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QuaesitUM is an annual publication that provides an academic forum where University of Memphis undergraduate students can showcase research from all disciplines.

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Quaesitum /kway-see-tum/: n. that which is sought
-- Merriam-Webster

To Our Readers

The opportunity to explore the world around us and discover that which is not yet known is a great gift. To ask questions and seek out answers is the driving force behind all scholarship and is the foundation on which this journal was built. At *Quaesitum* our goal is to showcase the best research being conducted at the University of Memphis. Since 2014, when our inaugural issue was published, we have refined and re-examined our vision for the journal, and our notion of what research is – a journey that expands and broadens perspectives, fosters collaboration, and above all, is driven by curiosity. Each article in this journal represents answers to questions born of that curiosity -- the answers the researchers sought.

Our overriding goal has always been to include and represent research from as many disciplines as possible, so as to most effectively represent the breadth of scholarly exploration that is ongoing on our campus. This 6th volume continues to showcase the best work of our most gifted students from a wide array of disciplines that include Civil and Electrical Engineering, Philosophy, Bio-engineering, Linguistics, and Religious Studies.

Anyone who has worked on any scholarly publication understands the complexity and number of tasks that must be accomplished, and there are many people whose contributions to this volume have been vital. In particular, I am extraordinarily grateful to the Director of the Helen Hardin Honors College, Dr. Melinda Jones and our Technical Editor, Mr. Scott Dutt. This publication would not be possible without their commitment and hard work.

The three of us would also like to express our appreciation to our Provost Dr. Karen Weddle-West for providing the resources and support that make our journal possible. Dr. Robin Poston, Dean of the Graduate School, has graciously funded prizes for the best papers, and for that we offer our thanks. We also continue to be grateful for the talents of Mr. Gary Golightly, who has once again designed a cover that captures the spirit of expansion that fuels research.

As with all scholarship, feedback is critical, and we would like to thank all of the reviewers who provided feedback to authors and helped insure the academic rigor that we represent: Dr. Remy Debes, Dr. Amy de Jongh Curry, Dr. Guiomar Dueñas-Vargas, Dr. William Janna, Dr. Daniel Larsen, Dr. Claudio Meier, Dr. Dursun Peksen, Mr. Zachary Pennington, Mrs. Ashley Roach-Freiman, Dr. Marla Royne Stafford, Dr. Jessica Swan, Dr. Sandy Utt, and Mrs. Brannen Varner. For their hard work and invaluable input we offer heartfelt thanks.

The faculty sponsors who have supported and encouraged their students from the inception of their research projects to their final publication stage are also worthy of praise. Their commitment to guiding their students and helping them achieve excellence is a large factor in making *Quaesitum* possible.

Finally, to the students themselves, we offer our congratulations. Not all submissions are accepted, and the work of the students published here exemplifies not only the curiosity to seek answers, but also the commitment to revise, edit, and refine that underlies good scholarship. To them all, we offer our appreciation for their hard work.

Dr. Sage Lambert Graham

Editor-in-Chief

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Publication and Review Process

William J. Cain is currently an undergraduate student in the Herff College of Engineering. He will graduate from the University of Memphis in May 2020 with a major in Biomedical Engineering and minors in Biology and Chemistry. He is a member of Alpha Eta Mu Beta (AEMB), Biomedical Engineering Society (BMES), and Alpha Epsilon Delta (AED). Throughout his time at the University of Memphis, he has been involved in multiple tissue engineering research projects under Dr. Gary Bowlin and has presented his research at various conferences, including the 2018 BMES Conference in Atlanta, Georgia. He plans to pursue a career in the medical field and hopes to apply his experience in research in his future profession.

William's paper received a *Quaesitum* best paper award.

William J. Cain, Allison E. Fetz, & Gary L. Bowlin

Fabrication and Characterization of Electrospun Templates from Polydioxanone and Its Co-Polymers

Faculty Sponsor

Dr. Gary Bowlin

Abstract

Electrospinning is a process through which tissue regeneration templates are fabricated. Since every tissue within a biological system is subjected to unique physical stresses and strains, implantable biomaterials, such as electrospun templates, must possess certain properties that can withstand the biomechanical forces of a native microenvironment. The aim of this study was to electrospin new co-polymers of polydioxanone (PDO) and evaluate their resultant mechanical properties. Results show that each electrospun co-polymer exemplifies some unique physical and mechanical properties which are polymer specific and can be tailored to a specific physiological need.

Introduction

Tissue engineering is the process by which a biofactor, such as a cell, gene, or protein, is transplanted within a porous degradable material (a scaffold) for the formation of a new viable tissue [1]. Within the last twenty years, a new tissue engineering technology called electrospinning has emerged with promising prospects for creating templates through which biological systems can regenerate tissue. The process of electrospinning involves applying a voltage source to a polymer solution, which is stored in a syringe. Due to the potential difference between the liquid surface and target, nano- to microfibers extrude from the syringe and collect on a grounded target opposite the syringe. As the extruded fibers collect, mats composed of nonwoven, randomly distributed fibers are formed which are biomimetic of native extracellular matrix (ECM). These electrospun templates can be fabricated with an array of finely-tuned physical and chemical properties which, as a result, create efficacious biomaterials for diverse applications in guided tissue regeneration. Ultimately, the polymer selection, the diameter of electrospun fibers, and the mechanical integrity of the template all influence the utility of electrospun materials.

When implanted in the body, electrospun templates initiate a host tissue-specific response. Soluble blood serum proteins adhere to the surface of the biomaterial first, followed by the recruitment of neutrophils, macrophages, and other inflammatory cells, resulting in acute inflammation and the foreign body response [2]. Ideally, electrospun templates will initiate a host tissue-specific response without triggering this large-scale inflammatory foreign-body response. By fabricating electrospun templates with appropriate polymers, the scaffold can degrade at a rate such that the native ECM will regenerate and replace the scaffold as it is broken down. Electrospun tissues are advantageous biomaterials due to their biomimetic properties and their tailorable biodegradability. Polydioxanone (PDO) is a synthetic polymer that is commonly used in electrospinning due to its ideal degradation rate, its tailorable material properties, and its non-toxic degradation products. Other non-toxic polymers include poly(lactic acid) (PLA) and poly(glycolic acid) (PGA) which have different mechanical properties, degradation rates, and degradation products which are appropriate for select tissue regeneration applications.

In this study, a variety of recently released PDO co-polymers from the drug device company Bezwada Biomedical Engineering LLC were characterized and fabricated for electrospinning applications. We electrospun PDO and three PDO co-polymers with PLA and PGA to explore their fabrication parameters for electrospinning and evaluated the resultant mechanical

properties. The purpose of this work was to explore the applicability of these co-polymers as electrospun tissue engineering templates. To do this, we electrospun each polymer to create templates composed of a range of fiber diameters and performed mechanical testing on each template. From this testing data, we evaluated if electrospun PDO/PGA, PDO/PLA, and PDO/PGA/PLA co-polymers were mechanically comparable to PDO. Additionally, we explored if mechanical properties changed when templates were composed of different fiber diameters and how these properties differed with the direction of testing. We hypothesized that these co-polymers could be electrospun, that they would have similar mechanical properties to PDO, and that the mechanical properties of each of these templates would be fiber diameter and orientation-dependent. Through this study, we demonstrated that these polydioxanone co-polymers can be electrospun to form templates with diverse, tailorable mechanical properties.

Materials and Methods

Template Fabrication and Characterization

In this study, PDO, PDO/PLA (90/10) (i.e. a co-polymer of 90% polydioxanone and 10% poly(lactic acid)), PDO/PGA (90/10), and PDO/PGA/PLA (90/5/5) were dissolved overnight in 1,1,1,3,3,3-hexafluoro-2-propanol (HFP, Oakwood Products, Inc., Pro. No. 003409) at different concentrations. Each solution was loaded into a 5-mL syringe (Becton, Dickinson, and Company) and attached to an 18-gauge blunt needle (Becton, Dickinson, and Company, Pro. No. 305196), which was connected to the positive lead of a Spellman CZE1000R power source (Spellman High Voltage Electronic Corp.). The syringe was placed on a syringe pump (Model No. 78-01001, Fisher Scientific). Fibers were collected on a grounded, stainless steel 200 x 750 x 5 mm rectangular mandrel, rotating at 1250 RPM and translating 6.5 cm/s over 13 cm. Polymer concentration, applied voltage, flow rate, and airgap for each electrospun template were optimized to produce templates composed of a range of fiber diameters. The templates (thickness 0.06 - 0.18 mm) were stored in a desiccator at 25 °C until analysis.

To characterize the templates by scanning electron microscopy, each template was sputter coated with 5 nm of gold-palladium in an argon gas field. The templates were then imaged using a FEI Nova NanoSEMTM 650 with a field emission gun at +20 kV and a working distance of 5 mm. The inside and outside surfaces of each template were imaged at 1000x to ensure the templates were composed of non-fused, non-beaded fibers. If the SEM image revealed a template composed of beaded or fused fibers, the template was discarded, and the fabrication and characterization process

was repeated until optimal electrospinning parameters were found. The fiber diameters of each template were quantified by analyzing the SEMs in FibraQuant 1.3 software (nanoTemplate Technologies, LLC). A minimum of 200 semi-automated random measurements were taken per image to generate averages and corresponding standard deviations.

Mechanical Testing

After fabrication and SEM characterization, the electrospun templates were cut into dogbone shaped samples (2.75 mm at the narrowest point) in two directions: parallel and perpendicular to the electrospinning axis of rotation. The thickness of each specimen was measured using calipers (Mitutoyo Absolute, Pro. No. 547-516), and the dogbone shape samples were loaded into a TestResources frame (model no. 220Q with 111 N load cell) with a gauge length of 7.5 mm. Uniaxial tensile testing was then performed ($n \geq 7$ punches of each orientation) at a strain rate of 10 mm/min, which is the standard for electrospun template uniaxial tensile testing, until failure to evaluate the ultimate tensile stress (UTS), Young's modulus, and maximum percent elongation as a function of average fiber diameter for each polymer type [3]. Stress strain data was recorded by the XY software associated with the testing frame, and then exported to Microsoft Excel.

Analysis

Data from Microsoft Excel was used to generate stress strain curves, which were then used to obtain UTS, modulus of elasticity, and maximum percent elongation for each mechanically tested sample. The data were analyzed with a Kruskal-Wallis analysis of variance and Dunn's multiple comparison procedure. Mechanical data was tested for significance between each polymer concentration and between each punch orientation. All analyses were performed in GraphPad Prism 6 at a significance level of 0.05.

Results

Electrospinning and Fiber Diameter Analysis

Electrospinning of each polydioxanone co-polymer was possible over a range of concentrations (Table 1). The maximum and minimum concentrations for electrospinning each polymer was determined, and then two intermediate concentrations were selected to provide a complete range of polymer concentrations. Whereas PDO has been electrospun at concentrations as low as 42 mg/mL and as high as 167 mg/mL, the Bezwada PDO only produced electrospun templates with uniform fibers for concentrations ranging from 60 mg/mL to 160 mg/mL [4].

The optimized electrospinning parameters for each of the polymers are shown in Table 1.

