 percent of creative direction roles and 68.75 percent of total roles went to non-native cast and crew members (Figure 1).

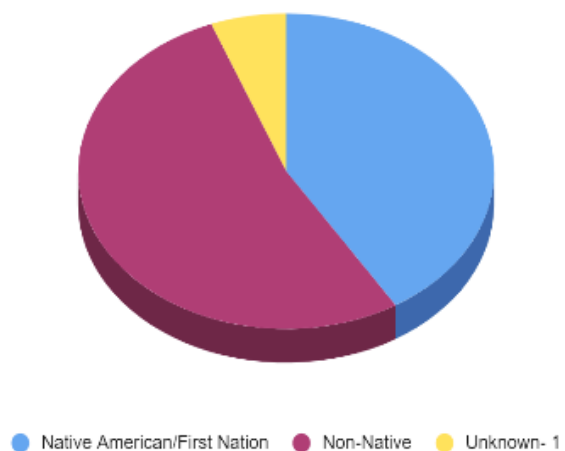


Figure 1. *Montford: The Chickasaw Rancher*, creative directing and acting roles.

Comparatively, in *Montford: The Chickasaw Rancher*, half of all creative directing positions were filled by Native American and First Nation filmmakers. These include authors Neil R. Johnson and C. Neil Kingsley, both direct

descendants of Montford T. Johnson, and executive producer Robyn Elliott. Of the top 10 listed performers, four of the on-screen positions were filled by Native American actors. In total, 41 percent of all above-the-line positions were filled by Native Americans, with 53 percent filled by non-Native people (Figure 1).

While this analysis is limited to that of two films, it lays the groundwork for further conversation and examination of industry hiring practices. If we accept the claim made by Chickasaw Nation Production about their inclusion of more than 200 Native American cast and crew members coupled with the previous examination of creative production roles, the numbers indicate a shift in off-screen representation. However, there is more research to be completed on how off-screen representation influences a film and the portrayal of Native Americans within.

7. The Significance of Identifying with Portrayed Representations

Representation in all stages of media matters, according to numerous scholars from various backgrounds. Dr. Kevin Leo Yabut Nadal, a distinguished psychology professor and a leading researcher in microaggressions and traumatic stress, is one such scholar. In Nadal's article "Why Representation Matters and Why It's Still Not Enough," published in the online media outlet *Psychology Today*, Nadal states that "representation can be helpful in reducing negative stereotypes about other groups." With an emphasis on the material conditions of social life, representation is a means of understanding one's place in the world (Aitken & Zonn 1994, 6). Representation in film matters because, as a factor influencing how children view their racial makeup, it provides visual examples of individuals with characteristics similar to or the same as their own.

Throughout this paper, the comprehensive

analysis of stereotypes and employment practices within the American film industry has yielded illustrative instances of how representation is shaped and manifested. Moreover, it is crucial to underscore that attaining positive and authentic forms of representation holds equal significance to, if not more significance than, simply achieving a numerical increase in representation alone. The endeavor to portray diverse and multifaceted perspectives in the realm of cinema goes beyond mere numerical representation—rather, the quality and authenticity of these portrayals play a pivotal role in dispelling harmful stereotypes and fostering an inclusive and culturally enriched cinematic landscape. In a communication research experiment, Dr. Markus Appel and Dr. Silvana Weber examined how participants responded after observing stereotypical characters in movies. Their study "Do Mass Mediated Stereotypes Harm Members of Negatively Stereotyped Groups? A Meta-Analytical Review on Media-Generated Stereotype Threat and Stereotype Lift" delved into the impact of media-generated stereotype threat and stereotype lift on individuals (Appel & Weber 2017). The researchers explored the potential harm that mass-mediated stereotypes may inflict on members of negatively stereotyped groups, shedding light on the crucial issue of stereotypical representations in media and their effects on perceptions and attitudes. Stereotype threat theory is the idea that an individual's actions are influenced by known stereotypes about their race or ethnic background. This means that those identifying with the presented stereotypical representations are more likely to alter their behavior to avoid any association.

While the American film industry includes all states and production companies, this section will examine the 2022 Hollywood Diversity Report, which summarizes the statistics from 2021. Published on an annual basis by the University of California, Los Angeles Sociology Department, this comprehensive report examines the demographic breakdown of those working within

the Hollywood industry and utilizes different master class statuses and job functions for categorization. While the following statistics represent an examination of the Hollywood system and do not reflect the entire American film industry, Hollywood is the most comprehensive system of film production companies in the world and thus makes for a strong case study. Of the 252 lead acting roles listed in the report, only one Native American actor made the list. When the analysis is expanded to include all acting roles—increasing the combined number of positions to 1,944—a total of 21 positions (14 male, seven female) went to Native American actors. Of the 252 films examined for the 2021 year, 143 of the film directors were white men, compared with just two Native American directors (one male, one female). Lastly, for the total year, 67.7 percent of all credited film writers were white, compared with only two Native American film writers, or 0.8 percent.

Within the broader American film industry, there remains another observable phenomenon related to Native American representation in film. Before the 1990 release of *Dances with Wolves*, there were three operating Native American film production companies. These were Shenandoah Film and Video, Na Maka O Ka Aina, and Turtle Island Productions L.L.C. Since 1990, the total number of Native American production companies has increased by 225 percent; one such emerging enterprise is Chickasaw Nation Productions, which opened in 2009. More recently, Camel Rock Studios surfaced in the year 2020. Following the transformation of the antiquated and disused Camel Rock Casino, the Tesuque Pueblo successfully inaugurated a vast 75,000-square-foot movie studio, complemented by an extensive 17,000 acres of backlot production space. Notably, Camel Rock Studios distinguishes itself not solely as the pioneering Native American studio but also as one of the most substantial companies exclusively committed to the pursuit of cinema

production worldwide. Others include Native American Media Alliance (2004), InterTribal Entertainment (2000), Vision Maker Media (1997), and Red Nation Celebration Institute (1995). As with Chickasaw Nation Productions and Camel Rock Studios, these companies perform a vast variety of roles within the American film industry.

8. Conclusion

When considering the two selected films, *Dances with Wolves* and *Montford: The Chickasaw Rancher*, I identify a considerable difference in the usage and employment of Native American stereotypes between the two. However, the filmmakers of both movies utilized a subset of the discussed stereotypes within their character representations. The story of *Dances with Wolves* centers around the idea of the White Savior, supported by the stories of the Celluloid Princess and the noble Medicine Man. Comparatively, in *Montford: The Chickasaw Rancher*, filmmakers employed character types like the Stoic Indian and the White Savior, amongst others. This research identifies areas in both films where the employment of stereotypes is a direct attempt to subvert these representations. For example, the exploration of the Half-Breed in *Montford* and the significant transition Wind In His Hair undergoes as he bonds with Dunbar in *Dances with Wolves* are both representative of stereotype subversion. In considering the on-screen presentation of Indigenous characters, it becomes evident that neither film is clean from featuring stereotypical portrayals. However, *Montford: The Chickasaw Rancher* appears to adopt a more deliberate and thoughtful approach to the utilization of these stereotypes. Feier (2011, 160) aptly summarizes the efforts of Native American filmmakers in challenging and subverting the long-standing images that have plagued America's original inhabitants for centuries. Through their cinematic endeavors, these filmmakers strive to introduce complex and multifaceted on-screen

characters that authentically represent the diversity inherent within Native American communities. The aforementioned filmmakers intentionally draw attention to the existence of these stereotypes and, in so doing, endeavor to dismantle and dissolve these limiting ideas through the careful development of characters.

The approach taken towards the portrayal of character types in films is often influenced by the individuals entrusted with the task of storytelling. A comprehensive assessment of the employment practices within production companies, both above- and below-the-line, reveals a notable racial disparity among the professionals involved in the creation of these cinematic works. For instance, *Dances with Wolves* did not employ any Native Americans in above-the-line positions outside of acting roles. It is worth mentioning that, while the Native American characters were depicted by Native American and First Nation actors, their absence from the creative decision-making process limits the scope and authenticity of their voices. Comparatively, in *Montford: The Chickasaw Rancher*, many behind-the-scenes positions were also filled by non-Native crew members. However, the film was inspired by a Chickasaw author, created by Chickasaw Nation Productions, and overseen by executive producer Robyn Elliott, Cabinet Secretary of the Chickasaw Nation Department of Communication and Community Development. Additionally, if we accept the claim made by Chickasaw Nation Productions about the inclusion of over 200 Native American cast and crew members in the *Montford: The Chickasaw Rancher's* production process, the nexus of control over the telling of these Indigenous stories has shifted when compared with *Dances with Wolves*.

It is important to note that the inclusion of storytellers and filmmakers is not a perfect counterbalance for those sections of the industry that engage in the continued misrepresentation of Native Americans. Rather, this inclusion is a separate addition to the American film industry, allowing for the voices of others to be heard. This

difference, while subtle, is significant because, while authentic Indigenous perspectives are increasingly incorporated, stereotypical portrayals are still utilized in America's most prominent film productions in Hollywood. An illustrative case in point can be observed in Disney's 2013 film *The Lone Ranger*, wherein Johnny Depp's costume involves the contentious practice of "redface" to embody a character purportedly representing the Crow and Cree nationalities. Such instances exemplify the persistence of harmful practices that undermine the strides towards authentic and respectful representation of Indigenous cultures within the film industry.

Through an examination of UCLA's 2022 Hollywood Diversity Report, it is clear that Native American actors, writers, and directors remain significantly underrepresented as compared to their white counterparts. As an alternative to the Hollywood system, Native American filmmakers have created numerous film production companies and taken on various roles in the film production process. Furthermore, through the creation of these organizations, Indigenous people can increasingly control who works on their productions and how their demographic is represented onscreen, as in the instance of Chickasaw Nation Productions.

Therefore, over the 31 years elapsed between *Dances with Wolves* and *Montford: The Chickasaw Rancher*, there lies a measurable change in Native American representation within the American film industry. While I have consistently maintained that this work is a limited case study, I also argue that there is sufficient evidence to signify a shift in representation. Whether looking to Chickasaw Nation Productions' calculated decision to employ and subvert the on-screen utilization of over-simplified, stereotypical Indigenous representations or the considerable industry growth in Indigenous-owned and operated film production companies, the shift of narrative control away from white Hollywood and into the hands of Indigenous filmmakers signals

that the American film industry has altered its relationship with Native Americans since 1990 and may well continue to do so. Apart from conducting a more exhaustive examination of the cinematic works generated during this temporal span, it becomes imperative to persistently monitor the unfolding transformations within the American film industry. This analytical pursuit is essential to comprehend the influence exerted on the representation of Indigenous filmmakers. By systematically observing the evolving patterns, one can discern the nuanced impacts on the portrayal and visibility of Indigenous voices in the realm of cinema. Such an approach will facilitate a more profound understanding of the dynamics shaping the presence and contributions of Indigenous creators within the film landscape.

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Reweaving the Uaman Luar: Cultural Reproduction and Autonomy among the Kamëntšá

Rowan Glass*

Abstract

Where there is colonial power, there is Indigenous resistance. Latin America offers many case studies for an analysis of Indigenous cultural survival, historically and to the present day. While some have received considerable popular and academic attention, most have gone comparatively unknown, particularly in the Anglophone academic mainstream. My research aims to address this gap by interpreting processes of cultural reproduction among the Kamëntšá, a culturally and linguistically unique people of the Sibundoy Valley of southwest Colombia. Building on ethnographic data collected during three months of fieldwork with artisans, shamans, land defenders, and community members in the Sibundoy Valley, I argue that the Kamëntšá, while facing cultural, political, and ecological threats on multiple fronts, are engaged in the integral reproduction of their culture to ensure the survival and vitality of their community. The Kamëntšá experience demonstrates the viability of Indigenous cultural survival and autonomy outside of the settler-colonial and neoliberal status quo. I conclude by arguing that Kamëntšá processes of cultural reproduction contribute to ensuring their cultural autonomy, demonstrating the pluriversal dictum that “another world is possible,” and that the Kamëntšá case sheds light on cultural reproduction and autonomy construction as they operate in other subaltern contexts.

1. Introduction

The Sibundoy Valley of southwest Colombia, a transition zone between the Andes mountains and the Amazon rainforest, has long been a nexus of intercultural encounter and exchange. Its Indigenous inhabitants, the Kamëntšá people, have consequently developed strategies for preserving, recuperating, and rearticulating their culture under transcultural pressures. In this paper, I draw on three months of ethnographic fieldwork with the Kamëntšá to examine how such strategies are put into practice within the community today, not only as part of a historical

legacy responding to past intercultural encounters, but also in response to new, distinctly twenty-first-century challenges—namely, the transculturating pressures of globalization and Western modernity, locally expressed as neoliberal capitalism,³ which tend

³ For the purposes of this paper, “neoliberalism” and “neoliberal capitalism” are understood according to David Harvey’s definition: “A theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets and free trade. The role of the state is to create and preserve the institutional framework appropriate to such practices... It must set up those military, defense, police, and legal structures and

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towards the reduction of Indigenous cultural difference. Under these circumstances, how do the Kamëntšá reproduce their culture and construct cultural autonomy?

To answer this question, I spent three months in the Sibundoy Valley during the summer of 2022 and February 2023 conducting participant observation and ethnographic interviews with Kamëntšá activists, community leaders, artisans, shamans, and others. During this time, I collected a robust dataset which sheds light on contemporary processes of cultural resistance and resilience in three core domains of Kamëntšá culture: 1) the artisanal tradition; 2) shamanism; and 3) Clestrinŷe, the most significant Kamëntšá festivity of the year. I provide an ethnographic survey of each of these cultural domains to analyze their relevance to contemporary processes of cultural change and preservation among the Kamëntšá. In doing so, I develop a grounded theory model which I term cultural reproduction, a four-pronged framework for describing cultural change through time consisting of 1) preservation, 2) recuperation, 3) rearticulation, and 4) invention. This concept and its implications for the construction of Kamëntšá cultural autonomy constitute the theoretical foundation of this thesis.

The Kamëntšá, far from giving in to the deculturating pressures of neoliberalism, globalization, and Western modernity, are engaged in the integral reproduction of their culture—or, to borrow a metaphor drawn from Kamëntšá terminology, they are reweaving the *Uaman Luar* (“sacred place of origin,” i.e., the Sibundoy Valley). Following my ethnographic analysis, I conclude this paper by exploring the implications of my model of cultural reproduction and autonomy among the Kamëntšá for Indigenous and subaltern contexts elsewhere in Latin America and beyond. I argue that the same processes of cultural reproduction which

help the Kamëntšá fortify their cultural autonomy operate—and therefore can be interpreted anthropologically—in similar contexts of subaltern resistance worldwide.

This paper begins in Section 1 by establishing the background information which defines the scope of this research, namely the geographic setting—the Sibundoy Valley—and the identity, history, and contemporary situation of the Kamëntšá people. Section 2 introduces the methodology guiding this research, identifying data collection and analysis procedures as well as methodological limitations; the latter also function as a positionality statement. Section 3 introduces the theoretical framework with which I interpret the ethnographic data in the following sections, including a final section on two Kamëntšá philosophical principles which aid in my analysis. Sections 4, 5, and 6 analyze, respectively, processes of cultural reproduction apparent within the domains of the artisanal tradition, shamanism, and Clestrinŷe. Finally, Section 7 concludes this paper by establishing the broader significance and implications of my research—for the Kamëntšá, for other Indigenous and populations engaged in cultural resistance and reexistence worldwide, and for the discipline of anthropology as a whole.

2. Background

2.1. The Sibundoy Valley: Geographic and Demographic Context

The Sibundoy Valley is an intermontane basin of the Andes-Amazon interface of southwest Colombia. At an average elevation of 2,200 meters above sea level, the Sibundoy Valley is an ecological transition zone between the Andean highlands to the west and the Amazonian lowlands to the east, containing flora and fauna native to both regions, although Andean ecology predominates (Bristol 1965). The Sibundoy Valley is coextensive with the upper region of the Colombian department of Putumayo, which in its

functions required to secure private property rights and to guarantee, by force if need be, the proper functioning of markets” (Harvey 2005, 2)

entirety ranges from the Andean highlands of the Sibundoy Valley down to the sparsely populated Amazonian lowlands that comprise most of the department's area. Despite the ecological and climatic differences between the temperate Sibundoy Valley and the hot jungle interior, the three subregions of Putumayo have long maintained historical, cultural, and commercial ties. Owing to its strategic position between the Andean department of Nariño and the Amazonian lowlands, the Sibundoy Valley also serves as one of the most traveled crossroads between these two regions of southwest Colombia (Davis 1997). There are two Indigenous populations in the Sibundoy Valley: the Kamëntšá and the Inga. Although speaking different languages and of different origins—the Inga speak a dialect of Kichwa and are thought to have migrated into the valley from Kichwa-speaking populations in either the Ecuadorian Andes or the Peruvian Amazon—centuries of cohabitation in the Sibundoy Valley have resulted in much cultural mixing between the two communities, though differences remain.

The Sibundoy Valley is primarily rural, with a total population approaching 32,000, according to the 2018 census (DANE 2018). The same census registered 7,521 Kamëntšá people, with the majority living in the municipalities of Sibundoy and San Francisco in the eastern half of the valley. The majority of the Kamëntšá population lives in rural districts called *veredas* that surround the urban zones of each municipality. Today, the urban zones are predominantly populated by *colonos*, or non-Indigenous settlers. However, the Kamëntšá retain a presence in the towns of Sibundoy and San Francisco, while some *colonos* have moved into the *veredas*.

2.2. The Kamëntšá: Identity, History, & Contemporary Situation

The complete endonym of the people conventionally known as the Kamëntšá is “Kamëntšá Biyá,” literally meaning “speakers of

the Kamëntšá language,” but sometimes translated more poetically as “people of this place with our own thought and language.”⁴ The Kamëntšá have resided in the Sibundoy Valley since time immemorial and speak a language isolate with no proven relation to any other language, although some linguists have proposed links to various language families in South America (Fabre 2001; Juajibioy Chindoy 2008). The most credible assertions associate Kamëntšá with the extinct languages of the prehispanic Quillasinga federation of the Nariño highlands to the west, of which the Kamëntšá may represent a remnant or migrant population (McDowell 1992, 96; 1994, 10; Ramírez and Castaño 1992, 292). However, firm evidence for any direct linguistic relationship is lacking.

Culturally, the Kamëntšá are distinct, demonstrating a transcultural Andean-Amazonian base intermixed with uniquely local elements and a colonially imposed Catholic overlay. While the Kamëntšá share some philosophical and religious principles with Andean cosmologies,⁵ they also share the shamanic system widespread across Western Amazonia, characterized by the ethnomedical use of the Amazonian entheogen *yagé*⁶ and other

⁴ These translations were provided by Natalia Jacanamijoy (personal communication, March 8, 2023); the second definition is also given on the “Kamëntšá” page of the National Indigenous Organization of Colombia (ONIC). The Kamëntšá have historically been known by a range of other names. Complicating matters is that the Kamëntšá language does not have a standardized orthography, giving way to alternate spellings such as Kamsá, Camsá, Kamentza, Kamëntšá, Camëntšá, etc., all of which are found in the literature. I employ “Kamëntšá” because it is the spelling preferred in several recent publications from the community itself. To my mind, it also best captures the pronunciation of the word itself, which can be rendered phonetically in IPA as: /kamənʃa/ (Adrián Múnera, personal communication, March 12, 2023).

⁵ The folklorist John H. McDowell, who worked extensively in the Sibundoy Valley from the 1970s to the 90s, has written extensively on Kamëntšá mythology and its parallels to Andean cosmologies. See also the Kamëntšá folklorist and ethnolinguist Alberto Juajibioy.

⁶ *Yagé* is a generic term in Colombia for an entheogenic brew produced by mixing the vines of the liana *Banisteriopsis caapi* with any number of secondary potentiating plants. The same brew is more widely known elsewhere as ayahuasca. The

lowland plant medicines. The traditional horticultural garden full of edible, medicinal, and magical plants kept by Kamëntšá households, the *jajañ*, also bears similarities to the *chagra* system widespread in the Amazonian lowlands below. Kamëntšá artistic traditions, on the other hand, are unique, as is their ethnobotanical use of the medicinal flora of the páramo region surrounding their valley (Bristol 1964; 1965; 1966; 1969; Schultes 1988; Schultes and Hoffman 1992; Schultes and Raffaui 1992; Seijas 1969).

In Western historiographical terms, it is unknown where the Kamëntšá came from or for how long they have inhabited the Sibundoy Valley, which in their language is called *Bëngbë Uaman Luar Tabanok*, “our sacred place of origin.”⁷ The Kamëntšá themselves, however, do not conceive of their relationship with their territory primarily in chronological or historical terms, instead relying on an extensive body of mythic narrative and oral history that places their origins in a distant, mythic past (Juajibioy Chindoy 1987; 1989; McDowell 1989; 1992; 1994). The most salient feature of Kamëntšá oral traditions with respect to their origins is the fundamental belief that the Kamëntšá have always inhabited their territory, to which they are attached by a sacred bond that is ritually affirmed

ceremonial use of *yagé* is one of the most salient features of Sibundoy Valley ethnomedicine and shamanism.

⁷ This is the most elaborate of several related terms for the Sibundoy Valley in the Kamëntšá language, all of which are rather ambiguously translated, with different sources frequently giving different definitions of each: the others that I have seen and heard are *Tabanok*, *Uaman Luar*, *Bëngbë Uaman Tabanok*, more or less meaning, respectively, “place of return” or “place of origin,” “sacred space” or “intimate space,” and “our sacred place of origin.” I asked Juan Carlos Jacanamijoy, who has long been involved in language recuperation efforts among the Kamëntšá to clarify these terms; the English glosses above are approximations based on our discussion, but a perfect definition of each eludes me. Juan Carlos added that *Uaman Luar*, now commonly employed to refer to the Kamëntšá parts of the Sibundoy Valley, is a recent invention on the part of contemporary land defenders, but *Tabanok* and *Bëngbë Uaman Tabanok* are ancestral terms. Of these terms, “*Tabanok*” is probably the most common in daily parlance and can be seen in street art and graffiti around the town of Sibundoy in a stylized and vowelless variant: “TBNK.”

throughout the lives of community members.⁸

As for historiographical approaches to the origins of the Kamëntšá, preliminary archaeological evidence suggests that people were living in the Sibundoy Valley by at least 600 CE, though it is probable that further excavation would produce evidence of earlier occupation (Patiño 1995). Whatever the origins of its inhabitants, the Sibundoy Valley has long been a site of intercultural encounter and movement between various peoples of the Andes-Amazon piedmont, in part informing the development of a profoundly syncretic cultural atmosphere among the Inga and the Kamëntšá of the valley today (Glass 2022).