	Concentration (mg/mL)	Voltage (kV)	Flow Rate (mL/h)	Airgap Distance (cm)
PDO	60	+24	2.75	12.7
	80	+24	3.00	12.7
	120	+25	5.00	12.7
	160	+26	4.50	15.2
PDO/PGA	60	+27	3.50	12.7
	80	+24	3.75	12.7
	120	+26	3.50	17.8
	150	+24	2.81	19.1
PDO/PLA	70	+13	0.40	11.4
	80	+23	4.00	12.7
	120	+25	5.00	14.0
	155	+25	2.20	17.8
PDO/PGA/ PLA	60	+21	1.75	8.9
	80	+23	4.00	12.7
	120	+28	4.00	17.8
	150	+27	1.90	17.8

Table 1. Electrospinning parameters optimized for four concentrations of PDO and its co-polymers.

Using the optimized electrospinning parameters, each polymer was used to fabricate templates on the grounded rectangular mandrel. Representative SEM images of each template are shown in Figures 1 through 4. Ideally, each electrospun template is composed of an array of fibers which are approximately the same diameter and are non-fused and non-beaded. This is important in the fabrication of electrospun templates for guided tissue regeneration because the extracellular matrix is a fibrous mesh of relatively smooth fibers. Since the purpose of electrospun templates is to mimic the ECM, the templates should, as closely as possible, recreate the micro-environment that would be found in the native biological tissue.

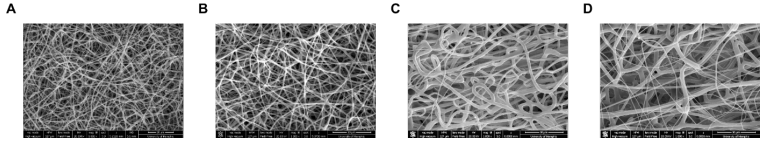

Figure 1. Representative SEMS of PDO templates fabricated with a concentration of (A) 60 mg/mL, (B) 80 mg/mL, (C) 120 mg/mL, and (D) 160 mg/mL (images taken at 1000x, scale bars = 20 μm (A) and 30 μm (B-D)).

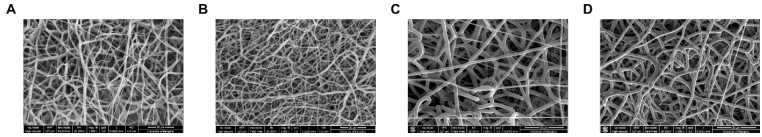

Figure 2. Representative SEMS of PDO/PGA templates fabricated with a concentration of (A) 60 mg/mL, (B) 80 mg/mL, (C) 120 mg/mL, and (D) 150 mg/mL (images taken at 1000x, scale bars = 20 μm (A) and 30 μm (B-D)).

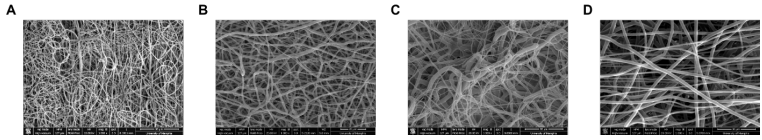

Figure 3. Representative SEMS of PDO/PLA templates fabricated with a concentration of (A) 70 mg/mL, (B) 80 mg/mL, (C) 120 mg/mL, and (D) 155 mg/mL (images taken at 1000x, scale bars = 20 μm (B) and 30 μm (A,C,D)).

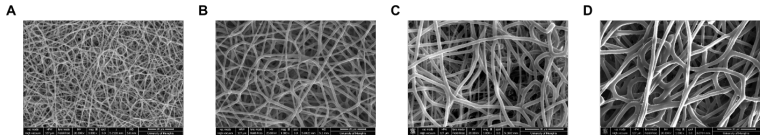

Figure 4. Representative SEMS of PDO/PGA/PLA templates fabricated with a concentration of (A) 60 mg/mL, (B) 80 mg/mL, (C) 120 mg/mL, and (D) 150 mg/mL (images taken at 1000x, scale bar = 20 μm (A-B) and 30 μm (C-D)).

The results from fiber diameter analysis (Figure 5) indicate a positive correlation between fiber diameter and increasing polymer concentration. However, for some of these polymers, fiber diameter did not continue to increase at the highest polymer concentrations. These exceptions include PDO/PGA and PDO/PGA/PLA, which were not statistically significant from the 120 mg/mL fiber diameters at their highest respective concentrations. When either co-polymer was fabricated at a concentration higher than 150 mg/mL, wet, fused fibers were formed. This implies that maximum fiber diameter for PGA co-polymers may not be as tailorable by changing polymer concentration as for other polymers. Additionally, each polymer was characterized by a unique range of fiber diameters at its low, intermediate, and high concentrations with PDO/PLA yielding consistently smaller fibers and PDO/PGA/PLA yielding consistently larger fiber diameters than PDO.

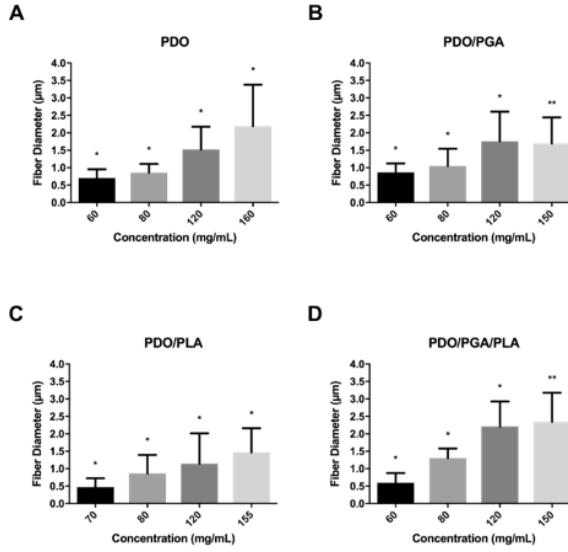

Figure 5. Fiber diameter vs. concentration histograms for (A) PDO, (B) PDO/PGA, (C) PDO/PLA, and (D) PDO/PGA/PLA at concentration. * indicates a significant difference from all other concentrations. ** indicates a significant difference from all concentrations except 120 mg/mL ($p < 0.05$).

Mechanical Testing Data

Uniaxial tensile was performed on dogbone-shaped punches oriented parallel and perpendicular ($n \geq 7$ each orientation) to the axis of rotation of each polymer at each concentration. Each sample was tested to failure to generate stress-strain data, which was used to determine UTS (Figure 6), Young's Modulus (Figure 7), and maximum-percent elongation (Figure 8). As shown in Figure 6, the mechanical strength of PDO and PDO/PGA templates do not show a patterned correlation between UTS and concentration. PDO/PLA and PPP templates exhibit a significant negative correlation between UTS and concentration. Additionally, there were more significant differences between the axial and perpendicular groups for PDO/PLA and PPP compared to PDO and PDO/PGA, suggesting that the UTS of electrospun PLA co-polymers may be orientation-dependent.

For Young's Modulus, shown in Figure 7, there were few significant trends between polymers or between concentrations of the same polymer. However, potentially due to deposition patterns, Young's modulus of 120 mg/mL PDO was significantly greater than all other PDO templates. By visually inspecting the SEM images for PDO (Figure 1), a more curled, overlapped fiber morphology for PDO 120 mg/mL can be seen. These overlapped fibers may have functioned as additional supports in the template, thereby increasing the yield stress of that template. Additionally, PDO was the only polymer that showed orientation-specific statistical significance, which was shown at both 80 mg/mL and 120 mg/mL.

Results for maximum percent elongation (Figure 8) show testing orientation-dependent results for PDO and each of its co-polymers. Axial data for each polymer displayed significantly larger strain capabilities for PDO/PLA at three concentrations, for PDO and PDO/PGA at two concentrations, and for PPP at one concentration as compared to their corresponding perpendicular data. Additionally, the data below consistently display greater maximum percent elongation for PDO co-polymers than for PDO alone (excluding perpendicular PDO/PLA at 70 mg/mL and 155 mg/mL). No consistent concentration-dependent trends were apparent in these data, which may indicate that maximum template strain is not fiber-diameter-dependent.

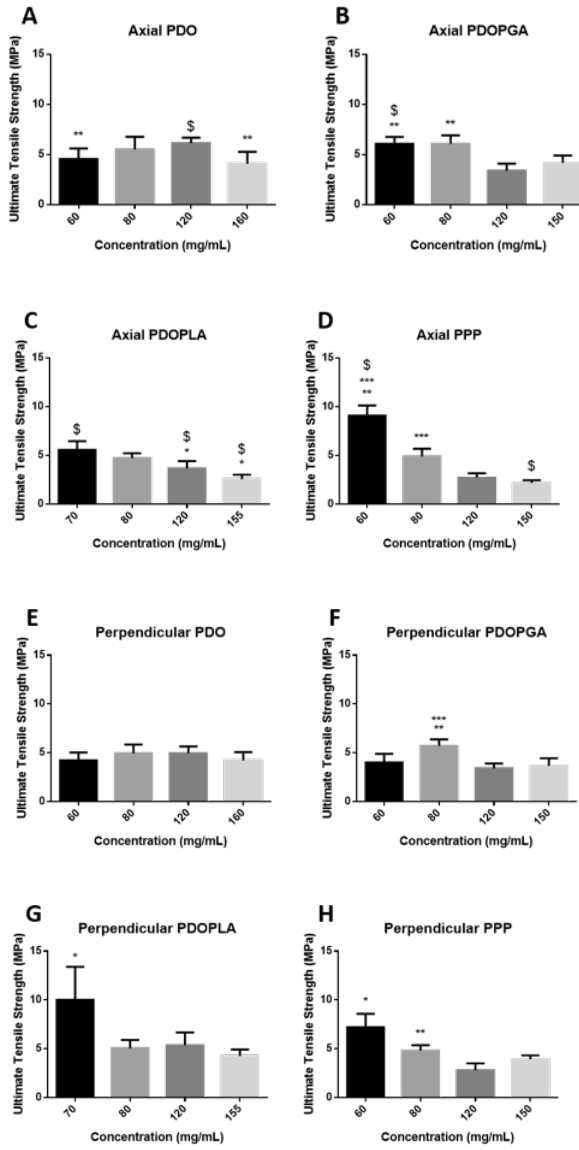

Figure 6. Ultimate tensile strength vs. concentration for each polymer at each concentration (Axial data A-D; Perpendicular data E-H). * indicates a significant difference from all other concentrations. ** indicates a significant difference from 120 mg/mL. *** indicates a significant difference from 150 mg/mL. $ indicates a significant difference between axial and perpendicular ultimate tensile strength of the same template (i.e. orientation specific statistical significance) ($p < 0.05$).

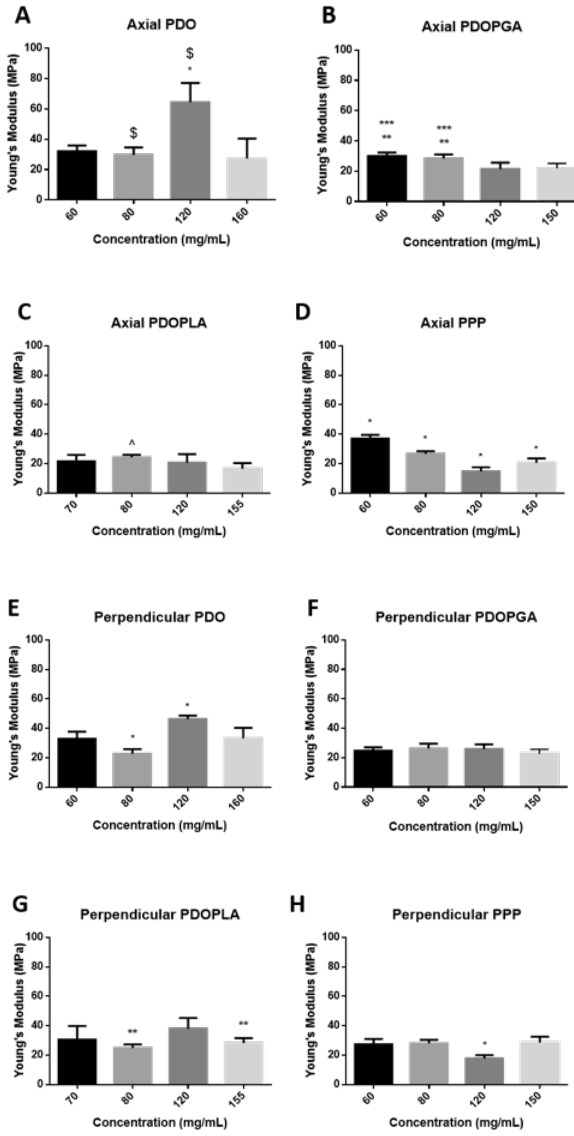

Figure 7. Young's modulus vs. concentration for each polymer at each concentration (Axial data A-D; Perpendicular data E-H). * indicates a significant difference from all other concentration. ** indicates a significant difference from 120 mg/mL. *** indicates a significant difference from 150 mg/mL. ^ indicates a significant difference from 155 mg/mL. $ indicates orientation specific statistical significance between axial and perpendicular Young's Modulus of the same template ($p < 0.05$).

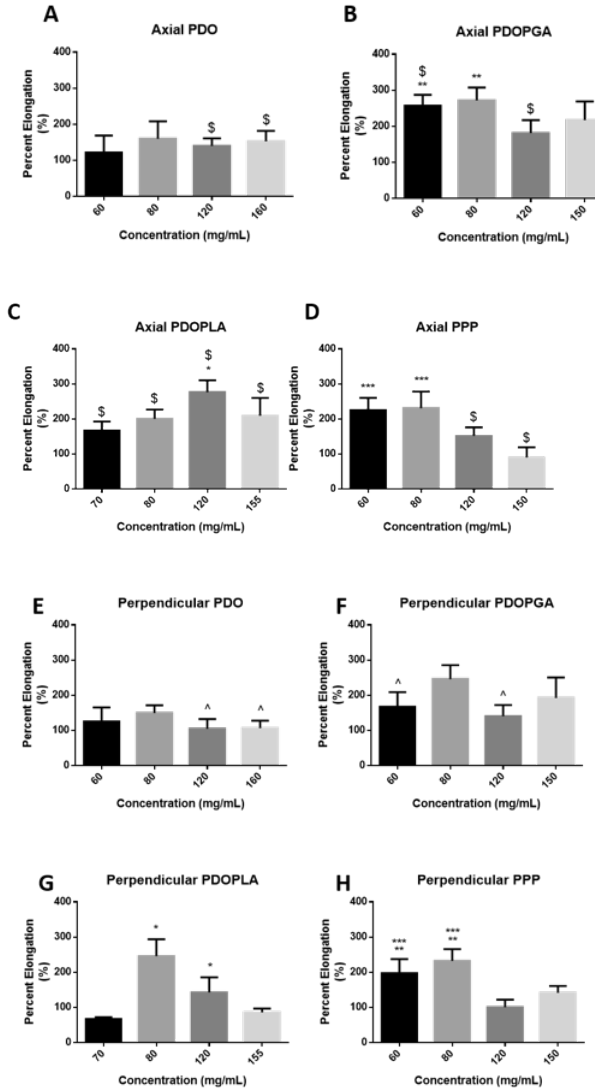

Figure 8. Maximum percent elongation vs. concentration for each polymer at each concentration (Axial data A-D; Perpendicular data E-H). * indicates a significant difference from all other concentrations. ** indicates a significant difference from 120 mg/mL. *** indicates a significant difference from 150 mg/mL. ^ indicates a significant difference from 80 mg/mL. $ indicates orientation-specific statistical significance between axial and perpendicular elongation data of the same template ($p < 0.05$).

Discussion

The goal of this project was to create electrospun templates of PDO co-polymers that were biomimetic of natural ECM and possess variable mechanical properties which could withstand the biomechanical forces required of different biological tissues. As displayed in the above results, each co-polymer can be electrospun over a range of concentrations to create scaffolds of tailorable physical and mechanical properties. Each polymer exhibited fabrication parameters similar to those of PDO as shown in Table 1. Concentration ranges, however, did have to be reduced for each co-polymer. This indicates a reduction in electrospinning breadth when PDO is co-polymerized. Despite these variations in concentration range, each polymer maintained a positive correlation between increasing polymer concentration and increasing fiber diameter. Exceptions included PDO/PGA and PPP which could not be fabricated at their highest concentration to produce large diameter templates that were significantly different from their corresponding 120 mg/mL templates. This disparity between highest polymer concentration and largest fiber diameter may indicate that electrospun co-polymers with PGA plateau in fiber diameter at a certain concentration threshold. Additionally, each polymer was characterized by a unique range of fiber diameters at low, intermediate, and high concentrations. PDO/PLA yielded consistently smaller fibers than PDO, while PPP yielded consistently larger dimeter fibers than PDO. Together these data indicate that a range of concentrations can be fabricated for each PDO co-polymer to create templates of tailorable fiber diameter.

In addition, mechanical testing revealed distinct properties among the different polymers. The UTS for PDO was consistently near 5 MPa for both axial and perpendicular orientation samples. These values for UTS did not display polymer concentration (thus fiber diameter) dependency. Similarly, PDO/PGA did not show a consistent trend between UTS and concentration, but the UTS values were lower than those of PDO alone. For co-polymers that included PLA, a general negative correlation was observed between UTS and concentration. Maximum UTS averages for each of these co-polymers were approximately twice that of the highest PDO and PDO/PGA UTS averages. Differences were further manifest for PLA co-polymers by considering the statistically significant differences between perpendicular- and axial-oriented punches. PDO and PDO/PGA only demonstrated significantly different UTS data for axial- and perpendicular-orientation punches for one concentration each. PDO/PLA and PPP templates displayed orientation-specific significance for three and two concentrations, respectively. These polymer specific differences may be due

to the use of PLA as a building block of each co-polymer, the effect of this, however, needs further investigation.

Unlike UTS, Young's Modulus did not vary considerably for each polymer. Two concentrations of PDO exhibited orientation-specific Young's Moduli, but these were the sole templates which exhibited this orientation dependency. Excluding the 120 mg/mL PDO sample, all PDO and PDO co-polymers templates had similar Young's Moduli with template averages ranging from 16.16 ± 2.15 MPa and 32.48 ± 0.57 MPa. As these co-polymers are 90% PDO, these results indicate that co-polymerization does not impact template stiffness at such small concentrations of PGA and PLA.

Percent elongation data varied vastly from polymer to polymer. PDO had the lowest average percent elongation, which was 50% less than those of the co-polymers, indicating that co-polymerizing PDO with PGA and/or PLA increases the maximum possible strain for electrospun templates, potentially due to differences in PLA and PGA monomer structure from PDO such as crystallinity. Percent elongation results also indicate greater direction dependency for each polymer compared to UTS and Young's Modulus. At least two concentrations of each polymer displayed orientation-specific significance differences with a trend towards greater percent elongation for axial punches compared to the corresponding perpendicular punches. This indicates the likely presence of some fiber anisotropy in each electrospun template as the axially-oriented punches consistently had greater maximum strain than perpendicular punches from the same template. Another possible confounder which may have caused this direction-dependency could be deposition differences on the periphery of a rectangular mandrel compared to the center of the mandrel. Fibers travel slightly further in the electrospinning process to come in contact with the center of the mandrel than with the rest of the mandrel. This slight difference may have created an area of weakness in the center of each punch taken perpendicular to the axis of rotation by decreasing fiber deposition at these loci, but it would not create a corresponding area of weakness in punches taken parallel to the axis of rotation. Together these data indicate that electrospun PDO co-polymers exhibit some mechanical characteristics that are unique and some characteristics that are shared with electrospun PDO.

Since different physiological tissues are subjected to different loads, stress, and strains, it is imperative that tissue engineered constructs exemplify different mechanical properties for the different applications that they will have. Electrospun constructs have utility in everything from vascular grafts to cartilage regeneration and dental implants. These unique force requirements of each tissue are dependent on mechanical characteristics

like those considered in this project. The variations in UTS and maximum percent elongation exemplified by these co-polymers of PDO indicate that each template is mechanically unique, and therefore may be ideal for a certain application which is dependent on these mechanical properties.

Conclusion

This project demonstrated that co-polymers of PDO from Bezwada Biomedical LLC can be electrospun for tissue engineering applications. The resultant electrospun templates of each PDO co-polymer share some mechanical properties, such as Young's Modulus, with PDO, but they have some properties such as UTS and maximum percent elongation that differ. This work holds significance for the field of guided tissue regeneration in that it demonstrates that three new PDO co-polymers have mechanical properties that are polymer-specific and tailorable to specific applications and physiological needs. Ultimately, these electrospun co-polymers of PDO may more accurately meet the stress-strain demands required for certain application than any currently available electrospun polymers.

Funding

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Cooper Morris is currently a sophomore Civil Engineering major at the University of Memphis. He is the current Conference chair of the American Society of Civil Engineers (ASCE) Student Chapter, and is a member of the American Institute of Steel Constriction (AISC) Steel Bridge Team. He also is an Engineering Ambassador for the Herff College of Engineering. In his free time, Cooper enjoys playing golf and fishing.

Cooper Morris

The Effect of Water Content on the Unconfined Compression Strength of Western Tennessee Loess

Faculty Sponsors

Dr. David Arellano

Abstract

The unconfined compression strength of loess can be affected by the water content. The results of an unconfined compression strength test are used to estimate the shear strength of the soil with the use of an empirical equation that assumes the soil is fully saturated. There is a lack of empirical relationships that provide estimates of shear strength as it relates to water content values that are less than the fully saturated condition. The literature suggests that as the water content increases, the unconfined compression strength decreases. A series of unconfined compression strength tests were conducted at various water contents on remolded loess specimens from soil collected in the Memphis area. Two primary conclusions about the soil behaviors of loess can be made based on the results from this study. First, loess exhibits brittle behavior at water contents less than 11.2% and dry unit weight of less than 18.1 kN/m^3 (115.3 lb/ft^3); a ductile behavior is exhibited at water contents higher than 15.2% and dry unit weights greater than 18.3 kN/m^3 (116.2 lb/ft^3). Second, specimens with brittle behavior exhibited higher unconfined compression strength values than specimens with ductile behavior. In the future, an empirical equation between water content and the unconfined compression or shear strength can possibly be incorporated into the design of foundations of various structures within the Memphis area.

Introduction

National Geographic Society (2012) defines loess as a loosely compacted, windblown sediment that can be found within the Mississippi River Valley as shown in Figure 1. Loess is made up of silt and sand particles which are coated in clay, and most of the strength in loess is attributed to the clay binder and negative pore water pressures. When the clay becomes wet, negative pore pressures are reduced and the clay binder softens, lowering the shear strength of loess (Beard 1983). This is also confirmed by Milovic (1988) who states, "Water content influences the unconfined compression strength of loess and the higher the water content the lower the strength."