Chronological certainty only comes with first contact between the Kamëntšá and a party of Spanish conquistadors under two lieutenants of Sebastián de Belalcázar in 1535, which was brief and violent. The valley was next visited by the conquistador Hernán Pérez de Quesada in 1542 during his ill-fated search for El Dorado (Bonilla 1968; Taussig 1987). In the following decades, a series of short-lived missions were established in the Sibundoy Valley by a succession of religious orders, but the isolation of the valley and the apparent reticence of its inhabitants forced these evangelists to periodically abandon their work (Bonilla 1968). Despite the Sibundoy Valley’s relative isolation, partial Christianization and sporadic contact throughout the colonial period saw the development of a syncretic Catholicism and other transcultural processes in the valley, as demonstrated by the oral tradition and surviving colonial-era documents (Glass 2022). The relative isolation of the Sibundoy Valley—and therefore the relative autonomy of the Kamëntšá, whose only regular contact with colonists came in the form of occasional missionaries, tax collectors,

⁸ Inga accounts differ owing to the recognition, both etic and emic, of their external origins in Quechua-speaking groups migrating through the neighboring Amazonian lowlands. For this reason, Inga ethnohistory is less relevant than Kamëntšá mythic narrative in terms of the ancient peopling of the Sibundoy Valley.

and landlords—ended with the advent of the Capuchin Order at the turn of the twentieth century.

In the late nineteenth century, as the Colombian state sought to consolidate its national frontiers, the Capuchins, a religious order of Franciscan friars within the Catholic Church, became the latest in a long line of missionaries to enter the Sibundoy Valley. Unlike their predecessors, the Capuchins established the first long-term colonial foothold in the valley, largely due to the financial and political support of the Colombian state. The Capuchin Mission—officially titled the Apostolic Prefecture of Caquetá⁹—was officially established in 1904, beginning nearly 70 years of Capuchin domination in the Sibundoy Valley. The Mission period initiated a process of colonization that saw the rapid dispossession of Kamëntšá lands by the Mission, an influx of colonos from other regions of Colombia, and systematic efforts to strip the Kamëntšá of their culture while encouraging assimilation to the forcibly imposed and mutually reinforcing institutions of orthodox Catholicism and Colombian national identity.

The first step taken by the Capuchins in establishing their new mission was to build a network of schools and churches. In the Mission's schools, Kamëntšá children would learn to speak Spanish, while speaking Kamëntšá was strictly forbidden and harshly punished. They were taught to sing the national anthem, to dress and behave like their White and mestizo classmates, and to identify as Colombian before Kamëntšá. The avowed goal of the Capuchins was to “civilize the savages” while opening the “virgin jungle” to exploitation and settlement at the hands of Colombian settlers (Bonilla 1968; Escandón 1913; Recalde 2002). In the Sibundoy Valley, the

“civilization” of the Kamëntšá (and their neighbors, the Inga) was supposedly to be accomplished via conversion to Christianity, violent discouragement of the practice of Kamëntšá customs, and schooling according to a Western model. It was during the Capuchin period, which only ended in 1969, that the Kamëntšá not only witnessed the near-total loss of their lands and a sustained attack on their culture and society, but also the settlement of their territory by colonists and its subsequent ecological transformation and degradation at the hands of outsiders (Bonilla 1968; Restrepo 2006).

By the time of the Capuchin Mission's decline, most Kamëntšá families had been displaced from the most productive lands of the valley's slopes to the less fertile wetlands of the valley's base, parts of which remained permanently inundated throughout most of the twentieth century. This left the former landholdings of the Kamëntšá in the hands of colonos, who soon outnumbered the Kamëntšá in their own territory. In the decades since, however, the Kamëntšá have made significant gains in securing legal protections and the reclamation of stolen land, although much remains to be done. Additionally, the Colombian Constitution of 1991 guaranteed for the first time in Colombian law, at least on paper, Indigenous peoples' right to political and territorial autonomy through the *cabildo* and *resguardo* systems, which establish Indigenous communities' right to operate local government councils on their own territory. However, both systems remain plagued by problems of corruption, ineffectively short electoral terms of one year per *cabildo* cabinet, and political gridlock between competing actors—not only between local governments at the municipal and departmental levels, which often move to block Indigenous political initiatives, but also within the Kamëntšá community itself (Bonilla 1968; Comunidad Kamëntšá 1989).

The problems mentioned above notwithstanding, the effective capacity of the

⁹ Caquetá is, today, a department within the Colombian Amazon bordering Putumayo. It is also an affluent of the Amazon River which gives the department its name. Prior to the Colombian state consolidation of the country's Amazonian regions, “Caquetá” encompassed a wider geographic area, including parts of present-day Putumayo.

Kamëntśá for political and territorial self-government has gradually increased in recent years, especially since 2010, when a social movement for territorial autonomy began in the community. Over the following decade, this movement, taking up the slogan “for land, for life, for our existence,” succeeded in considerably expanding the Kamëntśá resguardos. The most significant expansion occurred in 2016 following decades of activism aimed at restoring the borders claimed for the Kamëntśá by their legendary chieftain Carlos Tamabioy, who established the boundaries of the territory in his last will and testament penned in 1700. Since the territorial dispossession of the Capuchin period, this document has remained significant to Kamëntśá ethical and legal claims to legitimate sovereignty over their ancestral territory, so much that the recent social movement has applied his name in an act of homage: “Territorio Ancestral Carlos Tamabioy.” In 2016, the Ministry of the Interior formally returned Tamabioy’s lands to the community (McDowell 2022; Ministerio del Interior and Cabildo Indígena Kamëntśá de Sibundoy 2012; “Pueblos Kamëntśá e Inga” 2016; “Termina una disputa” 2016). Despite such gains, the land tenure problems in the Sibundoy Valley are far from resolved; colonos remain the largest and richest landowners while most Kamëntśá people subsist on small plots of substandard land.

Just as problematic are the economic and ecological pressures exerted by the extractive initiatives and development projects introduced by outside interests. An important dimension of the ongoing territorial movement in the Sibundoy Valley relates to contemporary extractive development projects undertaken on Kamëntśá territory. Such projects include mining and oil drilling concessions made to multinational mining corporations such as AngloGold Ashanti, Antofagasta, B2Gold, and Libero Copper, all of which have held or currently hold shares in local subsidiaries such as Mocoa Ventures Ltd (Harris 2022; Libero Copper 2022; 2023; Rowland, Sim,

and Davis 2021).¹⁰ Also important is a planned highway development, the San Francisco-Mocoa Bypass, which would connect the eastern terminus of the Sibundoy Valley with the capital of Putumayo department. While the Colombian state claims that the highway would save lives and modernize the departmental infrastructure of Putumayo by replacing the sole existing road between San Francisco and Mocoa—the deadly and decrepit “Trampoline of Death”—the planned trajectory of the bypass runs through an ecological reserve and an area of Indigenous territory. Kamëntśá protesters have blocked the completion of the partially built highway on both counts, but the issue remains unsettled, with developers hoping to resume work on the road. Some among the Kamëntśá also doubt the official line regarding the purpose of the highway, instead suspecting that its primary purpose is to facilitate the commercial exploitation of the ecological reserve that it would run through (Lizcano 2020a; 2020b; Sigindioy Chindoy 2013; Uribe 2011; 2019; 2020; 2021; “Variante San Francisco – Mocoa” 2020).¹¹ The arguments in favor of these projects often depend upon denying the ancestral and contemporary presence of the Kamëntśá on the land targeted for development.

In light of these development projects, the

¹⁰ Taussig (2004) has written compellingly on the parallels between Spanish conquistadors’ search for El Dorado through 300 years of colonial rule in South America, the Colombian origins of the El Dorado myth, and modern multinational mining concerns’ continued extraction of Colombian gold—modern legacies of a colonial myth. It is worth noting that one of the earliest expeditions in search of El Dorado, that of Hernán Pérez de Quesada, passed through the Sibundoy Valley in 1542 from out of the Putumayo lowlands.

¹¹ The San Francisco-Mocoa Bypass was formerly part of a series of international megaprojects under the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA). IIRSA, now defunct, was a development plan established at the first South American Summit (*Cumbre Sudamericana*) in August 2000 with the support of several regional development banks, and later taken over by the Union of South American Nations (USAN), itself now nearly defunct. IIRSA initiatives have been roundly criticized for their potential to cause serious environmental damage where developed, especially in the Amazon rainforest (Escalante-Moreno 2022; Killeen 2007; Melón 2022).

Kamëntšá territorial defense movement both affirms the legal right to sovereignty over the community's ancestral territory and encapsulates ecological concerns regarding the detrimental environmental effects of initiatives such as mining and road construction. These development projects not only threaten Kamëntšá territorial autonomy in a legal and ethical sense by denying their historical and cultural ties to the territory, but threaten the ecological integrity of the territory itself, which the Kamëntšá personify as *Tsbatsána Bebmá*, or Mother Earth. The Kamëntšá, then, approach the issue of territorial autonomy in terms of what McDowell (2022) has termed "ecospiritality," evincing deeply rooted territorial concepts of place and belonging.

This is the situation in which the Kamëntšá find themselves today, gradually recovering from the historical traumas of colonialism, land theft, and systemic exclusion while confronting new iterations of these processes in the present. The history traced above demonstrates that the Sibundoy Valley remains an arena for the development of settler colonial strategies of territorial and cultural dispossession in the Indigenous Colombian context. Indeed, the history of the Kamëntšá is situated within broader processes of settler colonialism, neoliberalism, and extractivism at work across Indigenous Latin America. The past struggles of the Kamëntšá and their contemporary legacies in the form of ongoing settler colonialism, neoliberalism, and extractivism in the Sibundoy Valley constitute the background of dispossession against which the Kamëntšá enact cultural reproduction to ensure their survival and autonomy.

3. Methodology

3.1. Data Collection

This paper is the product of more than a year of research at the University of Oregon and three months of ethnographic fieldwork, conducted

from the summer of 2022 to February 2023, among the Kamëntšá people of the Sibundoy Valley in southwest Colombia. In collecting data for this research, I primarily followed conventional ethnographic fieldwork techniques, employing the following methods: participant observation; written fieldnotes; unstructured non-recorded interviews; semi-structured audio-recorded interviews; semi-structured audio-recorded focus groups; and semi-structured video-recorded interviews. Ethnographic activities took place in a variety of settings, including personal homes, institutional and government buildings, and cafes and restaurants. Activities included events such as community gatherings, birthday parties, shamanic ceremonies, cultural festivities, concerts, *mingas* (collective work projects), workshops, and focus groups.

Participant recruitment proceeded primarily using the snowball method, whereby one contact led to another, beginning with my Kamëntšá host family. My hosts proved essential as bridges between myself and the community, introducing me to community leaders, artisans, shamans, artists, land defenders, and others who became key participants in my ethnography. Each new person I met was able to put me in contact with a network of other potential participants to the point that, after several weeks in the field, I was able to independently arrange interviews, meetings, and other ethnographic events with ease.

During my first fieldwork period of eight weeks in the summer of 2022, I recorded nine individual interviews and two focus groups in total. All interviews were semi-structured. I came to interviews with a list of five to ten prepared questions, which I modified depending on the background of my interlocutor. During each conversation, I would pose new questions as relevant and discard prepared questions as necessary. I also gave interview participants the option to modify my list of questions or suggest their own. This strategy characterizes my

interviews as collaborative endeavors in which the content of each interview was coproduced by both interviewer and interviewee, an approach suggested by Heyl (2001).

My approach to ethnographic interviewing is informed by the work of Charles L. Briggs (1986), whose *Learning How to Ask* is a classic in the literature due to his emphasis on the importance of accounting for culturally specific modes of communication when designing one's interviews. Briggs' work helped me ascertain the best approach to initiating and conducting interview encounters—and attuned me to cultural cues that indicated when this approach was unwelcome or inappropriate. For instance, there was a moment during a conversation with one individual—a respected Kamëntšá shaman and land defender—that crystalized for me the reflexive understanding that I had not yet “learned how to ask” according to the communicative norms of Kamëntšá culture. As John McDowell has documented in his studies of Kamëntšá speech performance (1983; 1990; 1995; 2000), formal and ritual speech occasions in the Kamëntšá community are structured according to age and social status. Young people are expected to listen quietly and respectfully while elders confer the wisdom of the ancestors. Once the elders have said their piece, the younger people present might later be invited to participate in a more egalitarian conversation. In the encounter in question, I first asked the shaman if I could record an interview with my field recorder. Instead, he gently advised me to turn off my recorder and listen rather than ask. After this encounter, I began to rethink how Kamëntšá communicative norms determined the type and nature of information that I had access to, and in later interviews I moved away from the structured format towards what this taita termed “open conversations” (*conversaciones abiertas*).

During my fieldwork, I had many opportunities for participant observation in group activities and community events. While most of these encounters only involved

participating and observing as data-gathering methods, on two occasions I was able to convene focus groups for semi-structured, audio-recorded group conversations. The focus groups yielded about three hours of audio content in total. Each meeting was organized around a central theme—in the first case “territory” and in the second “the future”—around which the conversation would focus, but both conversations were wide-ranging, providing insight into other themes of interest. The focus group format also helped bring out the particularities of Kamëntšá discursive procedures, which were especially apparent given the variation in age and experience among participants—an important methodological point to take into account, as noted by Romm (2014) in the Indigenous South African context.

I also recorded several semi-structured video interviews during two weeks of fieldwork in February 2023. Only one collaborator, a male artisan I met early on during my first fieldwork period, participated in both interview formats; the others participated in only one recorded interview of either type. In most cases, participants and I shared repeated unrecorded encounters which often rendered important data recorded in fieldnotes. Audio interviews and focus groups were recorded using a handheld Zoom H1n field recorder in WAV file format. Video interviews were recorded using a Sony Alpha 6400 mirrorless digital camera with 16-50mm kit lens mounted to a SIRUI AM-225 tripod and using a Deity V-Mic D3 Pro shotgun mic for external audio. The Sony Alpha 6400 camera was also used for taking most of the photographs that appear as figures throughout the text; the remainder were taken with an iPhone SE 1.

Writing fieldnotes also constituted a mainstay of my ethnographic methodology. My writing practice was informed by several staple texts of this method (Emerson, Fretz, and Shaw 2011; Konopinski 2013; Sanjek 1990). In the field, I never went anywhere without a weatherproof notebook and pen in my coat pocket, with which I captured many ethnographic details to be

expanded upon later at my computer. My fieldnotes, in combination with my interview transcripts, provided the basis for the analytic memos that I would expand upon during the data processing and analysis stage of my research.

3.2. Data Processing and Analysis

My approach to developing codes based on my data and then transforming these codes into a viable theoretical framework was guided by a grounded theory approach. According to Saldana, grounded theory “usually involves meticulous analytic attention by applying specific types of codes to data through a series of cumulative coding cycles that ultimately lead to the development of a theory—a theory ‘grounded’ or rooted in the original data themselves” (55). Charmaz and Mitchell (2001) describe all variants of grounded theory as including the following strategies: 1) simultaneous data collection and analysis; 2) pursuit of emergent themes through early data analysis; 3) discovery of basic social processes within the data; 4) inductive construction of abstract categories that explain and synthesize these processes; and 5) integration of categories into a theoretical framework that specifies causes, conditions, and consequences of the processes described (160). The product of the application of these strategies to my data is my original model of cultural reproduction, a theoretical framework grounded in and emergent from the ethnographic data.

Data processing began with clean-verbatim transcription of my collected audio recordings, which totaled about 12 hours of content. In tandem with the audio transcription, I also began coding my fieldnotes by identifying and sorting repeating themes. With my transcribed recordings in hand, I moved into the data analysis stage. I opted to employ qualitative coding methods guided by a grounded theory approach. As recommended by Saldana (2016), I applied a minimum of two rounds of coding to each transcript. I also periodically wrote analytic

memos as a preliminary form of engaging with the themes and patterns emerging from my data. I used the qualitative coding software Delve to facilitate the coding process. Over several coding cycles, I eventually reduced my codebook to a list of about twenty high-frequency codes consistent across transcripts. Core categories in my codebook include specific expressions of cultural reproduction, autonomy, cultural domains, and Kamëntšá philosophical concepts. These formed the basis of the grounded theoretical framework I began to construct from the data.

A note on translation: All interview excerpts quoted in this paper, as well as published Spanish-language materials which I cite, are in my own translation. Where the appropriate translation seemed ambiguous, I have retained terms in Spanish and Kamëntšá in brackets.

3.3. Methodological Limitations

Several methodological limitations became apparent over the course of my fieldwork. First is the problem of contradictory data offered by different collaborators. This presents a quandary—who and what can be trusted, and how do I know? However, as one collaborator succinctly explained, it is not my job to determine absolute truth; as an ethnographer, I am only supposed to document what people say, to compare it to what others have said, and eventually come to my own reasoned conclusions. This is, in fact, the task of the ethnographer in general—not to collect and retell *the* story of a place and its people, but only to represent, as accurately and responsibly as possible, *a* story, one drawn from the specifics of the places and people that the ethnographer encountered in their individual research journey.

The inclusion of visual methods, namely photography and video, brought to light problems of representation in the history of anthropology’s use of these methods, particularly where Indigenous people are concerned. In adopting these methods, I have followed ethical

procedures to the best of my ability. In accordance with IRB requirements, research participants signaled their informed consent to the use of these methods by oral consent during Phase I fieldwork (June–August 2022) and signed written consent forms during Phase II fieldwork (February 11–24, 2023). I also acquired formal permission to employ photography and video from the incumbent governors of the Sibundoy cabildo during both visits. However, given general suspicion surrounding the use of photography within the community, at times I was asked to put away my camera, which I did when requested.

Another limiting factor was my inability to speak Kamëntšá. To reach conversational competence in Kamëntšá would require a significantly longer period of residence in the Sibundoy Valley than was available to me for this project. Yet the potential ethnographic importance of learning the language—and therefore the limitations this inability imposes on the available data—should not be understated. Kamëntšá ritual speech precedes many important events in the community, and although speakers tend to repeat themselves in Spanish, I cannot be sure of the fidelity of the translation to the original. There are also philosophical concepts and other terms whose depth of meaning in the original Kamëntšá may be only partially apparent when translated to Spanish. Finally, some terms are frequently translated in multiple ways, but my ignorance of Kamëntšá precludes my ability to detect or distinguish between the valences of meaning in the original terms. For all these reasons, I assert that further work with the Kamëntšá will necessitate learning their language.

A final limiting factor is one of access. In general, I found many open, welcoming, and cooperative collaborators among the Kamëntšá. However, as an outsider to an Indigenous community which has historically suffered at the hands of unscrupulous researchers, I did sometimes encounter suspicion regarding my

intentions and ethics. In a few contexts I was prevented access to certain situations, events, or knowledge due to my outsider status. When this occurred, I did not press the issue or inquire further, but the result is that this thesis refers only to the knowledge and experiences that I had access to. I state this only for the sake of transparency—this research was conducted as ethically and thoroughly as possible, but it is from the perspective of an outsider. For truly emic perspectives that do not suffer from this problem, the reader is advised to refer to the growing body of scholarship produced from within the community by Kamëntšá anthropologists. The methodology highlighted above takes every precaution to limit misrepresentation or inaccuracy in the portrayal of the Kamëntšá people and culture, but as an outsider, it cannot be eliminated.

4. Theoretical Framework

4.1. Transculturation: Loss, Gain, Synthesis

The first theoretical tool underpinning my treatment of the ethnographic data is transculturation. This term was first introduced in 1940 by Cuban anthropologist Fernando Ortiz Fernández to describe the synthesis of Indigenous, African, European, and Asian elements that defines Cuban culture. For Ortiz, transculturation is defined first and foremost as a movement of cultural change occurring in three stages: 1) *deculturation*, or an initial loss of elements of the subordinated culture via the impositions of the dominating culture; 2) *acculturation*, or the partial gain and adoption of dominant cultural elements by the subordinated culture; and, finally, 3) *neoculturation*, or the synthetic emergence of new cultural elements out of the merger of multiple cultures in situations of encounter and negotiation (Allatson 2007; Millington 2007; Ortiz 1940). Ortiz had his native Cuba in mind when coining the term, but the

applicability of Ortiz's theory to other situations of colonial contact and cultural transformation would later cause it to circulate among scholars. Those interested in describing similar processes in other contexts found it invaluable, especially where Indigenous cultures elsewhere in the Americas demonstrated cultural survival, adaptation, and resilience under the deculturating pressures of nationally and globally dominant cultures. As Spitta (1995) writes, "Transculturation can thus be understood as the complex process of adjustment and re-creation—cultural, literary, linguistic, and personal—that allows for new, vital, and viable configurations to arise out of the clash of cultures and the violence of colonial and neocolonial appropriations" (1-2). It is in this sense that I have applied the concept of transculturation to Sibundoy Valley ethnohistory, and in which I here apply it to contemporary processes of Kamëntšá cultural survival through the strategic accommodation of colonially imposed cultural elements alongside, or within, recuperated, resignified, and reproduced Kamëntšá cultural concepts and categories. This feeds directly into my concept of cultural reproduction, as formulated below.

4.2. Cultural Reproduction: Preservation, Recuperation, Rearticulation, Invention

The grounded theory framework that I term cultural reproduction encompasses a range of social processes and practices involving both the reproduction of traditional cultural elements *and* the creation of novel cultural forms based on traditional models that may, in the future, become tradition themselves.¹² Cultural reproduction is a continuous and iterative

intergenerational process by which elements of a culture are *preserved*, *recuperated*, *rearticulated*, and *invented* as part of a continuous cultural transformation through time.¹³ The four principal mechanisms by which cultural reproduction occurs are defined below:

1. *Preservation* describes the stable conservation and maintenance of traditional cultural elements transmitted intergenerationally, with minimal modifications.
2. *Recuperation* describes the retroactive reclamation of traditions imminently threatened by devaluation or loss of cultural knowledge.
3. *Rearticulation* describes the re-signification of traditional elements, whereby traditions are modified during the process of intergenerational transmission.
4. *Invention* describes the synthesis of novel traditions which emerge from, draw on, or recombine features already extant in the culture. Invented traditions derive from preexisting traditions, but it bears remembering that all traditions were once invented from the cultural resources that preexisted them.