Figure 1. Approximate Locations of Loess Deposits in the United States (Bandyopadhyay 1983).

There is no established empirical relationship on how water content affects the strength of loess, so the fully saturated condition is typically used in practice to determine the strength of soil. The unconfined compression strength is commonly used to estimate the undrained shear strength of soil because these tests are simpler to perform than shear strength testing procedures such as triaxial tests. The general empirical relationship between the unconfined compression strength, q_u, and undrained shear strength, S_u, is shown in Equation (1):

$$S_u = \frac{1}{2} q_u \qquad (1)$$

Location and Description of Tested Loess

The loess sample material was collected from an exposed bluff located at Fulton Wildlife Refuge (GPS coordinates 35.6344400N, -89.8219360E), north of the city of Memphis. The disturbed sample was scraped from the edge of the bluff with a shovel, collected in buckets, and transported to the laboratory. Emhatsion (2018) reports that the soil from this location is classified as a low plasticity silt, ML, based on the Unified Soil Classification System with 0% sand, 83% silt, and 17% clay. The soil is considered silty loess, and Atterberg limit tests indicate the soil has a liquid limit of 30 and plasticity index of 1.

Sample Preparation

The original target of this study was three water contents which were 7%, 11%, and 17% with a dry unit weight of 16.0 kN/m^3 (102 lb/ft^3). The water contents were chosen based upon previous results from Emhatsion (2018), as these target water contents appeared to be the best choice to achieve useful specimens. If the water content was not in this range, the risk of specimen degradation increased. The target dry unit weight of 16.0 kN/m^3 (102 lb/ft^3) was decided after a trial batch of specimens were created. This dry unit weight was the best option to achieve specimens with approximately the same dry unit weight even with a variation of water content (W_C). The first step in preparing specimens was to compute W_C of the sample material by using Equation (2):

$$W_C = M_W - M_D \times 100\% \quad (2)$$

where M_W is the wet sample mass and M_D is the dry sample mass. The air-dried sample material was obtained from a bulk soil sample which was air-dried for several months. The air-dried sample material contained a minimal amount of moisture because most soils, especially those that contain fine-grained particles, will retain a slight moisture content after air drying. Thus, it was acceptable to neglect the initial W_C.

The next step was to mix the sample to the targeted W_C which was done by adding a calculated amount of distilled water to the air-dried soil sample in a mixing vessel. The amount of water to be added was determined by using Equation (3):

$$W_A = M_S \times W_{CT} \quad (3)$$

where W_A is the weight of water added to the sample, W_S is the weight of the sample, and W_{CT} is the target W_C. In this research, a No. 40 sieve was used to eliminate large particles such as pebbles and sticks from the material. Once the sample was mixed with water, it was placed inside an airtight container that was then placed inside a plastic bag to minimize moisture loss due to evaporation. The sample was allowed to cure for at least 48 hours to allow the W_C to stabilize. Then the sample was molded into 32.1 mm (1.263 in) diameter by 71.5 mm (2.816 in) high cylindrical specimens by using the Harvard Miniature Compaction apparatus shown in Figure 2.

Figure 2. Harvard Miniature Compaction apparatus.

In order to achieve a consistent density throughout the specimen, at least three layers of approximately the same thickness were used as shown in Figure 3.

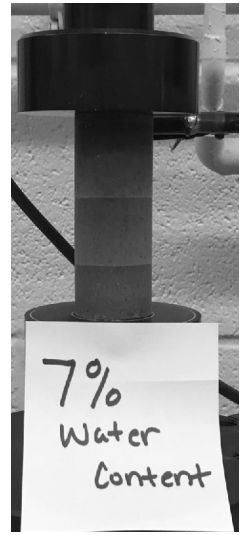

Figure 3. Individual Layers of Specimen.

The specimens were prepared using the procedure utilized by Tohidi (2017). The first step in making the specimen was to apply a light coat of oil, WD-40, on the inside of the mold to allow for easier extraction of the specimen. Before placing each subsequent layer, a soil knife was used to scratch the top of each molded layer to allow for better bonding. The next step was to try to apply the same amount of energy throughout the compaction of the specimen. After the sample molding process was completed, any excess soil was carefully trimmed from the top of the specimen to obtain a specimen that was the same size as the mold. Finally, the specimen was extracted from the mold and double-bagged to minimize the loss of W_C.

Constraints and Issues of Specimen Preparation

As with some specimen preparation methods, constraints were encountered and the specimen preparation procedure had to be modified. Initially, the goal was to target one dry unit weight that would be independent of W_C, but it became apparent that this goal could not be achieved with the Harvard Miniature Compaction apparatus. Since this device is manually operated, inconsistencies in the force applied by the user can result in a variation of the density in the specimen's soil layers. Thus, meeting a single targeted dry unit weight was difficult to achieve. Due to these reasons, the specimen preparation objectives were revised from achieving a target dry unit weight and W_C to only a target W_C.

Another issue was due to using at least three layers in each specimen to achieve as uniform a density throughout the specimen as possible. The first problem arose in compaction because it was very difficult to achieve three layers with equal thickness, and a thin fourth layer was often present in order to achieve the proper sample height of 71.5 mm (2.816 in). Second, the manual compaction associated with the Harvard Miniature Compaction apparatus could possibly yield specimens where the unit weight might vary within each layer. This variation was evident in the completed specimen when the color of each layer varied from the top to the bottom. Thus, to ensure this constraint did not affect the overall results, the unit weight was based on the total weight of the specimen. Similar constraints were observed by Felice (1986) who conducted a small study to determine the effects of this constraint. In this study, it was noted that specimens had a varied density throughout the sample from the use of the Harvard Miniature Compaction apparatus.

Specimen Testing

The unconfined compression strength testing machine shown in Figure 4 was used for this research.

Figure 4. Unconfined Testing Machine.

W_c	Peak Force (kN)	Strain (mm/mm)	A_c (m^2) ($x10^{-4}$)	Unconfined Compression Strength q_u (kPa)	S_u (kPa)	Dry Unit Weight γ_d (kN/m^3)
7.10%	0.818	0.00994	8.13	1000	500	17.4
10.1%	0.622	0.01460	8.19	759	380	18.1
7.90%	0.337	0.01100	8.19	412	206	16.0
11.2%	0.336	0.01490	8.19	410	205	17.2
15.7%	0.242	0.03130	8.32	290	145	18.3
7.60%	0.494	0.00852	8.13	607	304	16.6
11.0%	0.419	0.01140	8.19	513	257	17.8
15.2%	0.351	0.06430	8.65	407	204	18.8
7.74%	0.713	0.01300	8.13	874	437	17.3
11.0%	0.462	0.01390	8.19	564	282	17.7
16.4%	0.288	0.06500	8.65	333	167	18.3

Table 1. Data from Testing in SI units.

W_C	Peak Force (lb)	Strain (in/in)	A_C (in^2)	Unconfined Compression Strength q_u (lb/in^2)	S_u (lb/in^2)	Dry Unit Weight γ_d (lb/ft^3)
7.10%	184	0.00994	1.26	145	72.7	111
10.1%	140	0.01460	1.27	110	55.0	115
7.90%	75.7	0.01100	1.27	59.8	29.9	102
11.2%	75.5	0.01490	1.27	59.4	29.7	109
15.7%	54.4	0.03130	1.29	42.1	21.1	116
7.60%	111	0.00852	1.26	88.0	44.0	105
11.0%	94.2	0.01140	1.27	74.4	37.2	113
15.2%	78.9	0.06430	1.34	59.0	29.5	119
7.74%	160	0.01300	1.26	127	63.4	110
11.0%	104	0.01390	1.27	81.8	40.9	113
16.4%	64.7	0.06500	1.34	48.3	24.2	117

Table 2. Data from Testing in USCS units.

Figure 5 appears to show two different stress-strain behaviors because some of the specimens reach their peak stress at strains of less than 0.02 mm/mm and display a dramatic shear failure surface as shown in Figure 6. This type of stress-strain behavior is typical of brittle materials. Other stress-strain plots have a more gradual curve that peaks at strain values greater than 0.02 mm/mm, resulting in a bulging failure as shown in Figure 7. This type of behavior is typical of ductile materials. The specimens that failed in a brittle manner had a W_C range of 7.1% to 11.2% and a dry unit weight range of 16.0 to 18.1 kN/m^3 (101.7 to 115.3 lb/ft^3). The specimens that failed in a ductile manner had a W_C range of 15.2% to 16.4% and a dry unit weight range of 18.3 to 18.8 kN/m^3 (116.2 to 119.5 lb/ft^3).

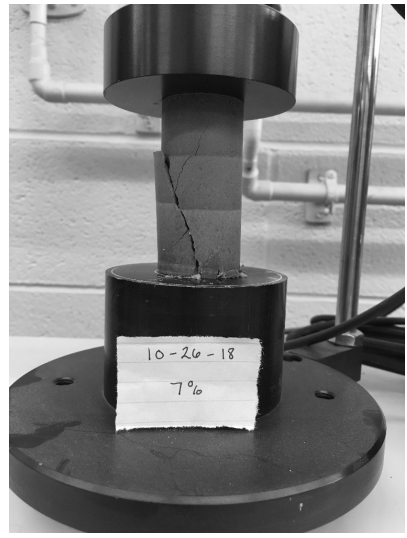

Figure 6. Typical Shear Failure.

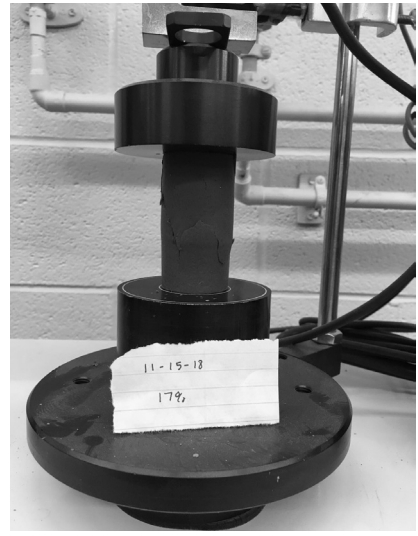

Figure 7. Typical Bulging Failure.

Thus, from this study, a W_C range between 11.2% to 15.2% was established where the two types of failures appear to change from brittle to ductile. In this W_C range, the dry unit weight is between 18.1 to 18.3 kN/m^3 (115.3 to 116.2 lb/ft^3). Another conclusion is that as the W_C increases the unconfined compression strength decreases, which is consistent with the observations of Molvic (1988).

Conclusions and Future Research

Two primary conclusions about loess soil behavior can be made based on the results of this study: (1) Loess exhibits brittle behavior at W_C less than 11.2% and dry unit weights less than 18.1 kN/m^3 (115.3 lb/ft^3). Ductile behavior was exhibited at W_C greater than 15.2% and dry unit weights greater than 18.3 kN/m^3 (116.2 lb/ft^3). (2) Specimens with brittle behavior exhibited higher unconfined compression strength values than specimens with ductile behavior. Therefore, specimens with lower W_C (less than 11.2%), yielded higher unconfined compression strengths than specimens of higher W_C (greater than 15.2%).

More testing will need to be conducted to add to the collection of data in order to develop an empirical equation that provides an estimate of unconfined compression strength with changes in water content and dry unit weight. From this research, different constraints have been identified, and different types of specimens, such as undisturbed specimens, will need to be tested in order to include in-situ natural conditions. These tests can be used to verify that the constraints encountered in this study do not affect the unconfined compression strength results. Undisturbed samples from the same field location where the loess were originally collected will need to be tested. Furthermore, these additional test results can confirm the accuracy of the Harvard Miniature Compaction apparatus, and if the results do not agree, then a correction for soil disturbance can possibly be introduced into the empirical equation. Once the undisturbed specimens have been tested, a critical W_C and/or dry unit weight value, where the transition from brittle to ductile behavior is located, can possibly be determined.

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Christopher Chattman

Enhanced Conductivity of Cu Foam via Graphene Deposition

Faculty Sponsors

Dr. Stephen Wayne & Dr. Jerry Marchetta

Abstract

Metallic foams hold promise as a class of materials to address challenging applications where increased surface area and/or reduced weight is needed. The presence of high-volume open cell porosity can reduce strength and thermal conductivity. In this study, high conductivity graphene was deposited onto copper foam with the goal of increasing electrical and thermal conductivity beyond that of pure copper. Immersing the Cu-foam into an alcohol solution of dispersed graphene was found to be an effective method that led to increased electrical conductivity; however, the conductivity was found to be dependent upon the number of immersion cycles. The bending stiffness of the foam specimens was also measured, and an increase of about 30% was attained for graphene-coated specimens. These findings indicate that graphene coated metallic foams may, for instance, become suitable materials for space applications where high conductivity, low weight and structural rigidity are needed.

Nomenclature

A	ampere for current
V	voltage
Ω	units for resistance, ohm
S/m	units for electrical conductivity, Siemens per meter
$g/cm3$	units for density
κ	thermal conductivity, W/mK
σ	electric conductivity
T	absolute temperature, K
e	carrier charge
L	Lorenz number
k_b	Boltzmann constant

Introduction

Metallic foams have found wide application as chemical filters, sensors, supercapacitors, lightweight structural panels and heat exchangers due in part to the large surface area created by interconnected porous structures. Commercially available foams made from aluminum or copper are readily available and can be sandwiched to form lightweight, stiff composite-clad metal plates. Metal foams have inherently high structural stiffness-to-mass ratio making them attractive materials for lightweight construction.[1] Bonding the foam between two dense metal sheets creates a composite sandwich material, whose properties depend on the bond strength and the foam and outer sheet metal properties. The result is a lightweight high-stiffness panel since the foam is much stiffer than an outer sheet of the same mass. The Ariane 5 rocket cone prototype demonstrated the use of aluminum foam sandwich material for aerospace applications.[1] Conceptually, such foam plates may be suitable for satellite applications where weight savings is a critical aspect of launch costs. Once in space, thermal management becomes a key factor. The ability of metallic foam panels to efficiently transfer heat

could open new possibilities for high performance cube satellites. CubeSats generate internal heat from power supplies and other surface mounted electronics, which must be rejected by conduction through body panels, that in turn, radiate the heat into deep space from outer panel surfaces. The present study is aimed at addressing the challenge of increasing the thermal conductivity of metallic foams with graphene, which has roughly an order of magnitude higher thermal conductivity when compared to other metals. The Wiedemann-Franz law[2] provides a direct relationship between the electrical conductivity and the thermal conductivity of metals which is shown in equation 1:

$$L=\kappa/(\sigma T) = (\pi^2/3)(k_b/e)^2 \approx 2.44*10^{-8}\ W\Omega/K^2 \qquad (1)$$

where κ is thermal conductivity, σ is electric conductivity, T is absolute temperature, e is a carrier charge (electron charge), L is known as the Lorenz number and k_b is the Boltzmann constant. Since the measurement of electrical conductivity/resistivity is straightforward, we use that as the basis for comparative measurements of graphene coated metal foam performance.

Numerous studies have evaluated the role of foam characteristics, such as size and number of pores, on electrical conductivity. Cuevas et al. studied the relationship between porosity and electrical conductivity in open and closed cell metal foams and found that both four-point probe and eddy current methods produced similar results for closed cell foams.[3] The relative conductivity of open cell foams measured by different authors was, however, quite different. In general, they identified that for a fixed porosity, a smaller pore size led to a lower electrical conductivity. Larger pore sizes led to a better-bonded structure, resulting in higher electrical conductivity. Dharmasena and Wadley studied the electrical conductivity of open-cell aluminum foam (commercially available as Duocel) and found that conductivity had a linear dependency on the relative density (porosity) ranging from 4-12%.[4] They used the four-point probe method and pointed out that the orientation of the unit cells with respect to current flow direction was random. Apparent electrical conductivities of Duocel aluminum foam ranged from 0.95 to 3.33x106 S/m for relative densities ranging from 0.04 to 0.12, respectively. Further model studies of aluminum foam thermal conductivity were carried out with fluid saturating the foam porosity. Boomsma and Poulikakos found that when the solid conductivity was markedly higher than the fluid, increases in the effective thermal conductivity were best made by manipulating the foam solid structure, which governed the thermal conductivity even at a very high porosity.[5] In the present research, the contribution of graphene is critical, and we have identified literature

concerning the electrical and thermal properties of flake, self-assembled and CVD 2D and 3D graphene structures. The thermal conductivity of partially suspended single-layer graphene was measured by Nika et al. and found to be in the range of ~3000-5000 W/mK, depending on the graphene flake size.[6] Others have isolated and studied the thermal conductivity of graphene flakes in comparison to bulk graphite. Nika et al.'s modeling efforts showed that the thermal conductivity of graphene grows with the increasing linear dimension of the graphene flakes and can exceed that of the basal planes of bulk graphite when the flake size is in the order of a few micrometers.

Their findings provide insight for applications such as lateral heat spreaders and interconnects for nanoelectronic circuits.[7] Electrospray printing of graphene oxide nanoflakes, at room temperature using a shadow mask, was used by Taylor and Velásquez-García to create low-cost gas sensors. This additive manufacturing approach deposited graphene oxide onto SiO2-coated Si substrates to create sensors for relative humidity and ammonia.[8] The assembly of graphite oxide single layers was studied by Cote, Kim and Huang, who found that stable monolayers could be obtained without the need for surfactants or stabilizing agents due to the strong electrostatic repulsion between the 2D confined layers.[9] They also reported that the graphite oxide monolayers could be chemically reduced to graphene for electronic applications. Graphene oxide self-assembly was studied by Putz et al. who described three proposed mechanisms for the formation of graphene oxide: (i) highly ordered layering, (ii) semi-ordered accumulation and (iii) disordered concentration. These were characterized by the ordered stacking of graphene oxide sheets, the formation of loose aggregate, or by forced alignment of the nanosheets.[10] The Ultrasonic assisted self-assembly of monolayer graphene oxide was studied by Chang in the production of field effect transistor (FET) devices for detection of E. coli bacteria.[11] The FET was fabricated by the self-assembly of graphene oxide sheets on the device electrodes, with sonication of the concentrated graphene oxide immersion solution. They found that their electrostatic self-assembly method, with assistance of sonication, formed stable, uniform devices over a large area without aggregation, whereas without sonication, they formed folded or multilayered graphene oxide films.

The creation of graphene composites and 3-D graphene structures have led to promising new material configurations with significant improvements in conductivity. Graphene foam composites have also been shown to be effective as electromagnetic interference (EMI) shielding for electronic applications by fabricating an ultralightweight, highly conductive graphene-polymer foam composite. Chen et al.'s graphene polymer-foam composite had a density of 0.06 g/cm3 and was very effective in EMI

shielding in the 30 MHz – 1.5 GHz frequency range far surpassing the best metals and carbon-based composite materials.[12] The thermal properties of an electrically conductive thermal interface material (a hybrid graphene with metal particle filler), was studied by Goyal and Balandin over the temperature range of 300 to 400 K. These authors found that the thermal conductivity of the composites was increased by 500% with a relatively small graphene loading of 5-vol%.[13] Advanced electronic applications for graphene foam have been studied by Dong et al., who synthesized a hybrid structure of zinc oxide (ZnO) on three-dimensional graphene foam for electrochemical sensors and supercapacitor applications.[14] These authors recognized that CVD-grown 3D graphene provides a highly conductive continuous network, and that hybridizing them with other functional nanomaterials would open new routes for the applications of graphene materials.

Wintterlin and Bocquet reviewed the literature pertaining to graphene on metal surfaces of Co, Ni, Ru, Pt and Pd with a focus on how the graphene layers interact with the metal. Their detailed analysis showed that there was great variability in the interaction of the graphene film with the underlying metals, which was not well understood. They identified interactions ranging from pure physisorption to a relatively strong chemisorption, with Cu, Ag and Au interacting weakly.[15] Tynan et al. studied the synthesis of 3D metal graphene foams using a soft template procedure, a 4-step process whereby a metal/dextran gel is annealed to form a metal oxide foam, then exposed to methane chemical vapor deposition (CVD), producing a metal graphene foam which is then washed in acid resulting in graphene foam. Graphene sheets of various thickness and layers were realized.[16] Chen et al., employing a template directed CVD process, accomplished the direct synthesis of three-dimensional foam-like graphene macrostructures. The 3D foam consists of an interconnected flexible network of graphene that serves as the fast transport channel of charge carriers for high electrical conductivity.[17] Nine et al. describe graphene interlayer interactions and molecular bonds, which are principally responsible for initiating self-assembly of graphene sheets and creating complex structures with one-, two- and three-dimensional morphologies. Numerous self-assembly methods and self-assembled superstructures including fibers, thin films, spheres, crumpled particles, aerogel/hydrogels and honeycomb are discussed.[18] The significance of self-assembly is in producing a conductive layer, or path, allowing for easy heat transfer between, for instance, the inside of a cube satellite to the outside space environment.

The current study had the goal of improving electrical and thermal conductivity of Cu-metal foam (thru the Wiedemann-Franz law) by using graphene to infiltrate and coat the Cu-foam porous structure. Simple

immersion techniques were employed to accomplish graphene deposition onto Cu-foam with the intent of demonstrating a scalable, low-cost and easy-to-implement method. The results are organized by microscopic inspection of the coated and uncoated Cu-foam specimens, their electrical conductivities, and their mechanical stiffness.

Materials and Methods

The materials used in the study were commercially obtained open-cell copper foam and highly conductive graphene, whose composition and physical properties are listed in Table 1.

Material	Composition Wt. %	Thermal Conductivity W/mK	Density g/cm^3
Cu foam	99.90% Cu	-	0.413
Graphene	C > 98%	3,000 - 5,000 *	0.03 - 0.1 **

Table 1. Composition and measured properties for copper specimens used in the study. * indicates single layer graphene,[19] ** indicates graphene nanoplatelets.[20]

Specimens were prepared for measuring electrical conductivity and resistivity according to ASTM standards using a Lavolta DC power supply and a Fluke 115 multimeter. Due to limited availability of Cu-foam material the specimen geometry used was 90 mm x 10 mm x 1.6 mm. The four-point method was used in measuring the resistivity of the foam.[21] By varying the current on the power supply, voltage measurements were taken to determine resistance, then resistivity and conductivity. Thermocouples were used to monitor the temperatures of the specimens before and after testing to ensure they were at room temperature 293 K (68°F). For all Cu-foam specimens, the multimeter was placed in three different positions along the length of the foam, as indicated in Fig. 1. The initial position had the multimeter probes 1 cm apart from each other and 4 cm from the ends of the foam specimen. The spacing between the multimeter probes was held constant while shifting to the left and right 0.5 cm from the initial position taking measurements in three different locations to determine resistivity. One important aspect of this method is that one must maintain the horizontal and vertical displacements or else the voltage across the foam specimen may vary. The uncoated foam measurements became benchmarks for the coated specimen.