The combined operation of the four mechanisms outlined above constitutes the broader social process of cultural reproduction in

¹² My theory of cultural reproduction emerges from my fieldwork and the terminology employed by my Kamëntšá collaborators, who themselves often used terms such as *recuperación* and *innovación* to describe what they understood as processes of rescuing ancestral cultural elements while, at the same time, reinterpreting and reinventing others. This theory is, then, the fruit of the grounded theory approach described below in section 4. Methodology.

¹³ "Modernity" is a tenuous notion with a range of possible values and interpretations. It is often assumed that tradition and modernity are at odds, or that "traditional cultures" cannot exist in a modern context without a considerable loss of local culture and tradition. In other words, "modern" connotes "Western" and "advanced," while "traditional" connotes "Other" and "primitive" (as the old anthropological and popular terminology has it). This perspective, of course, situates contemporary Indigenous peoples and other subaltern or subordinated (i.e., "traditional") cultures outside of modernity, the privileged purview of Western, capitalist, and globally hegemonic societies. Part of the impetus behind this thesis project is to critically examine what Indigenous modernity looks like—that is, how peoples like the Kamëntšá claim and create their own modernities outside of Western and colonial imaginaries.

application to the Kamëntšá case, but this framework could also be applied to describe cultural change and continuity through time in other contexts. This is especially true in situations of transculturation, interculturality, and institutional power imbalance—the general situation in which Indigenous peoples in Latin America presently exist. Indeed, it is in such circumstances that cultural reproduction bolsters Indigenous efforts to enact autonomy against external pressures. To better understand processes of autonomy among the Kamëntšá within a broader regional and theoretical context, I now turn to a description of the ways in which Indigenous cultural autonomy has been theorized in Latin American more broadly.

4.3. Cultural Autonomy in Indigenous Latin America

In recent decades, an academic conceptualization of autonomy has emerged through the work of scholars writing at the intersection of social movements and political ontology (Escobar 2008, 2020; Dinerstein 2014; Gonzales and González 2015; González 2015; López Flores and García Guerriero 2018; Rosset and Pinheiro Barbosa 2021; Sieder and Barrera Vivero 2017; Schavelzon and Pitman 2019). For these scholars, autonomy is understood in terms of “the integration of people and nature, traditional management practices, the role of traditional authorities, and the resulting conservation of the environment” (Escobar 2008, 58). Related to this conceptualization of autonomy are similarly relational notions of “territory, culture, and identity linked to particular places” (282). Movements for autonomy in the Latin American context are therefore movements not only for autonomous self-government and justice, but also for the recuperation of culture, territory, and identity.

More important than academic interpretations of autonomy are the autonomous movements of Latin America themselves, which

articulate and mobilize locally grounded visions of autonomy through specific acts of political, cultural, and territorial resistance throughout the region. Ethnographic case studies of these movements proliferate, documenting local manifestations of a growing international reaction to the legacies of colonialism and the rampant abuses of neoliberal multicriminalism in the lives, cultures, and territories of numerous marginalized groups.¹⁴ These case studies profile movements for autonomy along multiple lines and in vastly different cultural and regional contexts, but all contribute to a developing discourse around the theory and praxis of autonomous alternatives to the status quo (Altmann 2017; Amigo 2022; Baracco 2017; Cott 2001; Gaitán-Barrera and Aseez 2015a; 2015b; Hale 2001; Harvey 2016; Hope 2021; Laing 2020; Lang 2022; Larson et al. 2016; Postero and Tockman 2020; Ramos Cortez and MacNeill 2021; Stephen 2005; “The Indigenous Guard” 2020; Velasco 2011).

Cultural autonomy describes the right to cultural difference in situations of interculturality and colonial power imbalance. More concretely, cultural autonomy describes Indigenous peoples’ right to valorize, maintain, and reproduce their own cultures free of interference from nationally or globally dominant cultures. The recognition of cultural autonomy as an integral part of an overall state of autonomy derives from the understanding that Indigenous cultures have long been attacked, suppressed, or devalued by colonial ones, and that such cultural dispossession continues to occur today. Cultural autonomy applies to many spheres of social life, including language, Indigenous intellectual property, and forms of tangible and intangible cultural heritage, among other elements. In the

¹⁴ See the following ethnographic case studies, which vary considerably region, culture, and theoretical focus: Altmann 2017; Amigo 2022; Baracco 2017; Cott 2001; Gaitán-Barrera and Aseez 2015a; 2015b; Hale 2001; Harvey 2016; Hope 2021; Laing 2020; Lang 2022; Larson et al. 2016; Postero and Tockman 2020; Ramos Cortez and MacNeill 2021; Stephen 2005; “The Indigenous Guard” 2020; Velasco 2011.

case of this study, the domains under study include the artisanal tradition, shamanism, and Clestrin̄ye (Barrera Jurado 2015; 2016; Barrera Jurado, Quiñones Aguilar, and Jacanamijoy Juajibioy 2018). Indeed, any definition of cultural autonomy which is attuned to a specific culture must also account for the specific principles and categories of Indigenous theory that emerge from that culture. In that vein, we will next consider two Kamëntšá theoretical principles core to processes of cultural reproduction and autonomy construction in the Sibundoy Vally.

4.4. Indigenous Theory: Intergenerationality and Ancestrality among the Kamëntšá

Intergenerationality and ancestrality are the two characteristic principles of the transmission and valorization of traditional knowledge among the Kamëntšá. *Intergenerationality* describes a social practice of cultural, practical, and philosophical knowledge transmission that occurs across generational lines. *Ancestrality*, on the other hand, describes a mode of thought, namely the veneration of the ancestors as the essential source of the wisdom and traditional knowledge on which Kamëntšá thought and lifeways depend. In other words, intergenerationality is the social practice which enables the reproduction of Kamëntšá knowledge, which is imbued with significance by the principle of ancestrality.

The transmission of traditional knowledge and cultural values among the Kamëntšá occurs intergenerationally. On the individual and familial level, knowledge is passed directly from parents to their children, while on the sociocultural level, knowledge is passed from respected elders and traditional authorities to younger generations in a perpetual process of epistemic reproduction. This occurs in various settings, often in the form of narrative performances enacted for the benefit of younger audience members who are expected to receive the lessons imparted by the example of the

elders. Notably, there exists a ceremonial register in the Kamëntšá language reserved for formal speech occasions of an exemplary and performative nature, complete with stock phrases that signal to those involved that the conversation has entered a ritual realm of didactic discourse. Such encounters once took place on a regular basis around the *shin̄yak* (hearth fire) in every family home (Figure 1), but increasingly Kamëntšá homes are no longer built with hearth fires, a fact that many of my collaborators lament as detrimental to the intergenerational process.



Figure 1. A *shin̄yak* and several *bancos*, or low wooden stools hewn from a single block of wood. Hearths like this one, with the three stones representing father sun, mother moon, and their children the stars, were once installed in every Kamëntšá home, around which people would sit on *bancos* and talk away the evenings. Now such talks usually only take place on special occasions, such as during *yagé* ceremonies, where it is still customary to sit on *bancos* around a fire.

Today, ceremonial speech occasions occur less frequently and usually in contexts of exceptional formality or performative artifice, such as curing ceremonies, community gatherings with a ritual component, *cabildo* events, concerts, and festivals like Clestrin̄ye.

Outside of traditional performance settings and ceremonial speech occasions, intergenerational knowledge transmission is also expressed in the artisanal tradition, in Kamëntšá language recuperation, in land management and ethnobotanical practices, and in other practice-based domains. In each of these cultural domains, children and apprentices typically learn from elders and established practitioners. They learn from observing, mimicking, and dialoguing

with elders through implicitly pedagogical contexts. One collaborator, an artisan and member of a weaving cooperative, affirms the importance of intergenerationality in the artisanal tradition and the Kamëntšá language in the following terms:

These artisanal goods have come down through the generations, since the elders have taught us how to make them since time immemorial, and that's how we've learned. That has been passed down through the generations. In the same way, our mother tongue has also been passed down from one generation to the next. (I.1)

According to my interlocutors, this process creates a feeling of reciprocal obligation to pass their own knowledge and skills on to the younger generations as their elders did to them. According to another collaborator, a Kamëntšá shaman:

We must create memory (*hacer memoria*) of the ancestors, to make memories, stories, so that our culture is not lost. In the future, perhaps we ourselves will not exist, but the next generations will be able to say, “thanks to our elders, who have left us this.” (I.5)

This shaman believes that it is imperative to preserve cultural knowledge for the benefit of future generations long after he himself is gone. This points to the continued centrality of the principle of intergenerationality in Kamëntšá thought and practice today.

If intergenerationality describes the social process of knowledge transmission and cultural reproduction between generations, then ancestrality is the philosophical principle that undergirds this process and valorizes that knowledge. McDowell (2022) defines ancestrality as “adhering to the example of the ancestors in order to find the good life” (23) and “the charter for proper living laid down by the ancestors” (28). Proper living depends on adherence to a set of prescriptions established by the wisdom of the

ancestors. Many of my collaborators attribute problems in the Kamëntšá community to the failure to properly adhere to the wisdom of the ancestors. These same collaborators have therefore commented on the necessity of a “recuperation” (*recuperación*) and “strengthening” (*fortalecimiento*) of ancestral knowledge. It is this valorization of ancestral wisdom (*lo ancestral*) which constitutes the ethical foundation of the intergenerational process, itself the motor of traditional knowledge transmission in this community.

The theoretical framework traced above guide the ethnographic analysis that follows in the next three sections. Transculturation describes a process of cultural synthesis that emerges from situations of intercultural power imbalance. Cultural reproduction, a grounded theory model of cultural change and continuity, is the primary theoretical tool of this paper and describes four specific operations of cultural survival in transcultural situations: preservation, recuperation, rearticulation, and invention. Cultural reproduction is understood as contributing to the construction and maintenance of cultural autonomy, which is understood in the Indigenous Latin American context as the right to self-determination with respect to culture, territory, and identity. Finally, it is necessary to account for two principles of Indigenous philosophy which undergird processes of cultural reproduction in the Kamëntšá context: intergenerationality, or the reproduction of traditional knowledge between generations through time; and ancestrality, or the valorization of traditional knowledge and culture. Which this guiding theoretical framework established, I now turn to an analysis of contemporary processes of cultural reproduction and autonomy in three domains of Kamëntšá culture.

5. Cultural Reproduction in the Artisanal Tradition

5.1. Overview

Kamëntšá *artesanías*, or artisanal products and handicrafts, in their various forms of expression—principally weaving, woodcarving, beadwork, and instrument-making—constitute a mainstay of the traditional economy and are omnipresent in homes, shops, community spaces, and especially in rituals and ceremonies. These objects are so ubiquitous that they have become the symbols by which the culture is predominantly known outside of the Sibundoy Valley. Kamëntšá masks are especially well represented in the art museums of Colombian cities like Bogotá and Medellín, and are even exported and exhibited internationally on occasion, often available for purchase at a considerable markup compared to what the artisans who make them charge. Less well known outside of the valley are the woven textiles which are, in fact, more prominent within the artisanal industry of the community itself. The most significant of the woven products of the artisanal tradition is the ubiquitous *tsömbiach*, the long belt embedded with pictograms representing various aspects of the Kamëntšá world, from which the extensive Kamëntšá symbolic repertoire is derived.

In this section, I discuss processes of cultural reproduction at work in the artisanal tradition of the Kamëntšá to show that, although the specific media and techniques used have changed, the cultural significance of the industry and its products has not diminished. I argue that cultural reproduction in the artisanal industry is expressed by 1) the recent advent and subsequent widespread adoption of the beadwork tradition; 2) the rearticulation and negotiation of the meanings of certain traditional symbols; 3) the invention of nontraditional products using traditional techniques, and the use of nontraditional colors and designs in traditional products; and 4) the development of a type of cultural autonomy that the Colombian ethnographer Gloria Stelle Barrera Jurado has

termed “artisanal autonomy.” (2015; 2016; Barrera Jurado, Quiñones Aguilar, and Jacanamijoy Juajibioy 2018). The reproduction of the Kamëntšá artisanal tradition contributes to the construction of cultural autonomy in the community.

5.2. Beadwork: Case Study of an Invented Tradition

In the contemporary artisanal industry, beadwork is currently the most widespread and profitable practice. Unlike weaving, woodworking, and instrument-making, however, the contemporary beadwork tradition is not ancestral and has only emerged in the last several decades, in part deriving from commercially successful applications of beadwork in other Indigenous contexts, namely that of the Huichol people of central Mexico (Barrera Jurado 2015).¹⁵ The advantages of beadwork as compared to other artisanal traditions are essentially economic: 1) it is cheaper in terms of the costs of raw materials, namely plastic beads and thread; 2) it is quicker to learn the necessary skills and to produce individual products; and 3) it is more profitable because finished pieces are cheaper, sell more quickly, and make for more convenient souvenirs for tourists than heavy, bulky, or fragile artisanal products such as wooden masks and textiles. Beadwork is a tradition which better adapts itself to the pace and distractions of modern life, as compared to more labor-intensive and time-consuming traditions—and for this reason, many Kamëntšá youths learn and practice beadwork even if they learn no other artisanal traditions.

The rising popularity of beadwork among

¹⁵ It is necessary to distinguish between the contemporary beadwork tradition, which makes use of cheap plastic beads imported principally from the city of Pasto, and what is in fact an older beadwork tradition, which possibly dates to the Capuchin era and makes use of larger, irregular mineral beads in heavy coiled necklaces as part of the ceremonial regalia of shamans and traditional authorities (Barrera Jurado 2015, 131). Here I am discussing the commercial beadwork industry that has only emerged in recent decades.

young artisans is correlated with a reduction in the prevalence of older traditions, namely weaving and woodcarving, although both of those industries retain their cultural importance. Many of the artisans I have worked with who are engaged in more traditional industries—weaving, woodworking, and instrument-making—have expressed frustration at the difficulty of selling their crafts given that the artisanal market is saturated with cheaper and more convenient bead products, although many of the same artisans engage part-time in beadwork themselves. However, the invention of the beadwork tradition should not be seen as representing a harmful break with established traditions. In fact, there are reasons to believe that the emergence of this invented tradition has enabled the fortification of the Kamëntšá artisanal tradition. The ease with which beadwork techniques are learned, and the relative inexpensiveness of the materials, have been of benefit to many potential artisans who otherwise may not have the time, skill, or money to partake in the artisanal industry. This is especially true for those who do not have the resources to engage in more lengthy and expensive traditions like weaving and woodworking, but for whom beadwork can provide a source of supplementary income. And for those artisans who engage in beadwork alongside more traditional crafts, the added revenue stream from the sale of the former generates additional possibilities to produce the latter. Economic realities both within the community and externally drive artisans to invest in the beadwork tradition over or alongside more traditional forms of artisanry. While this introduces the risk of commercializing the artisanal tradition, it is also clear that greater economic control on the part of artisans correlates with greater autonomy in the realm of artisanal production.

However, the developing beadwork tradition holds no less cultural significance than other artisanal trades. Critically, beadwork partakes in

cultural reproduction through its inclusion of traditional symbolic motifs. The greater availability of beadwork products that incorporate traditional symbology allows, in turn, for the greater dissemination of these designs both within and outside of the community. One elderly weaver expressed this thought in the following terms:

If nobody buys from us, it isn't much use to know all the different practices. For example, we used to weave with wool, but now they're doing it with beads, drawing [*dibujando*] with beads. Now there's not much wool weaving anymore, but the same designs are still being made with beads. That's what happening. For me, artisanry with beads is a good thing. (I.4)

This traditional artisan only works with weaving, but she remains integrated in the larger artisanal community and regularly interacts with younger artisans who have adopted beadwork in their own craft. Through this interaction, she came to recognize the importance of transmitting traditional symbolism through beadwork in new, innovative ways. Her acknowledgement of the economic reasons for which beadwork is taking off is also noteworthy; she acknowledges that there are clear economic incentives to prefer beadwork over more labor-intensive and expensive crafts, but she recognizes that the same symbolism is still being reproduced in the nascent beadwork tradition.

Similar perspectives were articulated by several artisan women representing a collective of young mothers who regularly meet to practice their weaving, speak Kamëntšá together, and help each other with childcare needs. As they sat trying to teach me how to weave a simple chumbe on a traditional wooden loom called a wanga (I made a poor student), they explained that, before they learned to weave in the traditional way, they first began their artisanal careers with beadwork. Many of them learned beadwork during the lockdown phase of the coronavirus pandemic to

supplement their falling incomes. When I met with them, they were learning to weave the same symbols that they initially learned to stitch into bead bracelets and the wings of bead hummingbirds—which are also a recent innovation enabled by the spread of the beadwork tradition. In the case of these young artisan women, beadwork served as a gateway to more traditional forms of artisanry.

Therefore, despite the recent appearance of beadwork on the artisanal scene and the correlated decline in other forms of artisanal work, its emergence does not represent a hard break from more “traditional” forms of artisanal practice. As the following analysis shows, the nascent beadwork tradition instead demonstrates the intergenerational extension of the Kamëntšá artisanal tradition, contributing to cultural autonomy in the artisanal domain.

Relative to older artisanal forms, beadwork simplifies traditional symbolic representations. Figures 2 and 3 show the differing levels of intricacy in a traditional woven bracelet compared to several bead bracelets which are typical of those sold in shops all over Sibundoy.



Figure 2. A woven bracelet bearing tsömbiach designs. Although this style of bracelet is the most traditional, utilizing very fine weaving techniques, it is far more labor-intensive and time-consuming for the artisan, and therefore more costly for the purchaser. Bracelets of this style are difficult to find today.



Figure 3. A collection of bead bracelets. According to my collaborators, the symbols and colors used in these bracelets

represent, from top to bottom, 1) the sun or the womb; 2) the territory (green chevrons), the sun or the womb (red-yellow diamonds), and the “black gold” of the Putumayo oil fields that attract developers (black chevrons); 3) Clestrinŷe, the most important Kamëntšá festival of the year; and 4) the zigzag design known in Kamëntšá as *benach*, which represents both the footpaths that run between family houses and the metaphorical path walked by the Kamëntšá people.

The difference in detail is apparent between the woven bracelet and the bead ones. Although the first is more finely worked and better preserves the original forms of the symbols incorporated, drawn from tsömbiach symbology, bracelets like this one are difficult to find and more expensive than the simpler bead ones shown above. However, the bead bracelets, though simpler in form and using new materials, still make use of the traditional symbology.

Beads are also now applied within other artisanal traditions, as in the use of beaded masks (Figures 4). In the case of these masks, the use of beads also marks an evocative spin—and certainly a marketable one—on a traditional medium.



Figure 4. Various masks of the type called “gestos,” referring to their exaggerated facial expressions and gestures. While the most traditional masks are left bare or given only a simple layover of paint, most masks produced today are decorated

with colorful beads in a wide variety of patterns and designs.

While the mask-making tradition has incorporated beadwork more extensively and visibly than any other traditional artisanal domain, beadwork has also made an appearance in other types of woodworking, such as the production of *bancos*, low wooden stools traditionally carved from a single block of wood. Increasingly, artisans have applied beads and more elaborate painted designs to the bare wood to sell *bancos* with aesthetic as well as functional and ceremonial value. As in the case of beadwork applied to bracelets and masks, these designs often incorporate elements of Kamëntšá symbology, serving to strengthen and transmit traditional values in an aesthetically novel spin on a traditional medium in a way that retains its functional and ritual importance.

The same is true of beadwork experiments in the domain of weaving, where weavers are increasingly incorporating beads into their practice. For example, some artisans have recently produced *tsömbiach* belts and *coronas*, ceremonial headdresses (Figure 5), made partially or entirely out of beads. Here again, despite the application of recently developed beadwork techniques to established artisanal traditions, the symbolic value of the resulting products is not diminished. Today, bead products of all types are widespread in the community; many people of all ages and genders wear bead bracelets daily, while necklaces decorated with *tsömbiach* designs or in the image of jaguars and *yagé* visions are now a standard feature of shamans' ceremonial regalia.



Figure 5. Two examples of coronas, or crowns, elaborate headdresses used in the ceremonial dress of both men and women, especially during Clestrinŷe. Coronas are decorated with intricate woven patterns in brilliant colors and features dozens of small chumbes or fajas inscribed with *tsömbiach* symbology. Coronas and their chumbes are traditionally woven, several recent examples partially or entirely incorporate beadwork.

From this exploration of the beadwork tradition, I draw several conclusions. First, the advent and rapid growth of the beadwork tradition within the last twenty years is *complementary*, as opposed to *detrimental*, to the other, more established artisanal traditions. Economic hardships have driven many artisans and prior non-artisans alike, especially young ones, to adopt beadwork as a primary or supplemental artisanal practice. However, in doing so, these artisans continue to incorporate and reproduce the same ancestral motifs and symbolism drawn from older traditions. Second, beadwork can serve as an easy and affordable introduction to artisanal practice and as a gateway to the eventual production—and

therefore preservation—of more ancestral crafts, such as weaving and woodworking. This fact is demonstrated, for example, by the women who began their artisanal work with beadwork during the coronavirus pandemic before progressing to weaving when the accretion of experience and improving financial fortunes allowed. Third, the syncretic and creative application of beadwork, a recent arrival on the artisanal scene, to more established and ancestral artisanal domains (e.g., masks, bancos, and textiles) serves to mutually strengthen each tradition, new and old alike—especially considering that the colorful and elaborate beadwork designs applied to masks and other crafts are largely responsible for their popularity as tangible emblems of Kamëntšá heritage outside of the valley which can now be found in prestigious museums in the large cities of Colombia. Finally, although beadwork is not an ancestral tradition among the Kamëntšá, it has been welcomed by the community as a legitimate artform as well as an economic boon, to the point that many community members make daily use of bead objects and shamans have adopted them as part of their ceremonial attire. In short, although an invented tradition and a newcomer to the Kamëntšá artisanal scene, the advent of beadwork has contributed to its fortification and reproduction.