No.	Area	Perimeter	Max Diameter
1	2635.5960μm²	333.2247μm	100.8023μm
2	921.7183μm²	183.2679μm	52.9355μm
3	2805.8733μm²	491.3442μm	117.0308μm
4	2106.2558μm²	411.3908μm	111.6071μm
5	19774.3735μm²	1800.1844μm	313.7672μm
6	1410.4300μm²	235.3520μm	71.6019μm

No.	Area	Perimeter	Max Diameter
Average	4620.7319μm²	576.8414μm	134.0618μm
Standard Deviation	6685.1512μm²	664.4587μm	99.6457μm
Max	46755.9175μm²	5201.9388μm	565.0364μm
Min	740.3360μm²	132.3109μm	41.1299μm
Total	1437047.6232μm²	179397.6905μm	41693.2202μm

Total Area	1437047.6232μm²
Total Region Area	7107225.2142μm²
Area Ratio	20.2195%
Count	311 pcs

Figure 3b. Quantitative analysis of graphene by image contrast data, sub-evap specimen.

The immersion methods showed changes in conductivity; an increase of 3-13% in conductivity for the dipped specimen and an even higher increase when comparing the sub-evap results. The three measured positions are labeled as P1, P2, and P3 for the coated foam specimens. These were compared with the same three positions on an uncoated specimen. Table 2 presents the changes in the electrical conductivity with P3 having the greatest change for the dipped specimen and P2 for the sub-evap. The increased conductivity of the sub-evap specimen is attributed to the larger amount of deposited graphene. As coverage increased, so did the conductivity. The values obtained from all measurements are an average of 14 data points across three trials. Based on the data shown for dipped specimens, there is no apparent benefit for increasing the number of dips from 10 to 20.

	P1	P2	P3
Uncoated	19.9 ± 0.10	25.0 ± 0.10	25.0 ± 0.10
10 Dips	21.0 ± 0.17	26.2 ± 0.09	28.3 ± 0.12
20 Dips	20.8 ± 0.18	26.2 ± 0.11	27.9 ± 0.11
Sub-Evap	29.0 ± 0.49	50.7 ± 0.58	48.2 ± 0.57

Table 2. Electrical conductivity (S/m x 103) before and after dipping and immersion.

The sub-evap specimen results showed an increase in the stiffness of the foam, as compared to the uncoated specimens (Fig. 4). The slope of each line was taken to find modulus of elasticity, E, which is a measure of the material stiffness. The slopes were calculated to be 0.655 GPa for the uncoated and 0.858 GPa for the coated specimen. The bending stiffness of sub-evap specimen was in the order of 30% higher than the uncoated Cu-foam, no doubt a direct consequence of the graphene deposition.

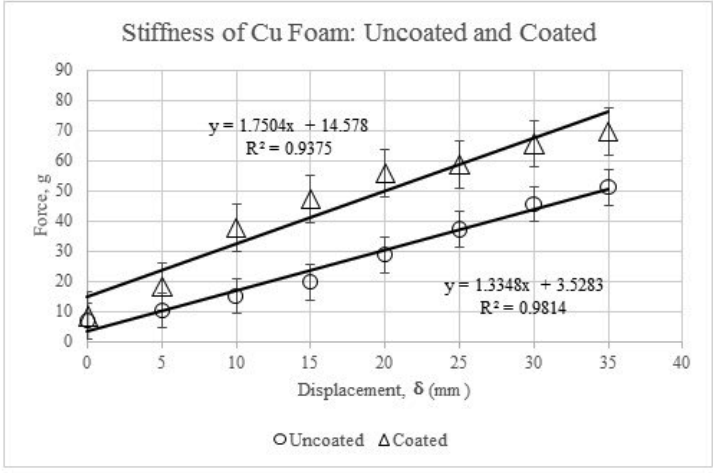

Figure 4. Plot of stiffness improvement after graphene deposition.

The trend lines in Fig. 4 are shown to have high R2 values meaning the stiffness curves are a good fit to the data. After 20 mm of displacement, some variation in bending force was observed for the sub-evap specimen and attributed to plastic deformation. Bending the coated specimen, the full

35 mm ensured permanent deformation and caused some graphene to flake off in regions where the highest bending stress occurred. While not shown, the stiffness measurements of the 10 and 20 dip cycled specimens were found to be equivalent to the uncoated specimen results shown in Fig. 4.

The calculated thermal conductivities (with respect to P2 from Table 2) were; 0.179 W/mK for the uncoated specimen, 0.187 W/mK for the 10 and 20 dips, and 0.362 W/mK for the sub-evap specimen. Based on these findings, the thermal conductivity of the sub-evap specimen was determined to be nearly twice that of uncoated Cu-foam.

Discussion

The goal of this study was to improve the electrical and thermal conductivity of Cu-metal foam by using high conductivity graphene to infiltrate and coat the Cu-foam porous structure. The graphene coating process chosen was economical and simple to execute by dipping the Cu-foam into a solution of ethanol with a graphene concentration of 5% by weight. This method led to variations in conductivity due to nonuniform graphene film deposition and is likely not the most optimal technique. More uniform coatings have been observed by CVD methods[14]. In order to achieve a highly conductive film of graphene, a high degree of graphene self-assembly is needed; there are a number of known alternative deposition techniques[17],[18]. Our coating method was shown to be capable of achieving ~80% coverage of the Cu-foam and that resulted in as much as a 50% increase in electrical conductivity as compared to uncoated foam, using our specific measuring techniques. The ability to measure thermal conductivity was not available at the time of this research and is considered an important measurement to understand the temperature sensitivity of the graphene coating. The possibility of improving the foam conductivity increases with full coverage and complete self-assembly of the graphene, so there is room for further improvement. In service, the Cu foam must have sufficient mechanical properties to be useful in electronic assemblies and to some degree also as a structural material. The bending stiffness of the graphene coated Cu foam was measured and shown to increase by 30% beyond that of uncoated material. This increase in modulus will translate to increased durability when handled and assembled into products. There is a great opportunity to create new high performance metallic foams through the integration of tailored coatings that, when combined, offer unique material properties for many engineering applications.

Conclusion

The electrical conductivity of pure copper foam and graphene-coated copper foam has been evaluated. It was found, by simple immersion of the copper foam into a sonicated solution of graphene flakes, that an adherent graphene film was deposited onto the copper foam. This resulted in an increase in electrical conductivity. The conductivity was found to be dependent upon the number of immersion cycles. Microscopic observations revealed that early in the dipping sequence, the electrically conductive network of graphene was established. A 22.5% increase in density was obtained and attributed to the filling of voids by graphene, resulting in a density of 0.506 g/cm3. This level of graphene infiltration also led to an increase in bending stiffness of about 30% for submersion-evaporated graphene coated specimens. These findings have shown that increases in electrical and thermal conductivity are possible by simple immersion deposition of graphene onto Cu-foam. These improvements offer promise for the future development of graphene coated metal foams as suitable materials for space applications where high conductivity and low weight are needed.

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John Dennis

On Absurdism

Faculty Sponsors

Dr. Kas Saghafi & Dr. Amit Sen

Abstract

This project will seek to broaden and elucidate Camus' concept of the absurd as presented in The Myth of Sisyphus, with the thesis being that, as given, it is too abstract and cursory to adequately rest on the conclusions that Camus has made. This task will be conducted in three main sections. The first will focus on the initial descent and transition into absurdity by analyzing the phenomena and psychology within Franz Kafka's The Metamorphosis. The second will focus on the nature of immediacy in absurd aesthetics and ethics, using Don Juan as the subject. The third will argue in defense of Sisyphus' heroic status and elaborate more on the motions of revolt and happiness in a fate with little to no possibility.

Introduction

Absurdism in Abstract

Albert Camus begins his definitive work, *The Myth of Sisyphus*, with these bold sentiments: "There is only one really serious philosophical question, and that is suicide. Deciding whether or not life is worth living is to answer the fundamental question in philosophy. All other questions follow from that" (Camus, p. 5). From this philosophical question arises the core subject of this project: philosophical absurdism. The basic formulation for absurdity provided in *Sisyphus* is when man's natural insistence for meaning in life is confronted with an irrational universe that either has no answer or does not offer one. Predecessors of Camus had already tried to answer this dilemma, as Kierkegaard did with his "leap of faith" and phenomenologists like Husserl did in proposing that meaning could be established through phenomenological hermeneutics. Camus rejected these answers as philosophical "suicide", or at least as incompatible with the absurdity he envisioned. What he proposed instead was a conscious revolt against a silent universe, lucidity toward one's own finitude, and a will to experience happiness in a sundry life rather than a secure one. Camus wanted to demonstrate to existential vagabonds facing the shadow of 20th century nihilism that life did not need meaning to be worth living, just something meaningful.

With that said, my thesis is that Camus' *Sisyphus* ultimately falls short as a satisfactory inquiry into the absurd in two ways. First, while Camus provides a solid foundation in explaining fundamentally what the absurd is and is not, he does not thoroughly enough define and categorize several of its identifiable features in a cohesive manner that adequately bridges them to his claimed resolution. These shortcomings are found most pronounced in three of the work's key figures: Gregor Samsa (*The Metamorphosis*), discussed in only a few sentences, Don Juan in five pages, and Sisyphus himself in only four pages. The issue is that these figures are introduced but are not illustrated through a narrative lens that demonstrates their absurd progression and experiences. This highlights a second shortcoming, which is the inaccessibility of the absurd to the common man and the undoubtedly shaky resolution of happiness at the work's end.[1] If the decision of suicide is the paramount philosophical question, and absurdity is indeed the actuality of life, as Camus asserts them both to be, then this decision requires an equally paramount philosophical response. That is, can one proclaim wholeheartedly that life is indeed worth living and suicide is not the answer that man seeks? More importantly, this answer must be one that the common man facing the threat of nihilism, the audience Camus was fundamentally writing to, can grasp and apply to their own lives.

Despite these shortcomings, the mission of this project is *not* to critique Camus' *Sisyphus*. I do not argue that Camus' understanding of the absurd or its conclusion are so much wrong as they are abstract and incomplete. It is also not the mission of this project to somehow complete Camus' work or offer an exhaustive account or understanding of the absurd. It is simply to better categorize and synthesize its concepts, as well as expand upon them with interpretations and concepts that I argue are consistent with Camus' vision. My hopes in doing so are likewise twofold: to encourage richer discourse of the absurd at the academic level and provide a better sense of what it means to live absurdly, if that is possible, at the personal level.

This article is divided into three sections. The first will focus on absurd existence within the narrative of Franz Kafka's *The Metamorphosis*. It will seek to better illustrate and categorize absurd phenomenology, psychology and, more broadly, what it looks like "to be" in absurdity. It will attempt to wrestle with the unique nature of the absurd itself, the Elusive Unknown, as well as how it operates and evades our understanding. The second will focus on qualities and characteristics of a flourishing absurd man, using Don Juan as the subject. It will discuss various aesthetic features of absurdism, such as immediacy, and tackle the absurd man's integrity-based ethics, contrasting them with that of conventional rational ethics. The purpose of this is to dispel notions of the absurd man somehow being nihilistic, which Camus fiercely opposed. The third section will focus on absurd revolt, discussing the significance of heroism and triumph for Sisyphus. Moreover, it will seek to elucidate what makes achieving happiness and mastering one's fate possible even in such seemingly hopeless circumstances.