5.3. Cultural Reproduction in the Artisanal Tradition

The nascent beadwork tradition explored above stands as the prime example of an invented domain in the artisanal industry of the Kamëntšá, but it is not alone in exemplifying processes of rearticulation and invention in the artisanal industry. In this section, I explore several other instances of cultural reproduction as they are at work in different domains and circumstances. Cultural reproduction is evident in 1) the rearticulation of ancestral symbols and the rejection of foreign ones; 2) the invention of nontraditional uses for ancestral symbols and

motifs; 3) the wholesale invention of new artisanal forms using traditional symbols and materials; and 4) the adaptation of pan-Indigenous artisanal objects. These processes, like beadwork, contribute to the creative fortification of Kamëntšá cultural autonomy in the artisanal tradition.

First, it is important to understand that the meanings inherent in Kamëntšá symbology are not static, like an alphabet, but ever-changing, like the dynamic words and concepts that each symbol represents. That is, each symbol represents a constantly expanding set of ideas, and can therefore be interpreted and reinterpreted in various ways. A representative example is the symbol for *shinyë*, the sun, a very common motif (Figure 6). According to Marisol, it is always situated at a certain angle, at a certain point in the sky, which varies depending on the time of day and the standpoint of the observer—the sun is never the same sun. The sun is also, by extension, time; ancestrally, time was approximated by reference to the position of the sun in the sky.¹⁶ Others have told me that this very same symbol also represents the womb. Consequently, the figures of Kamëntšá symbology are not static representations; they cannot always be read in the same way, for the concepts and objects they refer to are not the same from one moment to the next. There is, therefore, always a process of individual and circumstantial interpretation behind the reading of Kamëntšá symbology, whether in the form of a sole symbol or in the lengthy sequences of a *tsömbiach*. According to one artisan, “feelings, ideas, stories—everything is in the *tsömbiach*”—and here the *tsömbiach* stands in for the

¹⁶ According to Batá Marisol, “el sol era el tiempo, porque antes no teníamos reloj.” Owing to constraints of space and thematic relevance, I was not able to remark upon Kamëntšá concepts of time in the section on Kamëntšá philosophy and cosmology, but many collaborators have told me things to the effect of “time works differently here.” Some have gone so far as to say that before colonization, “el tiempo no existía para nosotros.” This fascinating subject certainly merits further exploration, but this is not the place for it.

Kamëntšá symbolic repertoire in general.



Figure 6. The shinyë motif, an emblematic symbol representing the sun. Others have told me that this motif can also represent the womb, demonstrating a type of symbolic rearticulation. This example is taken from a tsömbiach running down the middle of a scarf, a recent invention in Kamëntšá weaving.

It is partly by virtue of this fact of variable interpretability that Kamëntšá symbology has undergone continuous change with the passage of time, preserving certain ancestral symbols while others have been reinterpreted and some wholly invented. For example, most of the central figures of Kamëntšá symbology—those representing, for example, the sun, rivers, mountains, animals, and the footpath—are ancestral, having been passed down through generations of artisans with relatively little change in form or meaning. On the other hand, the meaning of some symbols, even well-established ones, seems to vary depending on context and the person interpreting them. This has to do partly with the pedagogical problems of imparting traditional symbology in the bilingual schools of the *resguardos*, where Kamëntšá children usually first learn weaving and other artisanal practices.¹⁷ One artisan collaborator explains learning Kamëntšá artisanal practices in the context of *resguardo* schools as the difference between learning how to write and learning how to draw:

We like to weave, we like colors, we pay a lot

¹⁷ This is as opposed to the traditional system in which children learn artisanal crafts in the home with their parents and other adults. This still occurs but is increasingly infrequent.

of attention to observing things. We go to the garden, we observe, we look, and we weave what we see. It's healing. In school they don't teach us to write [i.e., to weave symbols], which is another part of symbolic language. They don't teach us to write, that's why I say that today they might be bad at teaching the children in the schools how to weave... Because they don't have many printed copies [of symbols], in the school they draw the symbols for the children, but they don't teach them to memorize. Then, when a child wants to weave, if they don't have a copy to look at, they don't know how to make the symbol. That's not true for us [professional weavers]. I think that today we need to talk about artisanal education from our own culture [*desde lo propio*], from our own thought, and we need to inject it with our thought, because that thought will cleanse it [*ese pensamiento lo va a sanar*]. (FG.1)

According to these artisans, the fact that many Kamëntšá children learn the weaving of traditional symbols only by rote memorization has distorted their knowledge of the original values of these symbols. In effect, this artisan believes that in the weaving classes offered at *resguardo* schools, children do not learn how to “write” traditional symbology so much as to trace and copy. Even so, one consequence is that it opens those symbols to new possibilities of interpretation. Thus, *resguardo* education is partly responsible for cases of symbolic rearticulation wherein established symbols are resignified and assigned multiple values—what the artisan quoted above terms “distortions,” then, may rather be regarded as creative rearticulations.

However, not all cases of symbolic rearticulation are a matter of misinterpretation on the part of young artisans who were not properly taught the “authentic” values of the symbols they have learned to produce by rote. Professional and highly knowledgeable artisans

are also involved in the process of rearticulating established symbols. For instance, one of the older artisans in my focus group meetings shared the following anecdote regarding the ambiguous interpretation of a single symbol which is assigned different values by various people:

My mother said, “this is a comb.” That’s why, for us, the comb is a symbol of thought [*pensamiento*], because with the comb they cleaned us, they showed us how to change our thoughts. My mother says, “that’s what is in this symbol.” Some say it’s a comb, others say it’s a caterpillar. Imagine, it’s the same symbol! Whatever the case, for us it means thought. [Others say] this symbol represents the eyes of a guinea pig. All these interpretations are natural, these are all *uaman soyëng* [“sacred things”]. It all fits in the Indigenous cosmovision. One leaves a mark with a symbol, with a little drawing. Our mark is this symbol. (FG.1)

Although this artisan remarks on these different interpretations of the same symbol, she does not claim a single definitive value for it. Instead, she recognizes each meaning as a legitimate possible interpretation—the symbol is simultaneously a comb, a caterpillar, and even the eyes of a guinea pig. “All is natural,” she explains, “these are all sacred things.” Furthermore, this artisan seems to recognize each of these symbols, whatever their representational form, on a symbolic level refer to the same meaning: thought. She shrugs off the ambiguity in meaning: “it all fits in the Indigenous cosmovision.” Here an ancestral symbol has taken on multiple referents which are superficially contradictory or mutually exclusive but which, at least for this interlocutor and her reading of this symbol, refer to the same concept. This demonstrates both preservation on the level of abstract meaning and rearticulation on the level of symbolic interpretation.

Another example inheres in the symbol called *shinyë*, the sun (Figure 6). While I have not

heard this symbol referred to by any other name, its interpretation is variable. As often as it has been described to me as representing the sun, it has also been said to depict a woman’s womb.¹⁸ What seems to be happening is that the symbol conventionally known as *shinyë* is a composite of two symbols. Those who tell me it refers to the sun tend to say so with reference to the angular rays emitting from the central diamond design. Those who say it refers to the womb, on the other hand, tend to point to the diamond itself, or to the crosshatch matrix contained within it. This distinction finds support in the fact that others among my artisan collaborators have, with a greater degree of unanimity, characterized diamond-shaped designs *without* associated sunrays as wombs. This leaves two possibilities: 1) both meanings are ancestral and have always co-inherited; or 2) one meaning is ancestral and the other is a more recent rearticulation of a traditional design. The fact that the symbol goes by the term *shinyë* and not the Kamëntšá term for “womb” provides evidence for the latter explanation. Other examples of similar processes—ambiguities in meaning and the rearticulation of ancestral designs—abound, although this one exemplar is sufficiently demonstrative.¹⁹ Suffice it to say that this appears

¹⁸ This association suggests the body-territory principle explored above, as well as the notion of the territory as mother. It also brings to mind the Andean philosophical concept of *yanantin*, complementary dualism, insofar as the sun is the paternal principle thought to inseminate the fertile ground of the earth with its rays. This, in turn, recalls the shamanic use of quartz crystals in the Lower Putumayo and Vaupés, deep in the Colombian Amazon. These crystals, thought to embody the solidified semen of the sun, are (or once were) worn around the neck by shamans seeking to potentiate their powers with the vital essence of the sun (Reichel-Dolmatoff 1968). In short, it is perhaps logical that two apparently quite disparate concepts should be joined in the selfsame symbol. According to McDowell (personal communication, April 21, 2023), the quartz crystal is (or was) also in use in the Sibundoy Valley: “The quartz crystal, called *waira wawa* in Inga, was very much in evidence when I was in the valley. I recall *médicos* having the patient blow on the crystal for diagnostic purposes. I was told they are created where lightning strikes the ground, and you only find one if you are destined to be a *médico*.”

¹⁹ During my work with artisans, I encountered many other examples of ambiguity or negotiation in the meanings of the

to be a widespread phenomenon in Kamëntšá symbolism.

The above discussion demonstrates that ancestral symbols have been reinterpreted and assigned multiple—though apparently complementary—meanings in the recent history of the Kamëntšá artisanal industry. Also significant, however, is the former intrusion, and eventual erasure on the part of Kamëntšá artisans, of foreign symbolologies. These intrusions threatened, for a time, the cultural continuity of the Kamëntšá artisanal tradition; however, the artisans' eventual collective disavowal of foreign symbols and objects constituted an act of artisanal autonomy. One of my collaborators is an elderly woman who is well respected in the artisanal community for being one of the first artisans to establish a cooperative and exhibit her wares at the fairs and competitions sponsored by the nascent heritage industry of the 1970s and 80s. She explained to me how merchants and organizations arrived in the Sibundoy Valley from Bogotá and abroad with the stated intention of fomenting and improving the artisanal industry there. Although this weaver framed the arrival of outsiders as beneficial to the artisanal community, others were more critical. In general, my collaborators were quick to denounce what they interpreted as the “artisanal theft” and “artisanal injustice” that they claim undergirded the attempts of outside organizations to “develop” the Kamëntšá artisanal industry.

More than appropriating and reproducing Kamëntšá artisanal techniques and designs without the knowledge or consent of the artisans who taught them, these non-Indigenous Colombian and foreign merchants went so far as to introduce foreign designs into the artisanal repertoire of the Kamëntšá. These changes were meant to foment the commercialization of

Kamëntšá handicrafts, but in fact they introduced designs devoid of any cultural significance to the artisans, meant only to generate revenue through sale to tourists and outsiders. In effect, artisanal goods became commodities, and with this change came alienation between the artisan and her work. In her study of the Kamëntšá artisanal industry, Gloria Stella Barrera Jurado (2015) writes:

These dynamics of commercialization of Kamëntšá objects generated fundamental changes in various aspects of their artisanal universe... For that reason, the production of objects foreign to the material culture of Kamëntšá began to appear, such as table placemats, ties, belts, wallets, various articles of clothing, objects for interior decoration, and souvenirs for tourists visiting the Sibundoy Valley. (161).

Naturally, the production of objects wholly foreign to the Kamëntšá artisanal repertoire implied an attack—intended or not—on the cultural underpinnings of the ancestral artisanal tradition. Witnessing their culture and traditions eroding under the influence of outsiders, activists and artisans began rejecting the outsiders' artisanal impositions beginning in the 1980s. Barrera Jurado writes:

Finally, the artisans enacted actions of resistance and social control by beginning to erase the designs introduced by outsiders from the artisanal inventory. At the same time, the Bilingual Institution and Artesanías de Colombia [Colombian NGOs] sought, in the 1980s, to reduce the effects of commercial and technical homogenization and of the loss of identity-specific elements [*elementos identitarios*] caused by the action of these outsiders [*gringos*]. (165)

The rejection of the designs introduced by outsiders represents an agentic decision made by Kamëntšá artisans who saw their traditions under

same symbols. A comparative study of the rearticulation or resignification of specific designs in the Kamëntšá symbolic repertoire would make a valuable intervention in the literature. This, however, is not the place for that.

threat. This rejection exemplifies the distinction between *invented* traditions that emerge *from within* the community itself and *imposed* or *introduced* traditions brought by outsiders. Certainly, the symbolic repertoire of Kamëntšá artisans has expanded and certain ancestral symbols have been intergenerationally resignified. However, these changes have emerged from within the artisanal tradition itself and by the doing of Kamëntšá artisans; consequently, there is nothing foreign or inauthentic about these rearticulations and innovations. Instead of reproducing designs introduced by outsiders for commercial purposes, the artisans chose to recuperate and rearticulate their own traditions on their own terms. In other words, they drew on preexisting cultural resources to create new recipes with ancestral ingredients, strengthening their cultural autonomy.²⁰

In tandem with the symbolic rearticulations and innovations discussed above, Kamëntšá artisans are also engaged in processes of *formal* innovation—that is, the application of traditional designs and neotraditional media for the creation of novel artisanal objects. Kamëntšá artisans are thereby engaged in expanding their artistic and commercial repertoire, reproducing their craft through the creative recombination of ancestral motifs. This process is exemplified by the appearance of woven scarves and knapsacks,²¹

both nontraditional objects, which incorporate ancestral designs such as capisayo colors or tsömbiach symbols, as in Figure 7.



Figure 7. Examples of rearticulation and invention in the weaving tradition. These objects were displayed at the booth of a weaver during the artisanal fair in Sibundoy's Interculturality Park during the weekend prior to Clestrinje in February 2023. From a neighboring stall, I purchased a scarf incorporating the same capisayo colors, a nontraditional use of a traditional design.

The bag in the middle uses traditional colors in a nontraditional medium: a knapsack, a product with which the red, white, black, and blue stripes of the capisayo pattern are not traditionally associated. The bag is also decorated with a tsömbiach around the middle, another nontraditional use of a traditional design. While bags bearing tsömbiach symbology have been commonplace for some time, one of my close collaborators remarked on the use of capisayo colors as novel, suggesting individual innovation by the artisan who wove this bag.

²⁰ This activity bears semblance to Claude Lévi-Strauss's concept of *bricolage*, referring to a mode of creative thought in which a subject, be it an individual or a culture, creates and innovates by recombining whatever is at hand, making use of preexisting cultural resources to develop new syntheses in thought and design. This type of synthetic/syncretic invention using the cultural resources at hand aptly describes cultural reproduction in the Kamëntšá artisanal tradition (Lévi-Strauss 1962).

²¹ Here I refer to the generic type of artesanía known in Colombia as a *mochila*. The *mochila* is a type of woven shoulder bag originally affiliated with the Arhuaco people of the Sierra Nevada de Santa Marta on the Caribbean coast of Colombia. Since the development, from the 1960s, of a Colombian artisanal industry of national and international importance, the *mochila* has diffused far and wide through Colombian artisanal communities, particularly other Indigenous ones, to the point that it is now emblematic of

Indigenous Colombian artesanías writ large. Like the bead designs of the Huichols of Mexico which have become generalized among Latin American artisanal communities far and wide and which have informed the development of the Kamëntšá beadwork industry, the appearance of the *mochila* onto the Kamëntšá artisanal scene in recent decades signals both the syncretic, creative, bricoleur nature of Kamëntšá artesanías in particular, and a kind of a pan-Indigenous dialogue in which artisans from Mexico to Argentina readily adopt and adapt each other's innovations in aesthetics and technique (Villegas and Villegas 2000).

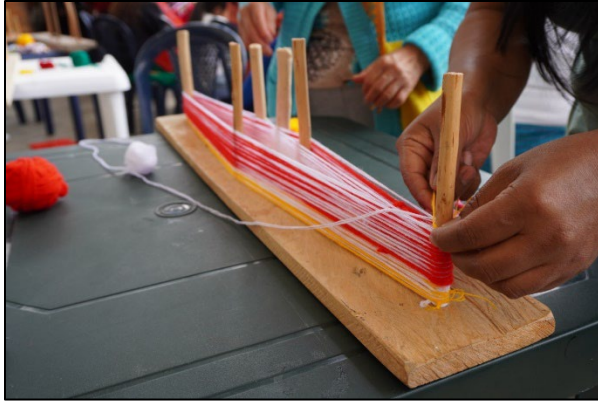


Figure 8. At a workshop sponsored by the Sibundoy cabildo as part of a series of cultural events prior to Clestrinje 2023, an experienced weaver teaches a younger woman how to weave using a *tabla*, a wooden plank with embedded poles that serves to begin the process of weaving a *tsömbiach*. Once the basic form is completed on the *tabla*, the *tsömbiach* is transferred to an upright *wanga* to complete the weaving process. Workshops like these evince the importance of intergenerational knowledge transmission within the artisanal industry. Notably, many children were present and eager to learn to weave with the elders invited by the cabildo.

The bag shown above is one clear example of the application of traditional designs to nontraditional forms in a process of symbolic preservation, rearticulation, and invention. At the same time, synthetic and syncretic designs like these are increasingly common within the artisanal community, suggesting a considerable exchange of ideas between artisans. In other words, creative exchange between artisans serves as the point of origin for a new tradition, one of experimental mediums. In fact, that these innovations may soon become established traditions themselves is a natural consequence of the intergenerational nature of knowledge and skill transmission within the community (Figure 8). Just as beadwork has quickly become one of the most salient artisanal forms in the community in just a few decades, now eagerly learned and applied by Kamëntšá children, the formal artisanal innovations being introduced today may be naturalized and pass into tradition for future generations of artisans.

It appears that, given the slower pace of cultural change in the past, overt modifications

or innovations in the traditional artisanal repertoire of the Kamëntšá were once limited compared to their abundance today—but they were never entirely absent, for all traditions are ever-changing. Today, however, the relative flexibility and openness to change that characterizes the contemporary artisanal community has resulted partly from loosening of conservative rules formerly governing the use of certain artisanal objects. For example, the bag shown above would not have been permissible to weave or wear in the era in which the *capisayo* colors—red, blue, and white stripes against a black background—were forbidden to all but current and former governors of the Kamëntšá cabildos, a situation that persisted into the late twentieth century. Anyone without the proper authority discovered wearing the governor's colors would be beaten and shunned, for his transgression was to undermine the traditional government along with the respect and privileges conferred on it. Likewise, women were not allowed to wear any sort of *capisayo* regardless of color or pattern. Men, on the other hand, were not supposed to make use of the *tsömbiach*, which was designed to be wrapped around a woman's womb or to swaddle the body of an infant. These days, however, the *capisayo* design once restricted for all but the highest male authorities of the Kamëntšá is worn by all as an emblem of the community in general. Today, women wear *capisayos* while men make use of *tsömbiach* belts. These changes suggest the far-reaching sociocultural impact of the rearticulation and invention of artisanal traditions.

The relaxation of rules regarding the proper use of artisanal objects may be seen as a loss of regulations having a preservative function vis-à-vis the artisanal tradition. It may be true that such stringent restrictions slowed the rate of innovation and change in the artisanal arts and in the community's use of artisanal products. However, the relaxation of those customs have resulted in a greater flexibility of artisanal

production and use which has contributed to the reproduction of this vital domain of Kamëntšá culture. The fact that many formerly gendered garments are now gender-neutral while others, newcomers to the artisanal universe of the Kamëntšá, have established a place for themselves in its repertoire, attests to the continued strength and relevance of the artisanal tradition of this community (Figure 9). These changes are representative of the proliferation of innovations and experiments that characterize the contemporary artisanal industry.



Figure 9. A weaver sits at his wanga, the wooden loom used to weave tsömbiach belts and other Kamëntšá textiles. This man is weaving a capisayo inscribed with tsömbiach symbology. The colors and design are not traditional, evincing a process of innovation in the domain of weaving that has only emerged in recent decades. Men are also traditionally not weavers, but instead woodcarvers, indicating changes afoot in the gendered associations of the different artisanal traditions. Just as men are beginning to weave, so too are women beginning to carve.

A final point relevant to the innovation and syncretism in the Kamëntšá artisanal tradition

merits attention: the prevalence of *borrowed* traditions of external Indigenous and pan-Indigenous provenance now being *incorporated* and *naturalized* within the Kamëntšá artisanal repertoire. This process differs from the coercive imposition of non-Indigenous designs discussed above by instead drawing on authentic Indigenous traditions borrowed from other cultural contexts. For example, the bead art of the Huichols, an Indigenous people of central Mexico, has significantly influenced the development of the Kamëntšá beadwork tradition (Barrera Jurado 2015). Another example is the adoption, by Kamëntšá shamans, of the dreamcatcher, which was originally an Ojibwe technology before becoming emblematic of the pan-Indianism movement in North America beginning in the 1960s (Oberholtzer 2017; Figure 10).



Figure 10. A Kamëntšá dreamcatcher. Note that it is hung from a chumbe and wrapped in a beadwork band.

The borrowing, by Kamëntšá artisans and shamans, of symbols and artforms from other Indigenous communities—in Colombia, Latin America, North America, and beyond—has been enacted for pragmatic, symbolic, and political reasons. As far as pragmatism is concerned, the commercial success of Kamëntšá beadwork speaks for itself, even though it draws from the bead art of the Huichols, an Indigenous people of central Mexico. Similarly pragmatic is the advent of the woven knapsack as a significant artisanal product among in the Kamëntšá despite its origin with the Arhuacos of northern Colombia; it is a

popular and recognizable design that the Kamëntšá can make their own while still catering to a tourist clientele, both domestic and foreign, that recognizes it as a characteristically Colombian artform. In other words, the adoption of techniques and designs recognized as “Indigenous” (even if only to regions and peoples located hundreds or thousands of kilometers from the Sibundoy Valley) enable Kamëntšá artisans to both profit from and participate in a pan-Indigenous, transnational artisanal tradition—one which is, in fact, a *mélange* of disparate and unrelated traditions from across the Americas.

The political reasons for which Kamëntšá artisans may have adopted techniques and designs from other Indigenous groups across the Americas shed light on the development of a pan-Indigenous affiliation that transcends national and regional divides—one that serves Indigenous peoples themselves, not only tourists and commercial endeavors. The adoption of different Indigenous groups’ artforms is an extension, in the age of globalization and pan-Indigenous transnational identity-building, of the same transcultural processes of borrowing, adaptation, and modification that have always made the Sibundoy Valley what it is—a site of cultural exchange, transformation, and creativity in which disparate elements and traditions are syncretically accommodated and recombined in a perpetual process of cultural reproduction and synthesis. A similar principle undergirds the cultivation of an Amazonian pan-shamanism within the Kamëntšá shamanic tradition, discussed in the next chapter.

5.4. Artisanal Autonomy

The foregoing discussion has served to survey and interpret processes of cultural reproduction currently at work in the artisanal industry of the Kamëntšá, a cultural domain which has undergone considerable and rapid changes in recent decades. Cultural reproduction in the

artisanal tradition serves Kamëntšá cultural autonomy in the following ways: 1) the valorization, preservation, and intergenerational transmission of ancestral knowledge, skills, and philosophical principles; 2) language recuperation and revitalization through intergenerational transmission and apprenticeship; 3) the interdependence of the artisanal tradition and other cultural domains of the Kamëntšá, including shamanism and Clestrinje—the subjects of the following two chapters.²² In this section, I briefly discuss each of these categories with reference to Gloria Stella Barrera Jurado’s notion of artisanal autonomy (2015; 2016; Barrera Jurado, Quiñones Aguilar, and Jacanamijoy Juajibioy 2018). This discussion demonstrates the close relationship between cultural reproduction and autonomy within the artisanal tradition of the Kamëntšá.

Barrera Jurado is a Colombian ethnographer who spent several years working with Kamëntšá artisans, investigating what she came to term “artisanal autonomy,” which the artisanal collective she worked with defines as “the ability to make our own decisions related to the regulation, interpretation, and meaning of traditional artisanal knowledge, affirming that the Kamëntšá people has collective rights over its material and immaterial heritage” (Barrera Jurado 2015, 195). Artisanal autonomy as thus understood has important ramifications in other domains of Kamëntšá culture and social life and can be situated within a broader movement for social justice and decolonization. For Barrera Jurado,

The struggle for autonomy seeks to create more just social relations through collective democratic action with an intercultural basis in spiritual, historical, and symbolic

²² This list is by no means definitive. For lack of space and time, for instance, I cannot include a discussion of orality and the tsömbiach narrative tradition (see Aldana Barahona and Sánchez Carballo 2021) in my discussion of the importance of artisanry for language recuperation. This and other points undeveloped here warrant in-depth exploration elsewhere.

principles, granting the market economy the means to secure the material means for the wellbeing of community members. (196)

This is an effective and compelling definition, and one that emerges from the Kamëntšá artisans with whom Barrera Jurado worked. However, it is possible to expand on this definition of artisanal autonomy in consideration of the following points, which are intended to highlight additional dimensions in which the reproduction of the artisanal tradition contributes to the overall fortification of the culture and community of the Kamëntšá.

The artisanal industry of the Kamëntšá plays an essential role in the cultural reproduction of the community at large insofar as it emerges from and strengthens ancestral lifeways, skills, knowledge, and thought. These ancestral values are not only embodied in and transmitted through artisanal objects themselves, in their capacity as the principal representations of the tangible cultural heritage of the community. More importantly, they are also transmitted and reproduced intergenerationally by pedagogy and apprenticeship, through which elders pass on to younger generations the skills and knowledge that their forebears in turn taught them. This is an integral process, in which the manual skills required to turn a block of wood into a mask or a bundle of yarn into a tsömbiach are inextricable from the cultural, ethical, and philosophical values and principles that give meaning to the art. This process is essentially territorial, for the principles that define Kamëntšá territoriality find embodiment in the artisanal objects elaborated by the community. As Barrera Jurado writes,

The artisanal object itself is a territory. In their carved or woven symbols one can identify places such as rivers, mountains, paths; and also real people, heroic characters, mythological or fantastical beings, all of which are represented in the carnival masks or in beadwork designs. These

motifs occupy a real place in the biophysical spaces of the Sibundoy Valley. These objectual territories demonstrate the relationship between the artisans and Mother Earth and its dimensions of fertility in the objects used in rituals for healing or to protect people. (197).

Or, in the words of a young musician and artisan,

The symbols [*la escritura*, lit. “the writing”] are a language. Imagine that our grandmothers [*nuestras mamitas*], those who weaved, did not know how to read, they didn’t know how to write, but in their weavings they told stories, they said “We’re going to make this figure in pairs.” When we speak of symbology and language, it’s because in each symbol we are telling the story of our territory. (I.7)

In short, artisanal objects are one of the vessels through which culturally essential values are reproduced through their elaboration and dissemination within the community.

Language recuperation and revitalization is a second crucial way that reproduction of the artisanal tradition bears important implications for Kamëntšá cultural autonomy. First it is necessary to understand the current situation of the Kamëntšá language, which is in a difficult position. Though exact figures are difficult to determine,²³ only a small percentage of the population, mostly older people, speaks it fluently. Others speak it to varying degrees and many understand when it is spoken but cannot competently produce it themselves. Young people are most at risk of losing the language and many only know scattered and generic phrases, such as the basic salutations which are still

²³ At time of writing, Colombian linguist Adrián Múnera is engaged in fieldwork documenting the current status of the Kamëntšá language and ongoing revitalization efforts for his PhD dissertation at the University of Buenos Aires. The publication of his results will include the first substantial and recent statistical data on the current number of speakers, efficacy and rate of transmission, etc.

customary in formal contexts and intergenerational encounters within the community. Language classes do exist in the bilingual schools operated in the *resguardos*, but many of my collaborators are critical of the pedagogy implemented in them, which often fails to teach the language to any substantial degree.²⁴ In general, the linguistic situation of the Kamëntšá remains grim, and many in the community are not confident of its survival in the coming generations (Fabre 2001; Radio Nacional de Colombia 2019).

In contrast to the challenging situation of general decline in which the Kamëntšá language finds itself, one of its relative safe havens is the artisanal domain. The Kamëntšá artisanal tradition constitutes a culturally meaningful venue within which the Kamëntšá language survives and is reproduced to a greater degree than in most other domains of social and cultural life in the community (Figure 11).

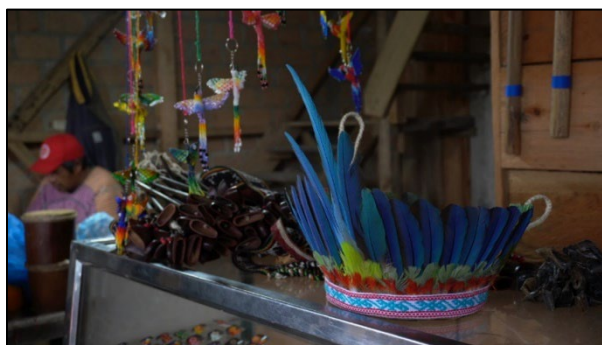


Figure 11. The new and the old coexist in an artisan's workshop. The headaddress and cascabeles (a type of percussion instrument) are of an ancestral type, while the bead hummingbirds are a recent but very popular innovation. All are integral parts of the contemporary artisanal industry. Kamëntšá is spoken in this workshop.

The importance of the artisanal tradition as a means of safeguarding and reproducing the Kamëntšá language is overtly recognized by many

of my collaborators in the community. As one weaver quite clearly put it, “the mother tongue [*la lengua materna*] can be strengthened through artisanry” (I.2). This is logical considering the centrality of both intergenerationality and ancestrality within the artisanal tradition; the valorization of the ancestral and its transmission in the artisanal context is best achieved through the linguistic medium that best conveys the values and principles of the Kamëntšá, i.e., their own language, rather than Spanish. Moreover, even outside of the artisanal workshop or the apprenticeship scenario, artisans generally have a heightened awareness of the sociocultural importance of speaking the language and strive to do so in other areas of their lives. Take the following account given by a professional woodworker who produces masks and instruments:

Those who are Kamëntšá in origin, “I am Indigenous,” they say, “I am Kamëntšá,” but they can’t even say hello [in Kamëntšá]. That’s why here, if you’re Indigenous, you must by [customary] law speak Kamëntšá, at least enough to say hello, because it’s said that colonos [i.e., non-Indigenous people] actually learn more Kamëntšá than we Indigenous people. In my family, we teach my daughters Kamëntšá. As a father, I teach them to speak Kamëntšá because I—thank God—didn’t lose my mother tongue, I keep it alive with my wife, my family, because that’s the very basis of our community, the traditional Kamëntšá language. I like people who appreciate artisanry, like how I play traditional music, I maintain the mother tongue, and I carve wood. I like it a lot. I teach them these things so that maybe tomorrow they’ll have a better future. There are young people, young Kamëntšá men and women, who don’t like to speak the mother tongue. That’s what’s being lost, our culture. That’s why I thank God that my father taught me artisanry and that’s why we’re here, it

²⁴ Allegations of bureaucratic incompetence and nepotism are often assigned blame for the inefficiencies of the pedagogies implemented in the “bilingual” schools. It is worth noting, however, that others among my collaborators have rejected these allegations. Further investigation into the true efficacy of the school programs is necessary.

provides for us [*es nuestro sustento*]. (I.3)

While this artisan recognizes the challenges facing his native language, he is committed to keeping it alive both through his artisanal work and in other contexts, such as with his family. He also recognizes the connection between the reproduction of cultural elements—traditional music, the mother tongue, and the woodcarving tradition—and what he terms “a better future” for coming generation; the reproduction of these interrelated cultural elements is essential to the fortification of the community’s cultural autonomy. Other interviews and observations from my fieldwork demonstrate that this multidimensional approach to the question of language recuperation is generalized within the artisanal community.

As the woodworker’s anecdote demonstrates, the artisanal tradition plays an important role in the recuperation and strengthening of the Kamëntšá language despite its presently tenuous position. If the language revitalization efforts currently underway in the community are to succeed, they may only be able to do so in collaboration with the artisans who are already essential to keeping the language alive. And insofar as language is one of the pillars upholding Kamëntšá culture, the importance of the artisanal domain for the defense of the community’s cultural autonomy is beyond doubt.

Lastly, the artisanal tradition strengthens cultural autonomy through its support of other traditions and practices, including shamanism and Clestrinje, as discussed in the following chapters. In brief, neither of the latter domains could exist in their current form without artisanal objects, a primary component of both—and it is likely that neither would be able to reproduce itself in their absence. The symbols and figures most representative of each tradition—namely, the shaman who leads a yagé ceremony, or the red-masked Matachín who leads the Clestrinje procession into town each year—are products of artisanal work. As long as taitas wear their

distinctive feather headdresses, jaguar tooth necklaces, distinctive capisayos, cascabeles, and bead accoutrements, the artisans who make those objects—magical symbols of the shaman’s power—will continue their weaving. As long as the Matachín and all the other figures in the Clestrinje procession are in need of a newly carved mask every year, the woodworkers who make those masks and the instrument-makers who provide the thousands of drums, rattles, flutes, and other instruments that accompany the procession will return to their workshops. In other words, the reproduction of all practices that make Kamëntšá culture distinctive depends integrally on the reproduction of the artisanal domain—and vice versa. If Kamëntšá cultural autonomy is truly to be realized—in whatever form it must take given local conditions—then the artisanal tradition will play a central role in determining its development.

6. Cultural Reproduction in Kamëntšá Shamanism

6.1. Overview

The shamanic tradition of the Kamëntšá is an important domain in which to explore contemporary processes of cultural reproduction and autonomy at work in the community. In this section, I discuss two aspects of the shamanic tradition in which these processes are evident: 1) the jajañ, the ethnobotanical garden full of medicinal and magical plants which shamans rely on for their work and thus preserve ecologically and culturally; and 2) the integration of Kamëntšá shamanism into a regional “shamanic network” (*red chamánica*) which allows the community to benefit from a broader ayahuasca tourism industry while valorizing local traditions, especially in terms of music and art. The reproduction of the Kamëntšá shamanic tradition in both categories contributes to fortifying the community’s cultural autonomy. Before analyzing its merits, however, it is first necessary

to briefly contextualize Kamëntšá shamanism.

The shamanic tradition of the Sibundoy Valley, which varies little between the Kamëntšá and the Inga, is well documented. In most respects it is essentially Amazonian, bearing many similarities to the shamanic traditions of the jungle lowlands that the valley overlooks. Broadly speaking, Amazonian shamanism centers on the personality of the shaman as a spiritual healer and an intermediary between the material world and the spirit world. The Amazonian shaman is a well-respected and occasionally feared figure known to possess magical powers and who is sometimes thought to ally himself with spirits that can prove helpful to his friends and dangerous to his enemies.²⁵ In general, shamans are primarily regarded as medicine men whose primary medicine—often regarded as a sacrament in various Indigenous and syncretic Catholic spiritualities—is generally known by its Quechua name as *ayahuasca*, a powerful entheogenic decoction which induces intense psychological and physiological effects. The powerful visions that emerge from the combination of these plants typically last several hours and vary in intensity depending on the amount consumed; it is not uncommon for people under their influence to lose all normal sense of self, time, and space until the effects pass. Yagé—the *ayahuasca* concoction used ceremonially by Kamëntšá shamans—is known to produce visions and feelings often considered deeply meaningful (Hamill et al. 2019; Homan 2016; Morales-García et al. 2017). As healers, shamans are frequently referred to as “traditional doctors” (*médico tradicional*), in contrast to the

clinician doctors of Western medicine.²⁶ The Amazonian shamanic complex is generally a highly salient institution in the many Indigenous communities that feature it, wherein shamans enjoy high social prestige and *ayahuasca* is recognized as an important aspect of the culture even beyond its medical use (Anderson, Labate, and De Leon 2014; Bristol 1965; 1966; Ramírez de Jara and Pinzón Castaño 1992; Reichel-Dolmatoff 1975; Rodríguez-Echeverry 2010; Schultes 1988; Schultes and Hoffman 1992; Schultes and Raffauf 1992; Taussig 1987).

Kamëntšá shamans are generally highly respected figures in their community; they are uniformly accorded the title of *taita* (Quechua: “father”) as a sign of respect and acknowledgement of their authority. Taitas generally descend from family lines of shamans; it is not unusual for this profession to be passed from father to son in an unbroken progression. Each family line may have its own idiosyncratic traditions and practices, though all shamans in the community are in regular contact with each other. It is possible, therefore, to speak of a general body of Kamëntšá shamanic tradition. The regular venue in which shamanic ceremonies are enacted is the *maloca* (Figure 12), a type of roundhouse modelled on those common in the lower reaches of the Amazon, though today generally built of finished wood or brick rather than the logs and thatch common in more remote regions. Wealthy and high-profile shamans generally have their own *malocas* on family estates, while others practice out of their homes.

²⁵ I use the masculine pronoun here because shamanism has generally and traditionally been a male domain. In many communities in the Amazon, women are not allowed to drink *ayahuasca*, let alone lead ceremonies (Thalji and Yakushko 2018). These restrictions are generally linked to reproductive notions and are related to the generalized taboo on women drinking *ayahuasca* during menstruation. While women can and do drink yagé in the Sibundoy Valley, to my knowledge there has never been a female shaman among the Kamëntšá.

²⁶ The two medical systems are generally seen as mutually complementary rather than exclusive. To paraphrase my collaborators: if your body is unwell, see a doctor; if your spirit is unwell, see a shaman. In cases of serious illness, it is not uncommon for people in the Sibundoy Valley to seek help from both sources (Seijas 1969).



Figure 12. A taita's maloca in vereda La Menta. Note the stenciled tsömbiach designs on the band around the second-floor veranda. This maloca is only a few years old and evinces a modern take on a classic design.

In ceremony, Kamëntšá taitas are distinguished by their elaborate regalia, generally consisting of a capisayo of the traditional design, feather headdress, jaguar tooth necklace, bead necklaces and bracelets, and other symbolic and magical accoutrements. Except for the recent addition of bead artisanry, the paraphernalia of the Kamëntšá shaman has changed little over the decades. In addition to his personal effects, shamans usually decorate their workplaces—whether maloca or living room—with objects and artistic designs representative of their profession. Shamanic art is distinguished by its vivid colors, motifs of animal transformation and jungle life, and its attempts to visually capture the visions experienced upon imbibing yagé. Also typical of the shamanic workspace is the presence of an altar or desk which syncretically combines Indigenous and Catholic objects and symbols; it is not uncommon to find a cross or a portrait of the Virgin Mary set alongside a jaguar pelt or quartz crystal.

Other aspects typical of ceremonial performance include burning incense for purposes of purification as well as playing music and singing songs to put patients at ease and provide auditory accompaniment to their *pinta*, the strong visions that yagé brings. Often these songs are sung in a mix of Kamëntšá and Spanish

and offer praise to yagé or to nature. The most common instruments are *cascabeles*, hollowed out seeds strung on bead necklaces worn diagonally over the chest, and the harmonica, with which the shaman sporadically plays a distinctive yagé song throughout the night. Guitars, drums, and other instruments are also sometimes employed. Subjectively, the music that usually attends a yagé ceremony, coming and going over the course of the night, is often experienced as a pleasant and centering presence that helps accompany and orient one's *pinta*. Many shamans are themselves musicians outside of their shamanic duties, and it is not uncommon for participants also to play music throughout the night. Overall, music is an integral part of the yagé ceremony.

The performative and aesthetic aspects of the ceremony cannot be disentangled from its spiritual and medicinal aspects. For example, the shamanic *limpieza* describes a cleansing ritual meant to purge patients of illness and malignant spirits (Figures 13, 14), and in a more expansive sense refers to the interior purification that occur through the yagé ceremony itself. If, as a popular Kamëntšá saying puts it,²⁷ the body is a territory, then much like the territory in which the Kamëntšá live, it must be cultivated and cleansed of contaminants to flourish. In Kamëntšá ethnomedicine, personal wellbeing is attained following the purgatory action of yagé, which is well known for its emetic effects, namely vomiting and diarrhea (Seijas 1969). The wellbeing of the individual, achieved through bodily and spiritual cleansing catalyzed by yagé, precedes and facilitates the social and communal healing which finds maximum expression in Clestrinŷe, the Kamëntšá festivity that will be discussed in the next chapter.

²⁷ The saying is usually quoted as "The body is the first territory."



Figure 13. A shaman performing in public at the artisanal fair leads a *limpieza*, or cleansing ritual, with a volunteer patient. *Limpiezas* may be performed on their own, but they always follow a *yagé* ceremony. They are often experienced by patients as profoundly emotional and cathartic, compounding the therapeutic and curing function of the *yagé* ceremonies which they bring to an end. Patients are usually shirtless during the procedure, which most traditionally involves whipping the body with nettle leaves; this is said to facilitate blood flow.



Figure 14. A *limpieza* performed by a shaman in his *maloca* prior to a musical performance, the *wayra* in his hand a blur as he shakes it to the rhythm of his chant. Note the incense being burned for cleansing purposes, the stenciled *tsömbiach* symbol on the left pillar, the palm fiber fire fan (a traditional woven object now rarely seen) hanging on the right pillar, the

mix of ancestral and recently invented elements in the shaman's regalia, and the syncretic Indigenous-Catholic features surrounding the altar behind him. Note also the dreamcatchers suspended from the ceiling, a non-traditional craft that signals the recent advent of pan-Indigenous influences in the community. Unlike the one shown in Figure 13, the object of this purification is a space rather than a person.

Having briefly surveyed Kamëntšá shamanism in its general outline, it is now possible to proceed with an analysis of the ways in which the reproduction of the shamanic tradition contributes to Kamëntšá cultural reproduction and autonomy at large. The first domain in which this occurs is that of the *jajañ*, the ethnobotanical garden which once surrounded every Kamëntšá home and which is the repository of a great deal of traditional ecological knowledge within the community. Shamans valorize and maintain this knowledge by use of the *jajañ* for magical and medicinal purposes in shamanic practice.

6.2. Cultural Reproduction in the *Jajañ*

The *jajañ* is the ethnobotanical garden of the Kamëntšá. The term is often used interchangeably with *chagra*, which comes from the Quechua and is the broader regional counterpart of the specifically Kamëntšá *jajañ* (Figures 15, 16). Among the Kamëntšá, the *jajañ* is a garden containing edible, medicinal, and magical plants which traditionally surrounded each family dwelling and provided for the primary sustenance of the family. Whereas large fields were held in common and used to cultivate staple crops such as maize and beans for the sustenance of the community, the *jajañ* provided food, medicine, and magical protection to single families. In this sense, the *jajañ* system as it formerly existed—in which every family kept and cultivated large, complex gardens with dozens of plant species whose interrelationships and properties were well known and accounted for—was once a vital repository of ecological knowledge and integral to the dietary and

medical wellbeing of the community (Agreda España 2016; Bristol 1965; Jacanamijoy Juajibioy 2019; Mujuy Ajeda 2019; Palacios Bucheli and Bokelmann 2017).



Figure 15. A mural depicting a woman in her jajañ painted on the side of a resguardo schoolhouse. In the Kamëntšá jajañ system, women are the keepers of botanical lore. The text in the left corner reads “My colorful garden.” The geometric designs in the background allude to the corona and the beadwork tradition, while the cosmic imagery on the woman’s tunic refers to the visions of the Milky Way associated with yagé.



Figure 16. A jajañ at an artisan’s house on the outskirts of Sibundoy. Although still actively cultivated, this jajañ is not as complex or dense as the most traditional gardens.