The Metamorphosis: An Absurd Existence

Absurd Phenomena

In congruence with *Sisyphus*, I have deduced three fundamental modes of absurd phenomena in *The Metamorphosis*: exile, strangeness, and tranquility. Exile is the immediate loss of or distancing from one's familiarity, rationality, and harmony with the world. This exile breeds strangeness, the pervading mood of bewilderment and existential dizziness caused by one's sense of

[1] "I leave Sisyphus at the foot of the mountain...He, too, concludes that all is well…The struggle itself towards the heights is enough to fill a man's heart. One must imagine Sisyphus happy." (Camus, p. 89)

self and belonging conflicting with an alien world.[2] If people manage to endure strangeness and acknowledge the futility of their circumstance, what follows is tranquility, that which fosters spiritual stillness and functionality. Though I have found these phenomena tend to manifest linearly in stages, this is not always necessarily always the case.

The story opens with Gregor Samsa awaking to discover that he has transformed into a giant insect with no rational explanation. Before today, Gregor projected himself into the world as a diligent businessman and devoted son and brother, a state that he and others could acknowledge harmonized and belonged with theirs. Gregor does not immediately bemoan his freakish condition but rather the prospect of being late for work. This initial response represents Gregor's resistance to his predicament. He desperately tries to apply reason to this irrational anomaly because arriving promptly for work is not only what Gregor *must* do, but all that he knows *how* to do. This obliviousness or clinging to the familiar is the first manifestation of Gregor's exile.

Gregor becomes bemused by the awkward legs and jaws he has acquired. They resemble nothing of the skin and quadrupedal frame he has always known and grown in, yet that still move under his human will. Gregor's mother asks if he is well at the door, and though the words forming his response are his own, the voice that utters these words is like that of a stranger.[3] This surreal, alienating inability to project his familiar self is the second manifestation of Gregor's exile. His thoughts up to this point could be surmised as, "I have these ideas of how I belong and project this belonging into the world for others to acknowledge. My former understanding of what this means no longer aligns with the world around me and thus my attachment to it falls into ambiguity." This initiates a transition from exile to strangeness, wherein Gregor becomes not only a stranger to his kin but also to himself.

The thought that Gregor could ever be sick is inconceivable to his family. Gregor's father announces that "there must be something wrong with him" while his mother remarks that his voice is like "that of an animal." His sister cries in her room while one of Gregor's coworkers arrives and suggests that Gregor is trying to "make fools of them." His family's objections here are not presented normatively but descriptively. It is not that "Gregor ought to go to work", but rather, "Our Gregor could not *not* go to work." However, their Gregor has become projectionally imprisoned while this new, "not-Gregor" materializes and assumes the former's place. Even before the family sees the monster, their irrational hysteria already conveys an awareness that something has assailed their idea of Gregor. This functions as the first

manifestation of the transition from exile to strangeness that involves other parties.

Gregor finally struggles to open the door and is not met with concern for his wellbeing by his family, as one would expect, but only terror. An existential struggle arises between both parties. The family must figure out how they are to acknowledge this revolting creature dwelling in Gregor's room, which in no way matches their Gregor's existential frequency. His family is not ultimately distressed because they believe Gregor *is* a giant roach, but rather that a giant roach has assumed Gregor's *place* in the world, sending their Gregor off into the ether. Likewise, Gregor must discover how he is to acknowledge himself and address the hostile strangers before him, who now only appear like his once-loving family.

Gregor's sister, Grete, leaves a bowl of sweetened milk inside Gregor's room, remembering it was his favorite drink. Gregor is initially thrilled, but upon drinking it exclaims that the milk "did not taste at all nice" and turns away from the dish "almost against his own will." Grete's kindly gesture is much akin to one who brings something warm and familiar to a sick loved one. It is with great hope and confidence that one believes such a personal gesture will help "bring them back to their old selves." This signifies the family's subsequent resistance to the exile and strangeness pervading their home. They treat the matter as if Gregor were still present and simply lost in the strange ether waiting to be found again. This is evident when Gregor's mother hesitates in helping Grete when the latter proposes to move all the furniture out of Gregor's room.[4]

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[2] "…in a universe suddenly divested with illusions and lights, man feels an alien, a stranger. His exile is without remedy since he is deprived of the memory of a lost home or the hope of a promised land. This divorce between man and his life, the actor and his setting, is properly the feeling of the absurdity." (Camus, p. 7)

[3] "The discomfort in the face of man's own inhumanity, this incalculable rumble before the image of what we are, this 'nausea', as a writer calls it, is also the absurd. Likewise the stranger who at certain seconds comes to meet us in a mirror, the familiar and yet alarming brother we encounter in our own photos is also the absurd." (Camus, p. 13)

[4] "…and by taking the furniture away, won't it seem like we're abandoning him to cope for himself? I think it'd be best to leave the room exactly the way it was before so that when Gregor comes back to us again he'll find everything unchanged and he'll be able to forget the time in between all the easier." (Kafka, p. 27)

Grete brings Gregor various foods to try, of which only the half-rotten leftovers from family dinners bring him delight. This is the first manifestation of Gregor's transition into tranquility which, while strange, is done effortlessly, as Camus puts it.[5] Gregor contemplates that people do not eat rotten food, which is a human thought, and yet is eating and enjoying rotten food anyway, as if he were something not human. He realizes that if he is to have any self-actualization at all, he must live in a way that is natural to him, namely in accord with his newfound beastly thoughts and desires. However, it should be noted that a new familiarity does not replace the old, as the absurd does not allow for one to reclaim this old mode of rationality. It is simply spiritual stillness and functionality, the two main components to tranquility as previously mentioned.

Absurd phenomena affect not only people, but places and things. Even after a month, Gregor notes that Grete's expressions are still of those of one entering the room of "someone seriously ill or even of a stranger" who would "bite her." This creates a dramatic shift in how both sides engage with and are conscious of one another. Adopting a new self-awareness as being burdensome and monstrous, Gregor hides under the furniture in his room to spare his sister from his appearance. This tension permeates into the rest of the household as well, with Gregor perceiving that their once warm and lively home has debased into a cold and silent house. Family dinners, in which Gregor can no longer participate, are filled only with gossip and frustrations about Gregor. These utterances mellow in the atmosphere and push Gregor, literally and metaphorically, deeper into his shell. While Gregor's room and all its contents are just as they were before, they now make him feel "uneasy." He can no longer use his writing desk for work or his bed to sleep as he always did, but now prefers to stick and scurry around on the ceiling, remarking that it feels more natural and easier to breathe. These former artifacts of order, purpose and familiarity now only further estrange Gregor in his current state. Inching closer toward a complete tranquility, the physical and mental death of old Gregor has been sealed, leaving only the idea tethering the Gregor of old to actuality.

Over time, the abstract hopes and memories of Gregor are soon absorbed by his sister Grete, who adopts an existential duality of a sort for the family. Meanwhile, Gregor's room is soon cleared of all its contents, which initially delights his now-animalized mind. With the taking of his prized possession, a painting of a woman in a fur coat, one last spark of his humanity is lit in protest. Gregor escapes from his room to retrieve the painting and inadvertently sends his mother into shock. This prompts Grete to address Gregor by name for the first and only time since his transformation. It is as if in uttering this aloud, the family can finally acknowledge what has long

been repressed: there is no hope of their Gregor returning. Gregor's family can no longer project their memories "brother and son" onto him but only their scorn as "beast and burden." [6] The idea of Gregor dies, and the idea of the monster has been fully realized in the former's place.

The Elusive Unknown and the Nature of the Universe

To better grasp the Elusive Unknown, the name I have given to the absurd's peculiar nature, two potential misunderstandings must first be dispelled. The first is that the absurd is an inversion of order, in which acts of chaos are favored. The second is simply that the absurd is entirely random. To assert that the absurd is a bizarre world, wherein living destructively is rewarded while living properly is punished, still establishes a degree of understanding and familiarity.[7] If the absurd man were able to recognize some universal law that dictated that chaos necessarily produced an enriching life, this would still offer a rationale for him to follow that Camus would not allow. This is not to say Camus would advise against pragmatic thinking. It simply means that no rationale can be fully rested upon by anyone because the Elusive Unknown always escapes human understanding without prejudice.

On the other hand, to suggest that the absurd is simply random is to reduce the great feeling of bewilderment and estrangement to the knowable that it brings, equally misrepresenting Camus' vision. If the absurd man were able to learn the universe was merely the product of a series of chances and accidents, there would be nothing else to evade his understanding. One can come to terms with randomness and make the most of it. This is not to say that there is a universal order, or chaos, or even that God does or does not exist, just that it is unknowable. Camus notes that the absurd almost

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[5] "Metamorphosis, in turn, certainly represents the horrible imagery of an ethic lucidity. But it is also the product of that incalculable amazement man feels at being conscious of the beast he becomes effortlessly." (Camus, p. 91-92)

[6] "'It's got to go,' shouted his sister, "that's the only way, Father. You've got to get rid of the idea that that's Gregor. We've only harmed ourselves for believing it so long. How can that be Gregor? If it were Gregor he would have seen long ago that it's not possible for human beings to live with an animal like that and he would have gone of his own free will…As it is this animal is persecuting us, it's driven out our tenants, it obviously wants to take over the whole flat and force us to sleep on the streets." (Kafka, p. 40)

[7] "A world that can be explained even with bad reason is a familiar world." (Camus, p. 7)

demands with it a certain agnosticism that is difficult to pinpoint.[8] What we are left with is an incomprehensible phantom, an outline of something constantly evading the absurd man's hunger for truth and clarity. The Elusive Unknown need not be a literal force or entity,[9] as even in being symbolic of our alienation from the universe it manifests the same way to us all the same.

To illustrate this, let us return to *the Metamorphosis* and ask this underlying question: Why does Gregor Samsa wake up a giant bug? To us, Gregor's transformation is undoubtedly a hyperbolic, preposterous event, even within its fictitious framework. Yet the strange and surreal feelings that accompany the story mirror our own feelings when life sends a devastating, albeit much less bizarre, misfortune our way. The absurd man experiencing such feelings will always be barraged with the same burning questions: What is happening? Why is it happening? Who is doing this, how are they doing it? Gregor could forever contemplate whether his misfortune was a mathematically inconceivable mutation or rearrangement of molecules, part of a simulation that he has unknowingly been living, or even a cosmic trick played by Loki, the Norse god of trickery. But it ultimately makes no difference which of these scenarios is the case because they are all equally out of Gregor's reach. Gregor will never know if there was any greater significance to his awaking as a beetle, or if he could have awoken as anything just as grotesque and debilitating while reaching the same outcome.