The jajañ system has been in decline since at least the 1980s owing to the advent of monoculture as the predominant land use strategy in the Sibundoy Valley—a system introduced by and for the colono landowners who, by the end of the century, had succeeded in buying, swindling, and stealing the majority of the valley’s plots from its Indigenous

inhabitants²⁸ (Bello Torres 1987; Bonilla 1968; Comunidad Camëntšá 1989; “Pueblo Kamëntšá” 2015). Today, many of my collaborators lament the gradual disappearance of the jajañ system, which is now only visible in its most complex forms in the most distant and traditional of the valley’s outlying veredas. Even in such cases, there exists a generational divide wherein elders tend to the jajañ, but without the assistance and observation of younger people who formerly learned to cultivate their gardens intergenerationally, by the example of elders. One shaman describes both the importance and the threatened loss of the jajañ tradition in the following terms:

For me the jajañ is as the grandparents of my grandparents, the ancestral ones whom I knew, taught us. From the jajañ comes every kind of medicine and every type of medicinal plant, it’s all there in the jajañ. There’s corn, beans, taro, squash, arracacha, cabbage, *achira* [*Canna indica*]... Within the jajañ is the medicine that the elders, the ancestors, have taught us. That’s what we have to conserve and care for. Unfortunately, the state itself has started polluting the air, trying to destroy everything that exists in the jajañ... We, as the caretakers [*dueños*, lit. “owners”] of our territories where we live, we try to care for it, and not to use herbicides, no... That does us harm. As landowners, as a community, we are struggling against the use of herbicides. Instead we encourage using hand tools to work the land. (I.5)

The herbicides that this interlocutor refers to are

²⁸ As discussed in Part I, processes of territorial dispossession began considerably early, going back to the colonial era, though it was only with the advent of the Capuchins in the early twentieth century that the Sibundoy Valley’s Indigenous communities lost the majority of their land to outsiders. It is important to distinguish colonial and Capuchin dispossession and land use patterns from the monoculture system that is predominant in the valley today, however. Unlike in earlier phases of colonization, the Sibundoy Valley’s land area today is overwhelmingly dedicated to cash crop production.

those of the monoculture system encroaching on the remaining jajañs of the Sibundoy Valley. This is the challenging situation facing those who continue to uphold and preserve the culturally and ecologically²⁹ integral jajañ system. Many in the community seem resigned to the fate, apparently foretold, of the jajañ, sure that it is destined to give way to the monoculture systems which threaten it. However, the continued centrality of the jajañ within the Kamëntšá shamanic system suggests that there can be hope to the contrary.

The shamanic tradition may play an important role in mitigating and even reversing the apparent loss of the jajañ system among the Kamëntšá, thereby contributing not only to the strengthening of an important cultural tradition, but at the same time fortifying the ecological wellbeing of the territory—much as shamans, through ceremony and the plant medicine yagé, help preserve the personal health and wellbeing of their patients. More specifically, Kamëntšá shamanism contributes to 1) the *preservation* and 2) the *recuperation* of the jajañ and its associated traditions insofar as shamans are among those in the community most responsible for cultivating jajañs and maintaining the traditional ecological knowledge that they safeguard and depend on.

In its ethnomedical aspects, Kamëntšá shamanism has an important preservative function with respect to the jajañ. During my fieldwork, every shaman I encountered kept his own jajañ, even though most Kamëntšá families no longer do. Most also depend primarily on their personal jajañs for the medicinal plants that their shamanic practice relies on.³⁰ One Inga shaman

explained with reference to his chagra—recall that both the shamanic and the jajañ-chagra systems of the Kamëntšá and Inga are highly similar—that “it is our own pharmacy, our traditional pharmacy.” All the traditional medicines of the Kamëntšá are there, and for as long as the Kamëntšá ethnomedical tradition persists within Kamëntšá shamanism, the jajañ will remain instrumental within that tradition. Furthermore, as long as shamanism in general remains a salient aspect of Kamëntšá culture—and its integration within a regional shamanic network will ensure this continued reinforcement—then the ecological knowledge on which the shamanic tradition depends will be passed on to the next generation of apprentice shamans. This process establishes the preservative nature of Kamëntšá shamanism with respect to the jajañ, demonstrating their mutually interdependent relationship.

A key example of the preservative function of Kamëntšá shamanism with respect to the jajañ is the *Datura* genus of flowering plants, which belong to the nightshade family (*Solanaceae*) and which are locally known as *borrachera* (“intoxicant,” “inebriant”). The Sibundoy Valley is home to the world’s greatest diversity of *Datura* cultivars, which have long been cultivated by the valley’s inhabitants; some of the thirteen distinct varieties found in the Sibundoy Valley are incredibly divergent from *Datura* varieties found in nature (Figure 17). *Datura* is a highly toxic plant that nevertheless has long occupied an important role within Kamëntšá ethnomedicine and shamanism. Formerly, it was sometimes mixed with yagé or taken on its own for its extremely potent hallucinogenic effects, which are known to be highly unpleasant in the best of cases and can result in insanity or death in the

²⁹ Compared to the ecologically harmful and culturally empty monoculture system imposed and run by settlers and now dominant in the Sibundoy Valley, the botanically diverse jajañ system stands as a far more efficient, ecologically sustainable, and culturally meaningful land use strategy. The relational and mutual nature of plant cultivation and communal labor in the jajañ makes it an excellent arena for the investigation of how Kamëntšá concepts of territoriality are put into practice.

³⁰ Yagé, the single most important plant medicine in Kamëntšá shamanism, is a notable exception. Although *Banisteriopsis caapi* and secondary additives can be cultivated in the

Sibundoy Valley, the vine itself is native to the Amazonian lowlands and generally grows much better in the hot and humid jungle than at the comparatively cold elevation of the Sibundoy Valley. Yagé vines cultivated in the Sibundoy Valley are generally stunted in their growth and most yagé is prepared from vines imported from the lowlands.

worst of cases (Bristol 1965; 1969; Schultes and Hoffman 1992; Seijas 1969). Today, *Datura* is no longer used as a hallucinogen,³¹ but the plant retains magical associations for which it is still very commonly cultivated in the valley, even where other jajañ plants are now absent.



Figure 17. A *Datura* cultivar in the jajañ of an artisan in vereda Palmas Bajas. Different cultivars vary by flower color and shape, leaf shape, flexibility or rigidity of vines and branches, etc. Phenotypically, some hardly resemble at all *Datura* varieties found in nature or in cultivation outside of the Sibundoy Valley.

As a magical plant, *Datura* is planted next to houses to provide protection to their inhabitants and its leaves are combined with other jajañ plants to create curing baths. For these applications, the plant remains one of those most widely employed by shamans for medical and magical purposes. Without the importance of *Datura* within the Kamëntšá ethnomedical and shamanic traditions, first as a hallucinogen and then as a plant with magical properties, it is likely that *Datura*'s cultural value would be forgotten. The continued importance of plants such as *Datura* within the shamanic tradition, however, ensures the continued cultivation of the jajañs and preserves the traditional ecological

knowledge vested within them.

In addition to its preservative function with respect to the jajañ system, Kamëntšá shamanism also has a recuperative function, serving to promote the recovery of the jajañ system within the community at large. This occurs primarily through the valorization of the jajañ tradition against monoculture, which the majority of the Kamëntšá community recognizes as a major threat to both cultural and territorial integrity and autonomy within the Sibundoy Valley. One collaborator, the nephew of one of the most prominent shamans of the Sibundoy Valley—both of them maintain jajañs of their own—speaks of this process at length:

The jajañ is polyculture [*policultivo*] and it is without order, it has no structure. The jajañ is an equilibrium. There are the medicinal plants, corn, minor species, everything, even artisanry, everything comes together there. One plant cares for the next. If in one place there is a medicinal plant, then there must be another plant that protects against pests [*plagas*], unlike monoculture, which is with one plant at a large scale and using chemicals. That has affected things a lot, because before [monoculture], there were no pests here. Now pests have started coming for the medicinal plants. Even corn, which we cultivate for our subsistence, is attracting pests. It is very difficult to conserve because of what we said about monoculture. But I think there are ways to recuperate through the jajañ, the traditional practices we are implementing through collective work, supporting each other in the community, with the cabildo or with people who own land. Something beautiful is the traditional seed bank, which we share. That's what we do here. If I don't have a plant, others will come and bring it, we share and exchange among ourselves, because that's a form [of recuperation]. If I lose a plant in my garden, I can say, "No, I gave it to someone else, let's

³¹ I am told that some shamans in isolated areas far from town still sometimes add borrachera to yagé as a medical last resort in extreme cases. However, I have encountered no definitive evidence of this practice. All collaborators I spoke to about the topic acknowledged the extreme toxicity of the plant and the dangers of its use.

exchange again and bring it back here.” It’s a big preoccupation, because the native seeds we used to have are being lost, the fruit trees are being lost. It is our duty to recuperate the territory through these practices, the practices we have been taught, the form of planting under a good moon [*en buena luna*], also of cultivating under a good moon.³² That’s why the moon is our mother [*la mamita*], the lunar cycles tell us when to cut and when to plant. Even in medicine, they tell us what day to take medicine.³³ Returning to these practices is our duty. In that sense, we are doing it here with what I told you about the four hectares of earth, and we are strengthening it more each day, learning with the elders. (I.7)

The “four hectares” that this collaborator refers to in the last paragraph are an area of land formerly owned by the Church in the Sibundoy Valley, but recently bought and developed by a *minga*, a collective labor team dedicated to projects relevant to the whole community. The *minga* consists of 43 Kamëntšá families who acquired this land to cultivate a communal *jajañ* for the benefit of those whose lands in the floodplain of the valley’s base are seasonally inundated. As the shaman’s nephew explains:

It’s a seed bank where we plant everything from the *jajañ*. That’s how we recuperate, there can be different movements and different forms of expressing oneself. We are doing it through the medium of dialogue, and

we already recuperated four hectares, which are for the people in the lower parts of the valley that flood when it rains. Those people can’t cultivate land when it rains, but here they can plant. They have their corn, cabbages, beans, taro, *guasimba* [*Tigridia*], tomatoes, blackberries. We see this as a form of action, and each person can decide if they want to participate in the social movement or if they instead want to help the community in other ways. (I.7)

Insofar as the shamanic tradition preserves and maintains the *jajañ* system for purposes of the Kamëntšá ethnomedical tradition, it has a key role to play in processes of general recuperation of the *jajañ* such as the case described here. It bears recalling that, as a “polyculture” system rather than a “monoculture,” the *jajañ* is characterized by relationships of mutuality and interdependence between the plants that make it up. To sustain and recover the *jajañ* for medical purposes, therefore, is also to promote its preservation and recuperation for all other purposes, such as for the purposes of communal food security sought through the *minga* described above. As this collaborator demonstrates, these are both valid ways to support the community in its processes of cultural reproduction and autonomy by way of the *jajañ*.

The difference between the Kamëntšá *jajañ* and the settler colonial monoculture systems, as two diametrically opposed land use strategies, represents the broader ideological and philosophical conceptions of territory that underpin each. The Kamëntšá conception of territory is, like the *jajañ*, relational and mutualistic; each aspect of the Kamëntšá lifeworld forms part of a continuous fabric from which no individual feature can be extracted in isolation, like the unique and beautiful *tsömbiach* textiles for which Kamëntšá weavers are justly famous. In the monoculture fields that now spread across the valley where once there were family plots containing dozens of different

³² Ancestrally, the Kamëntšá regard certain lunar phases as auspicious for conducting activities such as planting and harvesting, gathering wood, and performing rituals. This is perhaps a remnant of the pre-Columbian calendar of the Sibundoy Valley (McDowell 1989; 1994).

³³ We see here a relationship between the lunar cycles, the *jajañ*, and the taking of medicine (i.e., *yagé*); as this collaborator says, “everything comes together here.” It has not been possible to develop this theme in this thesis, but it is also worth noting that certain groups in the valley are actively seeking to reconstruct and recover the old precolonial calendar, which follows a lunar Andean model. Shamanism and the *jajañ* will be instrumental in this endeavor, should it prove successful.

species, there is no relationality, no interdependence—only a flat homogeneity that poisons the earth, unravels cultural ties, and eventually succumbs to its own unsustainable nature.

While the importance of the *jajañ* system to the shamanic tradition goes beyond its pharmaceutical uses, this presents one of the most distinctive examples of cultural preservation within Kamëntšá shamanism. Suffice it to say that from the examples and ethnographic references given above, the case is clear for Kamëntšá shamanism as one of the major factors behind current processes of preservation and recuperation of the *jajañ* system as a central facet of the integrity and wellbeing of both Kamëntšá culture and territory. Shamans are instrumental as guardians of the botanical knowledge contained in the *jajañ* and their preservation is necessary for the reproduction of this culturally and ecologically essential cornerstone of Kamëntšá life (Figure 18).



Figure 18. A selection of medicinal plants on display at a shaman's booth at the artisanal fair in Interculturality Park, central Sibundoy, the weekend preceding Clestrinŷe 2023. Kamëntšá shamanism makes extensive use of the medicinal and magical plants of the *jajañ*.

6.3. Cultural Reproduction through the Shamanic Network: Art and Music

Kamëntšá shamanism also contributes to broader processes of cultural reproduction and autonomy through the integration, in part ancestral and in

part invented, of Kamëntšá shamanism into a regional “shamanic network” which puts Kamëntšá shamans and their practices in dialogue with their counterparts in other Indigenous communities in the Colombian Amazon and beyond. This integration allows for 1) the *preservation* of distinctive aspects of Kamëntšá shamanism while simultaneously enabling 2) *rearticulation* and *invention* in local shamanism by drawing upon other shamanic traditions in the broader regional network.

For the purposes of this discussion, I define the “shamanic network” as the type of Indigenous-Catholic syncretic shamanism making use of *yagé* which is generalized throughout Western Amazonia, often drawing on New Age spiritualities in addition to its original blend of Amazonian animism and a colonially imposed Catholic overlay. It is important to distinguish this generic type of shamanism, which is a historically recent development, from the patchwork of diverse but related shamanic traditions which long pre-date it in the same region—broadly speaking, Western Amazonia and its borderlands. The former is the aestheticized and syncretic shamanism that attracts urbanites and tourists to *yagé* ceremonies which are generally similar in form and content throughout the Amazon basin—and which increasingly take place far outside of it, from urban hubs in South America to clandestine ayahuasca circles in the United States and Europe (Homan 2016; Labate and Cavnar 2014; Ramírez de Jara and Pinzón Castaño 1992; Valderrama 2003). The “shamans” who lead these ceremonies are often not Indigenous and may even not have learned from Indigenous shamans, though most claim to follow ancient teachings of vague provenance, which may have as much to do with yoga and chakras as with *yagé* and *chacrana*. Some however, are Indigenous, and this fact is relevant as it concerns the salience of the shamanic network in Sibundoy Valley shamanism. Although the Kamëntšá shamanic tradition long predates the recent development of

a somewhat homogenized shamanic network in Amazonia and beyond, Kamëntšá shamans have not missed the chance to capitalize on this development.

Although yagé has been consumed by numerous peoples of Western Amazonia since time immemorial, it is only in recent decades that an ayahuasca tourism industry has emerged in the communities that have always made use of the medicine. The Sibundoy Valley has not been affected in this way quite so much as other areas, but a local yagé tourism industry has still developed there in response to outside interest. The Kamëntšá—and not only their shamans, but other members of the community as well—have successfully capitalized on the Sibundoy Valley's reputation as a nexus within the regional shamanic network. They do so by adapting representative elements of the general shamanic aesthetic in much of their art and music in ways that both rearticulate Kamëntšá elements while creatively incorporating outside elements. This participation in a broader shamanic context serves to strengthen Kamëntšá shamanism and thereby the culture at large. Incorporation into the shamanic network opens Kamëntšá shamanism to a dialogue with its regional counterparts and opens other aspects of the community to visitors first attracted by yagé. Two examples of cultural rearticulation exemplified by Kamëntšá shamanism are the following: 1) The recent proliferation of street art in the town of Sibundoy which incorporates both generalized aesthetic elements characteristic of regional “shamanic art” and aesthetic elements particular to the Kamëntšá and their local shamanism; and 2) the similarly recent proliferation of “medicine music” in performative contexts which, likewise, both borrows from the regional network and includes and valorizes specifically Kamëntšá elements. The dialectic between local valorization and regional integration in both shamanic art and music serves to strengthen Kamëntšá shamanism by establishing a place for it within a larger regional, intercultural, and

increasingly international context.³⁴

The town of Sibundoy—or *Tabanok*, the endonym preferred by most murals (Figure 19)—is replete with street art, almost all by Kamëntšá artists, despite the town's majority colono population. Much of this art incorporates shamanic symbolism, particularly around the use of yagé.



Figure 19. One of the more elaborate murals making artistic use of the Kamëntšá term for the town of Sibundoy, here spelled Tabanokh. Many other murals throughout town use a vowelless stylization: “TBNK.” Note the gesto masks against the background and the figure of the Matachín in full regalia front and center. Murals like these demonstrate ongoing claims of Kamëntšá territoriality on settled land.

For example, just as many artisanal artforms among the Kamëntšá attempt to capture the essence of the yagé experience, so too are these aspects present in Kamëntšá street art, which frequently makes use of hallucinogenic imagery (Figure 20). However, Kamëntšá artists incorporate elements typical of what could be called “shamanic art” or “ayahuasca art” of a regional type with symbols representative of the Kamëntšá community in particular. This merger enables the valorization of the specifically Kamëntšá elements within the broader regional

³⁴ I do not develop this point further here, but it is worth noting that many shamans in the Sibundoy Valley, both Inga and Kamëntšá, travel far and wide to dispense their medicine in ceremony. One rather infamous case saw a Kamëntšá shaman arrested and jailed for a month in the U.S. for arriving with *Banisteriopsis caapi* vines in his luggage—a banned substance under U.S. law (Anderson, Labate, and De Leon 2014).

framework of the shamanic network. Processes of preservation, rearticulation, and invention are all present in the domain of Kamëntšá “yagé art.”



Figure 20. A mural next to the cabildo building in Sibundoy. This mural depicts what appears to be a shaman or a stylized Matachín blowing the Clestrinŷe horn, out of which is growing what may be a Banisteriopsis caapi plant, whose leaves are sprouting eyes. Note also the tsömbiach designs around the window and left side.

Figure 20 exemplifies these processes as they are expressed in Kamëntšá street art. This mural, painted on the side of a building next to the Kamëntšá cabildo building in Sibundoy, is typical of this culturally fused genre of street art. As its central subject, it takes a distinctly Kamëntšá figure, representing either a shaman or a stylized Matachín, the emblematic, red-masked leader of the Clestrinŷe procession. The figure’s dress—capisayo, necklaces, and crown—are all distinctively Kamëntšá, as are the Clestrinŷe horn he blows and the tsömbiach designs painted around the borders of the mural. Designs representative of generalized yagé shamanism, however, are also present, suggesting that the artist—in a move characteristic of emerging Kamëntšá street art—has drawn on the aesthetic styles of non-specific “shamanic art.” These features, which are typical of the shared artistic tradition of the shamanic network, include the references to yagé (the vine growing out of the Clestrinŷe horn) and the eyes, a common visual motif in both ayahuasca art and the experience of the medicine itself, which are seen sprouting from the vine. This artwork demonstrates an

aesthetically syncretic preservation and rearticulation of existing cultural elements alongside the introduction of external elements, i.e., those typical of broader yagé shamanism. This mural is not the only example of this process in the domain of Kamëntšá street art, but it does demonstrate many distinctive elements of this emerging artistic rearticulation.

The use of color is another feature unifying Kamëntšá art and ayahuasca art more broadly—and this is a topic on which several of my collaborators have remarked, as the use of color in all Kamëntšá art, not just in street art, is one of the most distinctive features of the community’s aesthetic tradition. The shaman’s nephew quoted previously, also a young musician and artisan, provides more detail:

Why do we use such vivid colors in our *ruanas* [capisayos]? Because through them we want to represent energy, we want to represent that force, because if we sing a song and we are with something that doesn’t radiate energy, we haven’t succeeded in linking artisanry, linking music. Before making music, we take *remedio* [yagé] to become inspired. (I.7)

The importance of color across various domains of Kamëntšá culture, also expressed in the artisanal domain, finds more overt support in street art incorporating the colors and designs typical of shamanic art in general. The murals depicted in Figure 21 illustrate this intersection, where symbols unique to Kamëntšá culture coexist with designs found throughout the shamanic network.

The community-building function of Kamëntšá art in relation to shamanism must also not be overlooked. Art is a focal point in the community, and much of this art is inspired by yagé. The art café called Benach, which opened in downtown Sibundoy several years ago, is key in this respect, serving as a place of community gathering and incorporating many of the

shamanic designs under discussion here.



Figure 21. Murals on the side of Benach, a café and art gallery across the street from the Kamëntšá cabildo in central Sibundoy. The figures and symbols are Kamëntšá—mamitas, coronas, borachera, pathways—while the yagé-inspired colors and designs resemble those typical of the shamanic network more generally.

Figure 22 shows a sign outside Benach which illustrates the kind of intercultural encounter at play in Kamëntšá art. Here, the internationalized graffiti style of the American inner city meets a distinctly Kamëntšá aesthetic which integrates local elements—native *frailejón* plants, depictions of Kamëntšá elders, *Datura* flowers, and yagé imagery—with those drawn from a regional shamanic network, such as the ayahuasca vines and geometric patterns.

The same processes apparent in Kamëntšá art are also evident in the domain of music, specifically what has come to be called “medicine music” (*música medicina*) in the context of both community performance and yagé ceremony.

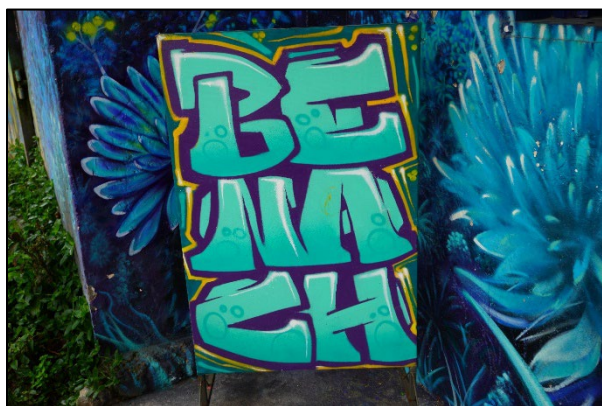


Figure 22. A signpost outside of Benach in central Sibundoy. In Kamëntšá, “benach” means “path” and bears both literal and metaphorical connotations. Its metaphorical value is often expressed in the proverb *botamán benach*, meaning “to walk beautifully.”

“Medicine music” describes a musical genre that has emerged from the shamanic networks and ayahuasca cultures of South America, with considerable external contributions, through the blending of several preexisting musical genres or influences. Songs in this genre often involve lyrics about ayahuasca, spirituality, nature, healing, etc., and frequently blend Indigenous elements with internationally inspired New Age spirituality.³⁵ The result is a homogenized *mélange* of heterogenous sources of inspiration. Medicine music typically provides musical accompaniment at events associated with the shamanic network, including concerts as much as ayahuasca ceremonies. Having spread far and wide along the transmission routes of the shamanic network, medicine music is widely heard today in the Sibundoy Valley.

An ethnographic anecdote illustrates my point. One night in February 2023, I returned to my host family’s home to the sounds of song emanating from the living room. I walked in to find the whole family—all accomplished musicians, several of whom have their own bands—singing a song that, after a few stanzas, I recognized. It wasn’t a Kamëntšá song, though my friends were putting a Kamëntšá twist on it using their own instruments and style. It was a song called “Cuñaq,” from the 2018 album *Call of the Wild* by the band Curawaka. A collaboration between a Norwegian singer and several Latin American musicians, Curawaka, according to the band’s website, seeks “to share the medicine

³⁵ For an example of an authentic Indigenous tradition which forms part of the invented and generic sort of music that has emerged from the shamanic network, one very common element is a style of guitar strumming that originated with Kofán shamans in the Middle Putumayo. This style has since spread through the shamanic network to the Sibundoy Valley and other Indigenous communities elsewhere in Colombia and in other countries.

frequencies with a wider public and connect to the mysteries of Spirit through music and dance.” The Norwegian frontwoman often sings in various Indigenous languages, in addition to Spanish and Portuguese, and has been invited to speak on “music as medicine” at events like the Plant Spirit Summit, an event held in the Amazon which brands itself as providing “ancient medicine for modern times” at the intersection of Western science and Indigenous plant medicine. Events like these are typical of the shamanic network, where Western interest in hallucinogens and New Age spirituality merges with Indigenous shamanism in the Amazon and elsewhere. Medicine music emerged from this fusion and provides the typical soundtrack to such gatherings.

How did it happen that a Kamëntšá family—whose members ordinarily write and play their own songs within a distinctly Kamëntšá musical tradition—came to adopt a song by a Norwegian woman who wears feather headdresses while singing in an accented mix of Spanish and Quechua? At first, I thought it strange that Indigenous musicians with a vibrant musical tradition of their own should adopt the homogenized or even appropriative music produced by non-Indigenous artists in imitation of Indigenous traditions. But upon further reflection, I realized this was not the first time I had seen this type of musical fusion. In June 2022, I was invited to attend a concert in Sibundoy that was named simply “Música Medicina,” featuring several Kamëntšá bands as well as the musician Nicolás Lozada, a non-Indigenous singer who positions himself as a “singer-songwriter of medicine music in the Colombian Amazon.” His songs are about the healing powers of yagé and the spirits of nature, couched in vague terms that could not be identified with any particular Indigenous group or shamanic tradition. And yet he was received warmly by the Kamëntšá public who came to see him play, as warmly as they received the Kamëntšá bands on stage alongside him. This event demonstrates that Kamëntšá

music exists alongside non-Indigenous, generic medicine music (Figure 23). Later I would hear several of Lozada’s songs played during yagé ceremonies. Clearly, Kamëntšá performers viewed generic medicine music as more than a derivative imitation.



Figure 23. The band Jashnan, an all-women musical collective, playing at a Kamëntšá music festival in February 2023. Frequently groups like this one, which sing in Kamëntšá and use traditional instruments and costumes, perform alongside non-Indigenous groups in the medicine music tradition.

The ease with which Kamëntšá musicians have accepted and even repurposed songs brought by the music medicine tradition indicates the negotiation of local valorization and regional integration underway in the Sibundoy Valley, where Kamëntšá shamanism and its corollaries (in this case, associated traditions of art and music) meet contemporary ayahuasca shamanism. Kamëntšá shamanism and its practitioners have struck a balance between the preservation and rearticulation of their own traditions. At the same time, they accommodate external integrations bridging the local with the regional. This is essentially a contemporary expression of the processes of transcultural accommodation that have long patterned cultural change and adaptation in the Sibundoy Valley.³⁶ Indeed, long before medicine music entered the scene, Kamëntšá musicians were taking cues from their Inga counterparts in the Sibundoy

³⁶ For more on “accommodation,” see Glass 2022.

Valley, a process which continues today. According to the shaman's nephew quoted previously, whose band is comprised of both Kamëntšá and Inga musicians:

That's why our group is called Luar Kawsay, meaning "space of life," and *kawsay* is in Inga, it means "life" in Inga. Space of life. Since we coinhabit our territory here with the Inga community, and in our family we also have Inga relatives, we wanted to accommodate it in that sense and mix the sounds [*las sonoridades*]. Music plays a role both for the recuperation [*el rescate*] of our culture and for the strengthening of it among the coming generations. We are seeing music arrive from outside [the Sibundoy Valley]. We ourselves have adapted rhythms from outside. For example, from Ecuador, Peru, Bolivia... But we have adapted them to our own context, with our own phrases in Kamëntšá, with our own style of sound which the medicine [*yagé*] inspires in us. Imagine, everything is linked, because even the capisayos we wear speak through our music. (I.7)

The key point is that in both cases discussed here—visual art and music—there is no tension or conflict between the valorization of Kamëntšá cultural elements and those introduced from outside. This process is underpinned by the Kamëntšá shamanic system; the fusions under discussion here are fueled by Kamëntšá shamanism's participation in a developing shamanic network, which brings multiple Indigenous shamanisms into dialogue with traditions outside of the ancestral purview in Amazonia, elsewhere in Latin America, and beyond. This is one of many expressions of cultural reproduction by which the shamanic tradition strengthens Kamëntšá cultural autonomy.

6.4. Autonomy through the Shamanic

Tradition

In this chapter, I have surveyed several of the most noteworthy dimensions of the Kamëntšá shamanic tradition in relation to contemporary processes of cultural reproduction within the community. These forms of cultural reproduction contribute to the strengthening of Kamëntšá cultural autonomy in several respects.

First, it bears remembering that shamans are, traditionally, one of the most important and authoritative roles in Kamëntšá society. To this day, their authority is not in doubt, whether in an ethnomedical, ceremonial, or political context. It is very common for cabildo governors to also have expertise in the handling of *yagé* and other plant medicines; and cabildantes often take *yagé* together, sometimes in ceremonies led by ex-governors, to build rapport or discuss community politics. Some scholars have also noted that the healing and reconciliatory function of *yagé* can serve to heal political rifts within the community, again suggesting the importance of the shamanic tradition as a political regulatory institution in Kamëntšá society (Gómez Montañez et al. 2020). Given these examples, shamanism clearly has an important role to play in future political developments towards greater autonomy among the Kamëntšá, but this is a subject in need of further research.

In terms of cultural autonomy, the shamanic tradition has always been deeply important to Kamëntšá culture across various domains, from ethnobotany and medicine to art and music. As discussed previously, the artisanal domain also comes into play here, providing the shaman with the tools of his trade. Despite the incursions of outside cultures and the integration of Kamëntšá shamanism into a broader regional network, this tradition has managed to maintain and valorize its particularities through tried-and-true transcultural processes of accommodation and reproductive processes of preservation, rearticulation, and invention. As a vital part of Kamëntšá culture in general, the future of the

shamanic tradition is guaranteed, and will indeed continue to play an important role in future developments towards further cultural autonomy—not in spite of, but with the support of the intercultural encounters which the Sibundoy Valley will continue to host.

Finally, the importance of shamanism to autonomy among the Kamëntšá is expressed by its contributions to the preservation and recuperation of the *jajañ* system, which itself constitutes an ancestral land use system far more sustainable, culturally and environmentally, than the encroaching monoculture system. Insofar as the shamanic system relies on and contributes to the traditional ecological knowledge embodied in the *jajañ*, the possibility of the full recuperation of this system and of a fuller territorial renaissance remains open. If such a renaissance is to occur, shamans and those invested in the shamanic tradition will lead the charge. Indeed, the experience of many shamans as community leaders and land defenders in the process of reservation expansion which began in 2010 attests to the importance of this tradition to the fight for cultural and territorial autonomy among the Kamëntšá.

7. Season of Flourishing: Clestrinje and Ritual Renewal

7.1. Overview

For many Colombians outside of the Sibundoy Valley, the only knowledge they have of the Kamëntšá people is what outsiders know as the “Carnival of Pardon,” a misnomer referring to the valley’s most significant annual Indigenous festival. What the Kamëntšá know as *Clestrinje* or *Bëtsknaté* is not a carnival, and originally it was not about pardon—these are misinterpretations imposed by the Catholicism brought to the valley by the Capuchin fathers. In fact, *Clestrinje*, though largely codified and standardized today, is a relatively recent invention with both ancestral and foreign roots. In this section, I examine the

significance of *Clestrinje* to contemporary processes of cultural reproduction and autonomy in Kamëntšá society. First, however, it is necessary to understand what *Clestrinje* is and where it comes from, for the history of the festival parallels its contemporary importance as one of the primary mechanisms of Kamëntšá cultural reproduction. After a brief historical overview, I then analyze the importance of the *Clestrinje* / *Bëtsknaté* tradition in relation to processes of cultural reproduction towards autonomy in the Kamëntšá community today.

Before proceeding, I must address the matter of terminology. Today, in general conversation, *Clestrinje* and *Bëtsknaté* are used interchangeably, though *Bëtsknaté* predominates. Ancestrally, however, these terms did not mean the same thing. Essentially, *Clestrinje* could be translated as “season of flourishing” and once referred to the harvest season or the summertime of the pre-Columbian calendar of the Kamëntšá. *Bëtsknaté*, on the other hand, refers to a single day—indeed, it translates directly as “Great Day” or “Big Day,” marking the most significant day in a season full of celebrations. One collaborator spelled out the difference more clearly in the following terms:

Clestrinje refers to a span of time, but *Bëtsknaté* refers only to a single day. That’s why the traditional song says “*Clestrinje*, *Clestrinje*,” that’s why it’s ancestral. The song doesn’t say *Bëtsknaté* anywhere. *Bëtsknaté* is new, modern, and from the new generations. *Clestrinje* was a period of sunshine, a period of summer, of abundance and much flowering [*floración*]. *Bëtsknaté* was the most important day of *Clestrinje*. (I.9)

As for *Bëtsknaté*, on the other hand,

The Great Day was a Tuesday, but it was very different. In those days [prior to the 1970s], there were no processions. Nor was there Mass. The Mission prohibited the celebration of the ancestors and *Clestrinje* was almost

stamped out. Clestrinje was prohibited until the 70s. In the 70s there was a growing awareness of the history of racism in Colombia, there were laws that dictated protections and respect for Indigenous customs. The missionaries who arrived after the Capuchins helped recuperate Clestrinje, but they started calling it “Carnival,” a term that stuck. (I.9)

From here on, I will use *Clestrinje* to refer to the overall festival season, which includes a range of cultural activities that take place in the two weeks or so preceding the Bëtskнатé, the Great Day itself. The term *Bëtskнатé* will be used to refer only to the day of celebration that takes place each year on the Monday preceding Ash Wednesday. This is in keeping with the ancestral distinction, which still bears relevance for the order of events preceding Bëtskнатé, even if it is no longer widely recognized within the community. With these definitions in mind, the next section describes the historic and modern practices surrounding Clestrinje and Bëtskнатé. What today superficially appears to be a single and well-consolidated tradition is really a syncretic composite, partially ancestral but largely invented, of several pre-Columbian traditions combined and subsumed under a colonial Catholic overlay. The complex historical roots of Clestrinje in relation to the operation of cultural reproduction through it are the subject of the following discussion.

7.2. Not the “Carnival of Pardon”: Case Study of an Invented Tradition

Outside of the Sibundoy Valley, and even sometimes within the Kamëntšá community itself, Bëtskнатé is more widely known as the Carnival of Pardon (*Carnaval del Perdón*). This term developed from institutional Catholic efforts to coopt the various Indigenous festivities that comprised Clestrinje prior to and throughout the Capuchin period. For most of the twentieth

century, under the Capuchins, Indigenous celebrations such as Clestrinje were banned, but continued in secret in the veredas and far from the strict oversight of the friars. During these years, the integrity of the various Clestrinje celebrations suffered, and in some areas of the Sibundoy Valley they were at risk of disappearing. The ambiguous nature of the various former Clestrinje celebrations can be attributed to the clandestine nature of their practice for most of the twentieth century.

The successors to the Capuchins, following the latter’s removal from the valley around 1970, sought to consolidate Catholic orthodoxy in the Sibundoy Valley, where religious practice and belief remained much too syncretic for some in the Church. To this end, agents of the Church recognized an opportunity in the Clestrinje celebrations that still occurred in a disparate and fragmented manner: if these practices could be Catholicized, it might allow them to spread the gospel more effectively among the Indigenous peoples of the Sibundoy Valley under the veneer of protecting their cultures.³⁷ At the same time, since it was no longer expressly forbidden to celebrate Indigenous identity, activists and intellectuals within the community interested in valorizing their own culture also began thinking about how to market it to outsiders. According to one collaborator, the notion of Bëtskнатé as the maximum expression of Kamëntšá culture was introduced by Kamëntšá university students in the 1980s in order to market the event as show for outsiders—and thereby attract interest and investment in the community.

These two concurrent and interrelated processes—on the one hand, the opportunist

³⁷ I use the plural “Indigenous peoples” here to include the Inga, who celebrate their own variant on the Sibundoy Valley festival template called *Atun Puncha* (“Great Day”), also called *Kalusturinda*, a Quechuacized variant of the Kamëntšá *Clestrinje*. In most respects, the Inga festival is highly similar to the Kamëntšá version, from which it probably borrows heavily, although there are some differences between the two traditions. The Inga variant was codified in tandem with the Kamëntšá festival and occurs the day after, i.e., the Tuesday before Ash Wednesday.

evangelizing of the Church; and on the other, the agentic resignification of the festival within the community itself—explain the coalescence and emergence of a unified Clestrinŷe tradition in the late twentieth century. However, the precise origins and nature of the different traditions which eventually coalesced into Clestrinŷe in its current form are foggy. It is known that some of the character archetypes associated with modern Clestrinŷe once had their own festivals dedicated to them throughout the year. Originally, some of those festivals were not strictly associated with Clestrinŷe, so it is the origin of the Clestrinŷe tradition which is the subject of this analysis.



Figure 24. The Matachín leads the Bëtsknaté procession into Sibundoy on February 20, 2023. The Matachín, it is said, represents the ancestral solar god worshipped in the pre-Christian Sibundoy Valley; his red mask is the visage of the sun. This original significance is no longer widely recognized in the community, however.

The festival season of Clestrinŷe originally took place in September, beginning at noon as a sun-worshipping festival; prior to the advent of syncretic Catholicism in the Sibundoy Valley, the Kamëntšá worshipped a solar god of Andean origin (Figure 24). Clestrinŷe was also, in part, a harvest festival which celebrated Kamëntšá cosmological beliefs in the origin of life. Clestrinŷe, more than only a sun-worshipping festival or a harvest festival, was a holistic and integral celebration of life. In those days, Clestrinŷe was understood as, in the words of one collaborator, “a celebration of the power of life, of one’s ability to be part of that miracle, the

miracle of creation” (I.9).

In its original form, Clestrinŷe was totally unique to the Sibundoy Valley, the various individual days and celebrations that comprised it tuned to the cyclical rhythms of the Kamëntšá calendar. As it was consolidated and codified in the late twentieth century, however—and especially as Catholics in the Sibundoy Valley sought to identify Catholic principles where, ancestrally, there were none—many of these unique features were reduced or removed from the collective consciousness of the community. The notion of “pardon” became the primary attribute of Clestrinŷe in both the local and national consciousness, even though this addition was entirely of orthodox Catholic origin. Thus, ancestral elements related to the festival’s original emphasis on intracommunal reciprocity and harmony were rearticulated as Catholic rites focused on pardon and absolution from sin. A clear example of this process is the Clestrinŷe flower, which my interlocutor describes in the following terms:

Clestrinŷeshá is the flower that is placed on the head. These days people use any flower, but in the old days they only used the Clestrinŷe flower, which grows wild and is at risk of extinction. The placing of the flowers was a rite of blessing meant to bring good luck, health, abundance, and harmony. These days it’s more to show than to feel [*más para mostrar que para sentir*]. Now people know that they’re being filmed. (I.9)

The flower today signals an act of forgiveness (of fundamentally *negative* attributes) rather than one of blessing (an act with *positive* connotations). A symbolic rearticulation thereby occurred in this aspect of the festival, though one that favored the Catholic reinterpretation rather than the Kamëntšá ancestral model. The identification of the festival as a “carnival” likewise signaled a Catholic interpretation, linking the Kamëntšá celebration to others identified as “carnivals”

throughout Colombia. In this sense, there was also a nation-building directive behind the festival's designation as the "Carnival of Pardon." By the 1980s, the consolidation of the Clestrinje was complete; the extended festival season of Clestrinje had been reduced to a single day—Bëtsknaté—characterized by the procession practiced today.



Figure 25. The "castle" erected in the street next to the Sibundoy cabildo, where the procession goes after Mass.

The procession is led by the figure of the Matachín—no longer widely remembered as a personification of the ancestral sun god—and accompanied by the masked San Juanes, the whirling Saraguayes, flagbearers, and other characters of symbolic value. The procession begins in a church outside of Sibundoy before proceeding into town, filing into the cathedral for Mass, and then progressing to the cabildo building across Interculturality Park, where a "castle" of woven palm shoots has been erected (Figure 25). Alongside the Indigenous elements, there are, notably, introduced Catholic elements whose religious significance is clear. A key example is the entourage of women who carry aloft between them a portrait of the Virgen de Las Lajas, an apparition of the Virgin Mary which is the patron saint of the Kamëntšá (Figure 26). This tradition was another introduced by the successors to the Capuchins in a bid to Catholicize the festivals that their predecessors never succeeded in stamping out.



Figure 26. The Virgen de Las Lajas accompanies the procession from the vereda where it begins until the cathedral in Sibundoy, where it is deposited in a place of honor as the rest of the procession files in for Catholic Mass. This tradition was added to the Bëtsknaté procession in the 1970s.

A complicating factor is what some collaborators have referred to as the increasing commercialization of the festival through the years. As certain scholars have shown in other cases of heritage declaration in Colombia (Escallón 2019), the consequences of commercialization are not always to the benefit of its recipients. Some of my collaborators have voiced concerns that the crowds of tourists entering the valley every year for Clestrinje may risk watering down or commercializing the festival tradition. The salience of this risk was illustrated one night in February 2023 when, sitting around the dinner table with my host family, one collaborator reacted with evident disgust upon seeing Clestrinje branded a "shamanic new year" by an American influencer visiting for the festival. It is, of course, nothing of the sort. My friend's reaction hints at the harm that such misinformed interpretations can do when they are uncritically broadcasted to thousands of equally uninformed followers.

Where does this leave Clestrinje today? It is still the most important festival of the Kamëntšá year, but it is now a deeply syncretic one—and one that lends itself, therefore, to a profusion of different interpretations and meanings, some ancestral and others Catholic, and all in a state of continuing evolution (Castaño 2021). One could

therefore analyze Clestrinŷe as a discursive field in which competing visions of Kamëntšá pasts and presents are played out over constantly shifting terrain. Whether one chooses to emphasize and valorize the ancestral elements and interpretations or the colonially imposed Catholic ones—or whether one forgoes interpretation altogether in lieu of the commercialization and simplification fueled by mass tourism—has meaningful bearings on the contemporary significance and prospects of the most important festival in the Kamëntšá year. Regardless of the semiotic contestations behind the invention and development of Clestrinŷe, this festival presents an excellent venue in which to observe several expressions of Kamëntšá cultural reproduction.

7.3. Cultural Reproduction through Clestrinŷe

The ethnographic trope of the festival has traditionally been characterized by anthropologists as a “release valve” which, in the structural functionalist terms of Radcliffe-Brown (1952), provides controlled and temporary sanction for an outpouring of collective emotion that, one released, enables the return to a stable status quo. This is a serviceable description of the festival in general terms, but this explanation is insufficient for the interpretation of Clestrinŷe developed here. The structural functionalist model of anthropologists like Radcliffe-Brown does not account for the dynamics of power and its negotiation which animate many festivals and celebrations cross-culturally. For the Kamëntšá, the element of collective catharsis through festival is important, but Clestrinŷe is more than just its ritual inversion of the social order (Sandoval Zapata and Lasso Otaŷa 2014). It is, more than society’s inversion, its renewal, valorizing the ancestral principles that enable the perpetuation of Kamëntšá society and culture (Quiñones Triana 2019; Tobar and Gómez 2004). Or, in McDowell’s (1992) terms, during Clestrinŷe

“the ancestors appear to walk the earth once again, and the modern people renew their contract with the ancestral model” (110).

This “contract” invokes the ethic of reciprocity, the exchange of advice, and the mediation of intracommunal conflicts—significantly, *not* the Catholic notion of pardon, which implies absolution from one’s sins. Fulfilling this contract guides the course of events during the festival as a form of remembering and honoring the ancestors, paying one’s respects to and asking advice from the elders and traditional authorities, and also renewing the crucial bond between the Kamëntšá people and *Tsbatsána Mamá*, Mother Earth. According to one collaborator, there are six original functions of Clestrinŷe, paraphrased in the following terms:

1. Giving thanks to the ancestors, elders, and traditional authorities.
2. Fomenting unity within the family.
3. Recognizing that the whole community is one family.
4. Resolving conflicts in the family and in the community.
5. Finding love or courtship [*conquistar*] through music.³⁸
6. Requesting council from the elders and traditional authorities so that young people and aggrieved parties in conflict could resolve their problems amicably. This rite was confused with the Catholic notion of asking pardon, giving rise to the lasting misnomer. (I.9)

This list highlights some of the major underlying

³⁸ I do not develop this point further here, but it is interesting to note that several collaborators told me that, traditionally, and to some extent still today, young people use the dancing and music of Clestrinŷe to mingle with their peers and find a romantic partner. Since everyone plays an instrument during the festival, they would use certain musical cues to signal their interest, as if flirting with sound. Similarly, I am told that music could also be used as a challenge, to show discontent and interpersonal conflict; the insulted party would then return the challenge with a musical cue of their own. Further investigation of this type of musical communication is necessary.

themes of Clestrinŷe for this collaborator, but it bears reiterating that the precise meaning of the festival depends on who is interpreting it. This collaborator inclines towards the ancestral model and the interpretations favored during his youth, when the Sibundoy Valley was a very different place. Now new interpretations are in vogue. However, although the interpretations and practices have changed, Clestrinŷe, more than any other event in the Kamëntšá year, continues to embody the annual renewal of the principles that undergird Kamëntšá social life and culture. Clestrinŷe is the expression of collective resistance, harmony, and continuity in which all other elements of Kamëntšá culture and thought are concentrated—arts and artesanías, music, language, philosophy, and more—which provides for the perpetual reproduction of Kamëntšá culture.

One central mechanism of cultural reproduction in Clestrinŷe is the practice of asking for advice from elders and traditional authorities. This is the ancestral practice which, in part, gave rise to the Catholic misnomer identifying Clestrinŷe as the “Carnival of Pardon.” Traditionally, this act took place in the Kamëntšá language. The person seeking advice, usually relating to a conflict between families or within the community, would approach an elder and speak a formulaic phrase to the effect of “father, please regale me with your wise knowledge” (I.9). The elder would then respond in ceremonial language with personalized advice meant to help defuse the situation. Sometimes this person would also serve as mediator between two aggrieved parties, helping both come to a mutual understanding. According to Gómez Montañez et al. (2022):

For the Kamëntšá, advice [*el consejo*] is synonymous with wisdom, so that providing advice is a spiritual practice that aims to reconfigure the victimizer’s thinking. Any conflict resolution process, carried out at home or in the cabildo, must begin with

ceremonial words of advice by an elder. These are not intended to judge, but to educate or re-educate. In the cabildo, for example, it is the governor [*taita gobernador*] who is in charge of teaching through words, and it is thanks to this that in many cases guarantees of non-repetition are achieved. (132)

This practice, in addition to invoking the authority and wisdom of the elders and traditional authorities, also valorizes the principle of orality. Oral tradition is important among the Kamëntšá, as the spoken word is the vehicle by which interpersonal and intracommunal harmony is maintained:

The word *joybuambayan*, or orality, is an element that has facilitated the exchange and preservation of knowledge for Indigenous peoples... The word, when pronounced by a member of the community, implies commitment and respect for the other, making orality an elemental value to harmonize and regularize social relations that strengthens ties that converge components such as *knowing how to listen* [*saber escuchar*], a basic foundation for a healthy convenience, a proof of respect, trust and esteem for the other person. (139–40)

It is unclear to what extent the practice described above is preserved in its ancestral form, unmodified by the Catholic resignifications of Clestrinŷe over the past half century. However, there still inheres in the practice a mediating and regulatory function, whereby the act of asking and giving forgiveness strengthens the ancestral values of interpersonal respect and intracommunal harmony. The reciprocal and relational nature of Kamëntšá social life is restored and maintained. In the words of my collaborator, the festival reinforces “that the whole community is one family” (I.9). Figure 27 exemplifies a contemporary expression of the

ancestral exchange of advice, though the Catholic element of pardon is more pronounced in this case, as it often is in Clestrinŷe today. Even where the Catholic practice has overtaken the ancestral one, however, there remains the important process of rearticulation, which allows ancestral practices to persist under a colonially imposed overlay—another indicator of contemporary Clestrinŷe’s deeply syncretic character.



Figure 27. One taita, a shaman, offers another taita a shot of aguardiente, a strong Colombian liquor. Gestures like this exemplify the centrality of forgiveness, reciprocity, and the maintenance of communal harmony within Clestrinŷe.

Also key to the communal spirit of Clestrinŷe is the emphasis on the sharing of drink. This occurs with offerings of aguardiente (Figure 27), but even more commonly with *chicha*, or Andean maize beer. At traditional social events in the community, *chicha* always flows freely. During Clestrinŷe, the cabildo brews enormous amounts of *chicha* and distributes it all day and night to keep the celebrants well-stocked. The sharing of *chicha* has important symbolic value and can be interpreted as another social regulatory function within Clestrinŷe. It is not uncommon for requests for advice or forgiveness to be accompanied by an offering of *chicha*, an act signifying the restoration of interpersonal and intracommunal harmony (Figure 28).



Figure 28. Chicha, a pan-Andean alcoholic beverage typically fermented from maize, is a staple of community festivities and especially Clestrinŷe. On the Great Day, huge quantities of *chicha* are stored in the cabildo for free and generous distribution to those dancing outside.

Of a similar function to the sharing of *chicha* is the prevalence of *yagé* ceremonies leading up to the Clestrinŷe celebration. *Yagé* performs an important mediating function within the Kamëntšá community whereby the cleansing and healing of an individual’s body is seen as a prerequisite for the healing of the social body and the territory writ large. Clestrinŷe extends this metaphor, putting the harmonizing power of *yagé* in the service of the revitalization of the community, the renewal of its “ancestral contract.” As Gómez Montañez et al. (2022) writes:

Just as *yagé* disposes the physical body to the spiritual opening that connects, it is important that the body itself is disposed to such connections, no longer in the healing space, but in the net festive-collective space of integration and coexistence. For this, *yagé* gives way to the *chicha*, allowing transactions to develop and channel as appropriate to the passage of the different ritual orders of *Bëtsknaté*. (213)

The prevalence of both *chicha* and *yagé*, both of a mediating and harmonizing function in the community, attests to the importance of such processes of mediation within Clestrinŷe itself.



Figure 29. Religious syncretism runs deep in Bëtsknaté. In the 1970s, after the lifting of the ban on its celebration which was imposed by the Capuchins, the missionaries who succeeded them managed to establish Mass in the cathedral of Sibundoy as a central feature of the Bëtsknaté procession, imposing a Catholic vision of repentance and “pardon” over an Indigenous emphasis on community and reciprocity, and thereby resulting in the inaccurate but lasting misnomer identifying Bëtsknaté as the “Carnival of Pardon.”

Another important factor to account for is the layered significance of the Bëtsknaté procession itself. Bëtsknaté starts in the early morning in each family home in the valley. Families rise together, put on their regalia, pick up their instruments (everyone plays an instrument, contributing to the cacophony of sound that characterizes the Great Day), and then walk out the door and meet up with the other families of the vereda. The whole vereda then walks to the church in vereda Sagrado Corazón, about a mile outside of Sibundoy. The whole community gathers there until the Matachín and his entourage arrive—the San Juanes, the Saraguayes, the flag-bearers, the horn-blowers, all bedecked in the elaborate and traditional clothing that signifies Clestrinýe (Figure 30). They wait there until the women bearing the portrait of the Virgen de Las Lajas leave the church and join the throng. From there, all march together to celebrate Mass in the cathedral of Sibundoy (Figure 29).



Figure 30. This mural on the side of the cabildo building in Sibundoy evokes the wisdom of the ancestors. The elders in the painting are dressed in Clestrinýe regalia.



Figure 31. A man and a woman play music in Interculturality Park as the Bëtsknaté procession files into the cathedral built by the Capuchins that looms over Sibundoy. The man’s regalia and his choice of harmonica as instrument suggest that he may be a shaman.

On one level, the Kamëntšá occupation of the cathedral can be seen as an inversion of Mass, whereby colonially imposed rites are subversively undermined by the remnants of a religious tradition that precedes Catholicism in the valley (Quiñones Triana 2019; Sandoval Zapata and Lasso Otaña 2014; Tobar and Gómez 2004). In the words of one collaborator, “Bëtsknaté is a seizure of the city that was once Tabanok. The Mass is profaned, it is the seizure of a different cosmovision” (I.9). Except once the Bëtsknaté procession arrives in Interculturality Park, not everyone files into the cathedral, where the taita gobernador and the other members of the cabildo take their seats alongside the priests to pay homage to the Catholic god. In fact, most

of the procession holds back outside, preferring to continue the festivities free from the forlorn atmosphere of the cathedral—an unusual site of formality and quiet in an otherwise boisterous and unrestrained day (Figure 31).

What of those who do not join Mass, those who remain outside and continue the revelry? Interculturality Park, at the center of Sibundoy, is said to sit at the heart of Tabanok itself—the “place of return” of the Kamëntšá, the “general womb” of the Kamëntšá people (Gómez Montañez et al. 2022, 216). The central plaza of Sibundoy sits atop an ancient cemetery where the bones of the ancestor repose under the cobblestones laid down by the Capuchins. In the park today one finds a series of wood carvings depicting episodes from the history of the Kamëntšá: the taitas and shamans in their capisayos and jaguar tooth necklaces, the Capuchins with their brown robes and tonsures, the Matachín and other masked figures from Kamëntšá myth and folklore. All convene in the place where the spiritual power of the ancestors—what Taussig calls an “underground of time” (1987, 372)—meets the assembled community at the heart of Tabanok, enabling a return to mythic time whereby the Kamëntšá people renew their contract with the ancestral model through music, dance, shamanic rituals,³⁹ and acts of remembrance (Gómez Montañez et al. 2022, 216). Clestrinje is therefore, fundamentally, an annual performance of cultural reproduction and autonomy.

7.4. Autonomy through Renewal

Clestrinje is the single cultural institution which best represents and embodies the totality of Kamëntšá culture. Insofar as this ritual can be seen as a holistic reiteration of Kamëntšá philosophical principles and cultural

expressions, the persistence of this ritual both contributes to and is itself the product of the processes of cultural reproduction that permeate Kamëntšá society writ large. In this sense, the preservation and continued rearticulation of Clestrinje must be recognized as one of the pillars of Kamëntšá cultural survival in the contemporary period. It is the venue in which the Kamëntšá today renew society by reiterating their integral bonds to their ancestors and to the land they walk upon, the Uaman Luar.

As noted above, the mass tourism attracted to the valley each year—and, consequently, the misinterpretations of Kamëntšá culture that result—bears uncertain tidings for the future of this festival and its meanings. Even within the community, the meanings of Clestrinje remain contested between ancestral and Catholic interpretations. When I attended the Bëtsknaté Mass on February 20, 2023, the cabildo governor ended his customary speech at the pulpit on a defiant note, asking people in Kamëntšá to jeer and make noise if they were dissatisfied or disillusioned with the Church. This was meant to be a form of showing discontent and resistance, but no one made any noise; according to one collaborator, the older generation—those who grew up in the Capuchin Mission—are still too reverential towards the priests and the Church to fathom speaking out against them. This demonstrates contestations of legitimacy and power in this space of interculturality and syncretism, where two very different cosmovisions vie for legitimacy. For now, institutional Catholicism remains dominant. But from outside the Church came the sounds of music and revelry, where thousands—many more people than filled the cathedral—chose to honor the ancestors whose bones lay under their feet instead of paying homage to an ecclesiastical hierarchy that many in the community feel no longer represents them. Now two interpretations of Clestrinje exist side-by-side: one, the music and revelry of thousands, venerating their ancestors and defying the Catholic connotations

³⁹ For example, on the Saturday prior to Bëtsknaté, the taitas gather in the park to perform a “harmonization” ritual, involving the burning of incense and the blessing of the wood carvings that stand there.

of the festival; and the somber, pensive prayers of the people within the church, asking for forgiveness of their sins. To many, Clestrinje is no longer just “the Carnival of Pardon,” but is undergoing a transformative rearticulation (Figure 32). (Figure 32).

Future possibilities for the political, cultural, and territorial autonomy depend on the cultural vitality of the Kamëntšá community year after year. The importance of the single day which best provides the conditions for that continued vitality cannot be questioned; Clestrinje remains central to the Kamëntšá project of cultural reproduction and autonomy.



Figure 32. “It’s not carnival, it’s Clestrinje or Bëtsknaté.”

Some people in the Kamëntšá community are beginning to push back against the Catholic co-option and misinterpretation of their most important festival.

8. Conclusions

“The struggle for liberation is above all an act of culture.” —Amílcar Cabral (1973, 16)

*“Se van cruzando estos caminos creados por tus abuelos; son para encontrarse y darse la mano. Pon tus huellas hijo, así, seguirán viviendo.”*⁴⁰ —Hugo Jamioy Juagibioy, Kamëntšá poet (2010, 83)

In colonial circumstances, what are the prospects for a genuinely Indigenous modernity—one in which subaltern, colonized, and marginalized peoples the world over can find

their place in the world village without sacrificing, but instead celebrating and strengthening, their cultural particularity and uniqueness? How, under these conditions, do subaltern cultures remake and perpetuate themselves? While such questions have been posed by academics and Indigenous peoples alike for decades, the numerous contemporary movements for Indigenous autonomy in Latin America are now providing concrete answers through praxis and the lessons that emerge from it. The case of Kamëntšá cultural reproduction and autonomy is an informative example among these movements, demonstrating how Indigenous communities still marginalized by the legacies of colonialism and dispossession ensure their cultural survival in the face of change.

In the words of Marshall Sahlins (1993), “[e]thnography in the wake of colonialism can only contemplate the sadness of the tropics (*tristes tropiques*). Like the rusting shanty towns in which the people live, here are bits and pieces of cultural structures, old and new, reassembled into corrupt forms of the Western imagination” (6). However, it is no longer self-evident that cultures excluded by this hegemonic mainstream are doomed to annihilation by it. It is now possible to contemplate possibilities of cultural creativity and adaptation, rather than confine ourselves to lamenting the inevitability of cultural destruction. As Sahlins writes:

Cultural continuity thus appears in and as the mode of cultural change. The innovations follow logically—though not spontaneously, and in that sense not necessarily from the people’s own principles of existence. Traditionalism without archaism. [...] Notice that for the people concerned, syncretism is not a contradiction of their culturalism—of the indigenous claims of authenticity and autonomy—but its systematic condition. [...] Rather than the overthrow of the World System, which is now an irreversible fact of their existence, the local peoples’ inventions

and inversions of tradition can be understood as attempts to create a differentiated cultural space within it. And actions that are at once indigenizing and modernizing appear as structural rather than just hypocritical. (19–20).

For Sahlins, writing in 1993, the task of anthropology in the wake of an earlier phase of “scientific” pessimism had already become the documentation of the “indigenization of modernity” (25). Since then, anthropological scholarship has taken up this call—and a good deal of it has paid close attention to the Indigenous social mobilization and cultural revitalization that began in Latin America in the 1980s in response to the neoliberal turn.

Cultural reproduction—a grounded theoretical model of cultural change and continuity developed through observation of Kamëntšá processes of cultural survival—supports efforts for Indigenous autonomy in three major domains of Kamëntšá culture discussed in this paper: the artisanal tradition, shamanism, and the festival of Clestrinje. While discussing these major domains, I have also touched on numerous others, from street art and music to traditional ecological knowledge and the philosophical and cosmological principles that undergird it all. Given the ambitious scope of this approach, it is important to stress the provisional nature of my findings and interpretations. There are, nonetheless, several important analytical points drawn from this ethnography. First, the identified cultural domains are of an intricately interconnected nature within the Kamëntšá cultural universe; one cannot isolate the artisanal industry from the shamanic tradition, both of which come into play significantly in the Clestrinje festival through which the ancestral contracts undergirding Kamëntšá sociocultural life are annually renewed.

Likewise, the processes of cultural reproduction and autonomy analyzed in each domain touch on political, cultural, and

territorial issues—these being, themselves, arbitrary and mutually interdependent categories, though necessary ones for conceptual and organizational purposes. One of the mainstays of the anthropological perspective is that culture is holistic; the parts are inseparable from, and integral to, the whole. In so deeply a relational culture as that of the Kamëntšá, this truth is self-evident. This fact justifies my high-level analysis of cultural reproduction within the Kamëntšá community: an investigation of the same processes in only one cultural domain would have too limited, ignoring their necessary interdependence. This holistic analytical framework provides the general context that will facilitate future investigations of more particular aspects of Kamëntšá culture and of more specific social processes operating therein.

The Kamëntšá, like all Indigenous peoples of the Americas, continue to suffer the legacies of colonialism in both its historical and contemporary dimensions. What is remarkable, however, is the extent to which this community has survived and reclaimed its cultural autonomy by both heeding the wisdom of the ancestors and adapting creatively to contemporary changes. That the Kamëntšá have reproduced their culture and community so successfully despite 500 years of colonial pressures demonstrates the resilience and adaptation that all so-called marginalized and oppressed peoples are capable of. The Kamëntšá demonstrate that the same processes of cultural reproduction which Indigenous peoples employ as a matter of cultural survival also provide the conditions for autonomous and dignified alternatives to the impositions of what Escobar (2018) terms the one-world world—the assertion that there is only one way of being in the world and that all cultures are fated to be subsumed by it. The Kamëntšá example shows, to the contrary, that other worlds are possible; that the one-world world is not inevitable. The Kamëntšá case illustrates what the “Indigenization of modernity” looks like in the Sibundoy Valley, where an Indigenous community in resistance is recreating

itself under the transculturating pressures of globalization and the legacies of colonialism. In this respect, the story of the Kamëntšá exemplifies that of many other Indigenous peoples worldwide; it demonstrates the processes through which Indigenous communities can reclaim their culture and their autonomy.

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Appendix

Interview and Focus Group Descriptions with Anonymized Participant Information

I. = interview

FG. = focus group

M = male / F = female

I.1: June 23, 2022. This interlocutor (M) is a middle-aged artist and taita who runs a shop in Sibundoy. He is known as a traditionalist who always wears traditional garments and prefers to speak Kamëntšá over Spanish. He is also an activist who has been a significant figure in political and territorial movements within the community. Our conversation revolved around themes of autonomy, territoriality, extractivism, and the land defense movement.

I.2: June 28, 2022. This interlocutor (F) is a middle-aged weaver who runs an artisanal collective with a store in Sibundoy selling textiles, beadwork, and masks. She is also the daughter of a noted Kamëntšá anthropologist and ethnolinguist who produced a considerable volume of scholarship on the myths and narrative art of the Kamëntšá. Our conversation was about artisanal work, its importance within the community and Kamëntšá culture, and its relationship to autonomy and territoriality. We also discussed the work and influence of her father within the community.

I.3: July 5, 2022. This interlocutor (M) is a middle-aged woodcarver who makes a living producing masks, instruments, and other traditional artesanías. He also plays a *saraguay*, one of the archetypal characters in the procession of the

Bëtsknaté celebration. His family is influential within the artisanal industry of the community and his carving work is on display in Sibundoy's central Interculturality Park. Our conversation centered around his artisanal work, its relationship to autonomy and territoriality, the importance of woodcarving and traditional masks within the community, and processes of cultural reproduction within the carving tradition.

I.4: July 23, 2022. This interlocutor (F) is an elderly artisan who has been weaving all her life and continues to work into old age. Her daughters are also traditional weavers and important artisans within the community in their own right. Our conversation was about her childhood and early life growing up during the Capuchin mission and partaking in the expansion of the artisanal industry following its collapse. We discussed processes of change in the artisanal tradition over her lifetime and touched on what she termed “artisanal theft” or “artisanal injustice,” referring to the appropriation of Kamëntšá artesanías and artisanal techniques by outside organizations without proper remuneration to artisans in the community.

I.5: July 29, 2022. This interlocutor (M) is an older shaman who performs ceremonies in a maloca in one of the outlying veredas outside of Sibundoy. One of the more popular choices among foreigners and tourists looking to try yagé, this shaman runs comparatively large ceremonies with groups of ten to twenty patients with the help of his sons, who are apprentice shamans in training. Our conversation was about the relationship between yagé, Kamëntšá ethnomedicine and shamanism, territoriality, and autonomy. We also touched on the importance of traditional land use patterns, such as the *jajañ* tradition, as opposed to the unsustainable and ecologically harmful monoculture practices introduced by settler colonialism.

I.6: July 29, 2022. This was a double interview

conducted during a yagé ceremony with an Inga shaman and his wife, both land defenders in the bi-ethnic Guardia Indígena, an autonomous and bi-ethnic unit of activists Kamëntšá and Inga activists who regularly patrol the Indigenous territories of the valley and surrounding areas. Recorded under the influence of yagé, our wide-ranging conversation touched on the importance of the yagé tradition, the *jajañ*, the relationship between the Kamëntšá and the Inga, and the relationship between women and territoriality.

I.7: August 4, 2022. This interlocutor (M) is a young musician and artisan who plays in the band Luar Kawsay, a Kamëntšá-Inga portmanteau meaning “Space of Life,” which performs songs in both Kamëntšá and Spanish. His family also runs an artisanal workshop that produces masks, textiles, instruments, and other artesanías. Our conversation touched on the importance of music in contemporary Kamëntšá society, intergenerationality, and the importance of transmitting Kamëntšá ethical values and philosophical principles through music and art.

I.8: August 5, 2022. This interlocutor (M) is an old friend of Dr. John H. McDowell and a relative of my host family in vereda Tamabioy. Known to be suspicious of outside researchers, he only agreed to speak to me when he learned that I was recommended by Dr. McDowell. We met at the family house in the vereda to converse, beginning with an oral history of his youth in the Sibundoy Valley as it was fifty or sixty years ago. Our conversation also touched on issues of kinship, territoriality, and the transmission of traditional knowledge and the ethical values and philosophical principles of the Kamëntšá.

I.9: February 22, 2023. This was a follow-up interview conducted with the same interlocutor recorded in I.8, who I found to be an incredibly insightful and articulate conversationalist whose oratory skills must have been inherited from the

traditional narrative contexts described by John McDowell at the time that the two knew each other in the 1970s and 80s. In this conversation, we discussed Bëtsknaté / Clestrinje two days after its celebration and this informant provided me with many details regarding the historical development of this festival. We also discussed elements of Kamëntšá philosophy in relation to processes of cultural reproduction witnessed by this informant over the course of his lifetime.

FG.1: July 30, 2022. This was the second of three focus group discussions—and the first of two that I recorded—with a group of artisan women at the house of a prominent artisan who runs a shop in Sibundoy. There were about eight women who ranged in age from a teenage girl to an old batá in her seventies, all of whom are traditional weavers and many of whom worked with other researchers in the past on themes of artisanal autonomy and the weaving tradition. The theme of this discussion was “territory,” but the conversation was wide-ranging, covering themes of kinship and intergenerationality, philosophical principles and the “three pillars of Kamëntšá life,” *tsömbiach* symbology, and artesanías in relation to cultural reproduction.

FG.2: August 6, 2022. This second focus group meeting took place with the same people and in the same house as the previous one, though with the addition of an old bacó, an uncle of one of the artisan women, who was invited to talk about how he remembered life in the Sibundoy Valley in his youth. This served as thematic contrast to the subject of this discussion, which was “the future,” as in the possible futures of the Kamëntšá people. The conversation was once again wide-ranging, approaching that question with reference to issues of autonomy, cultural reproduction, gender roles, birth rituals and midwifery, and more.