We are likewise given no indication that Gregor has committed some great atrocity to warrant this twisted fate, as he selflessly devoted himself to his work and family. Though it is often the case that an upright person, through their naïveté or poor timing, can end up in horrible circumstances, there is no textual indication for this scenario either. As we are creatures dispositioned and cultivated to demand meaning and order, the absurd man is left saying, "there must be a why." But in the absurd, order and meaning can appear to be whatever the Elusive Unknown allows. Genuine love and earnestness can manifest as vileness and aggression, such as is the case with Gregor to his family.[10] In the span of just a few months, Gregor has gone from son to alien to animal to monster and finally to scapegoat for all the Samsa family's sins and angst. He is a martyr but of something he will never know.

When Gregor dies, all is well again with the Samsa family and his memory fades into obscurity, leaving no one to tell his side of the story. It is not ultimately the events that transpired that utterly unsettle us, but the manner in which they concluded when we expected some sense of resolve to appear. This is the proper feeling of the absurd. What then is to be said of the nature of the Elusive Unknown, be it God or some phantom idea manifesting solely in our thoughts and emotions? All that can be said is that

it is utterly creative. It is creative in its seemingly infinite ways of tricking human understanding. It plays the role of the performer that, just when we believed we've figured out how the last act will play out, rewrites the ending to include yet another final act.

Don Juan: The Absurd Man

Absurd Aesthetics

The absurd may be void of attainable order and meaning, but it is far from being void of attainable gratification. Should those seeds of tranquility take root and endure the absurd's initial, cruel strangeness, they blossom into a new mode of experiencing beauty. The absurd man is controlled by the absurd insofar as he holds onto the nostalgia for his previous existence. But if he can manage to kill his nostalgia, the world becomes his. As is the case with Don Juan, an ideal of an absurd character that very few people could realistically attain, while also being the quintessential aesthetic subject. Just as with the Elusive Unknown, absurd aesthetics do not manifest as any one thing. What is significant of Don Juan is not so much what he does or why he does it (this just so happens to be seducing), but rather *how* he does so.

Arguably the most important feature of absurd aesthetics is immediacy. Immediacy interests itself with neither the past nor the future, only the present. The past can be regarded as nostalgic harmony or binding regret that the absurd man has since abandoned, while the future can be regarded as hope or fear that the absurd man has likewise rebuked. Each present life contains within it a myriad of possible experiences for new thoughts, moods and sensations that kindle the flame of human desire and sensuality. Every present life inevitably becomes past and is discarded to never be reflected

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[8] "I did not say 'excludes God', which would still amount to asserting." (Camus, p. 31)

[9] "…it is an insistence upon familiarity, an appetite for clarity. Understanding the world for a man is reducing it to the human, stamping it with his seal…If man realized that the universe like him can love and suffer, he would be reconciled." (Camus, p. 15)

[10] "'Father, Mother,' said his sister, hitting the table with her hand as introduction, "we can't carry on like this. Maybe you can't see it, but I can. I don't want to call this monster my brother, all I can say is: we have to try and get rid of it. We've done all that's humanly possible to look after it and be patient, I don't think anyone could accuse us of doing anything wrong." (Kafka, p. 39)

upon again. Likewise, the future present life is not considered because it only becomes of interest when it enters the immediate.

Another crucial aspect of immediacy and absurd aesthetics is that it prioritizes quantity and novelty of experiences rather than security and sentiment. Don Juan has seduced over a thousand women across Europe, but he does not do this to fill an emotional void or to reach some arbitrary milestone.[11] The number itself is not tracked to serve any higher purpose. Don Juan seduces because to do otherwise would not be in accord with his absurd nature. The girls he seduces are not ultimately what excites him, but the act of seduction itself. This is why he never loves the same woman twice.[12] Each motion of the seduction falling effortlessly into place is like that of an improvised melody, following certain intuitions but never with total predictability. Whether he moves this way or says that, he is certain of his success. This is because Don Juan overflows with an essence analogous to the ancient Greek understanding of charisma, wherein one is blessed by the gods with all their charms, attractiveness and creativity. In this, he possesses a sense of wholeness in himself that is divine and renders him irresistible to any woman in his path. The absurd man likewise becomes an expeditious artist with his particular craft, creating fine piece after fine piece but never pausing to reflect on or revisit one. To return to something of old implies nostalgic longing which the absurd man must give up in order to aesthetically thrive. Moreover, to premeditatively craft something for the future implies a hope for something which is outside the absurd man: his immediate world.

One useful method of understanding absurd aesthetics is by contrasting them with those of the absurd man's opposite, the rational and nostalgic man of old. The nostalgic man tends to build up big experiences and preserve them sentimentally. They are precious, one of a kind and part of his internal makeup. The absurd man, in contrast, breaks down experiences and indulges them to the finest sensual detail. To him, nothing is so precious that one ought to immortalize it, instead preferring to experience something new and thrilling. The fatal toxin for the absurd aesthete is boredom, caused by the same safe and sentimental repetitions that the nostalgic man both lives and dies by. Yet one such as Don Juan also lives by repetition, seducing women as if it were like breathing for him. There is an almost paradoxical nature to his seduction: even before he finishes loving one woman, his spirit has already fleeted to the next he can seduce. Each new woman is a particular, and while the art of his seduction may be unique each time, it is always drawn toward the universal feminine. The absurd man may have his preferences, but his tastes must never impede him from trying new flavors, so long as they be pleasing to him.

The nostalgic man desires "one of many" while the absurd man desires "many ones." [13] The nostalgic man fundamentally seeks stability. When he meets the woman he wishes to love, he is crippled by uncertainty of whether or not that wish will be reciprocated. If it is not, he is heartbroken because he had already hoped for a future with her in his heart. If it is, he is still crippled by fear of losing that one precious love, so he fights restlessly to preserve it. She is the whole of all her dear sums and never narrowed down into any one feature. She has all the potential to be a synthesis of friend, partner, mother, etc. which such a man longs for with a meaningful union. He seeks the right thing, at the right place, at the right time in accordance to his rationale and virtues. For Don Juan, the right place and time is always in the present. He is crippled by nothing because he places his bets not on any one person or thing but on life as a whole. It is that very uncertainty that strikes fear into the heart of the nostalgic man that fuels the appetite for experience in Don Juan and the absurd man alike.

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[11] "It is not through lack of love that Don Juan goes from woman to woman. It is ridiculous to represent him as mystic in a quest of total love. But it is indeed because he loves them with the same passion and each time with his whole self that he must repeat his gift and his profound quest. Whence each woman hopes to give him what no one has ever given him. Each time they are utterly wrong and merely manage to make him feel the need of that repetition…Why should it be essential to love rarely in order to love much." (Camus, p. 51)

[12] "As for satiety, Don Juan insists upon it, on the contrary. If he leaves a woman it is not because he has ceased to desire her. A beautiful woman is always desirable. But he desires another, and no, this is not the same thing." (Camus, p. 52)

[13] "What Don Juan realizes in action is an ethic of quantity, whereas the saint on the contrary tends towards quality. Not to believe in the profound meaning of things belongs to the absurd man." (Camus, p. 53)

Absurd Ethics

The particular set of ethics that accompany the absurd man are rooted in his own intuitions and integrity, rather than any conventional moral conviction or traditions. These are important to establish because they combat the notion that the absurd man is immoral, thus adhering to nihilism. Concerning Don Juan, his seductions are not to be viewed as malicious or reckless because they are done with neither motive nor all-consuming appetite. He follows his absurd instincts to fruition and possesses those whom he loves for a short time but continues no further. It is a sincere love, to be sure, but not one that is given to last. The moral realist, one of the absurd's most tenacious critics, would accuse the absurd man of being a nihilist for adhering to such a capricious lifestyle. I believe it is of great importance to Camus' project that the absurd man be firmly established as a uniquely amoral ideal who can still adhere to integrity without harboring rational moral sentiments.

As the absurd man's art can manifest through a multitude of crafts, the moral realist may ask what would happen if the absurd man's affection was for killing. Firstly, the absurd does not beckon the absurd man to act in whatever manner he pleases. Camus states that he must simply learn to act as if moral convictions were pointless and discern the consequences for which his absurd freedom cannot pay the price.[14] If one were to take up killing as a craft, the act would seem to fall into either one of two archetypes that exist outside of the absurd: the tyrant and the madman. The tyrant seeks to seize power but is afraid of losing if he achieves it. He is often one who has been wounded and seeks to harm others either to exact revenge or absolve pain. The tyrant is lucid to the destruction he creates but does not consider the consequences of his tirades. Returning to Don Juan, he is not a tyrant because he never fears losing what he desires. He does not need to seize his lovers because they desire him, and he only seeks to possesses each one for a night. Don Juan has not been harmed and so does not seduce out of emptiness or melancholy; he seduces with joy.[15] Of those whom he seduces, Don Juan does not desire their everything, as to destroy or own them. He simply desires a small piece of them, that being their unique feminine experience in the moment.

The other archetype, the madman, would enjoy killing for killing's sake. He dehumanizes his victims because they are his trophies and seizes what makes their individuality possible at all: that being their freedom to choose. Unlike the tyrant, the madman is not lucid to his actions. He has slipped out of the absurd actuality in favor of his own, either because he can not bear the crushing reality of the actual absurd or because he simply favored his own. For Don Juan, his absurd craft does not amount to "collecting", as Camus

would label it[16]. Don Juan *does* love each and every lover he seduces, but he does not leave them in ruin when his sensual spirit calls him to another. Most importantly, Don Juan is lucid of the existence he lives, longing only for the infinite of this life and not the one beyond.[17] The absurd man cannot flourish in killing because, if he were lucid and tyrannical, he would realize enough killing would result in a life of always looking over your shoulder, such a life that offers no room for flourishing. If he were mad and unlucid, then he would have already failed one of Camus' unbreakable doctrines: the absurd man must be aware of the absurd reality at every corner.

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[14] "The absurd does not liberate; it binds. It does not authorize all actions. Everything is permitted does not mean that nothing is forbidden… All systems of morality are based on the idea that an action has consequences that legitimatize or cancel it. A mind imbued with the absurd merely judges that those consequences must be considered calmly. It is ready to pay up. In other words, there may be responsible persons but there are no guilty ones, in its opinion." (Camus, p. 50)

[15] "Is Don Juan melancholy? This is not likely. That laugh, the conquering insolence, that playfulness and love of the theatre are all clear and joyous. Every healthy creature tends to multiply himself. So it is with Don Juan. But furthermore melancholy people have two reasons for being so: they don't know or they hope. Don Juan knows and does not hope." (Camus, p. 51-52)

[16] "The absurd man is he who is not apart from time. Don Juan does not think of 'collecting' women. He exhausts their number and with them his chances of life. 'Collecting' amounts to being capable of living off one's past. But he rejects regret, that other form of hope. He is incapable of looking at portraits." (Camus, p. 53)

[17] "For nothing is vanity to him except the hope of another life. He proves this because he gambles that other life against heaven itself. Longing for desire killed by satisfaction, that commonplace of the important man, does not belong to him." (Camus, p.52)

Sisyphus: An Absurd Revolt

Of Heroes and Happiness

By the end of his four-page chapter on Sisyphus, Camus has already given us his rationale for what makes Sisyphus the absurd hero[18] and the beneficiary of happiness he allegedly is. It is from these passages where a plethora of questions arise. Indeed, we are given visuals of what Sisyphus' happiness *is*, but not told how it is possible that he *could* be happy? What *makes* him victorious, when by all appearances he seems to have lost as badly as one could lose? It requires little deliberation for us to find ourselves wrestling with the puzzling logic of these notions. If the absurd is truly a prescriptive philosophy these kinds of details are imperative. What does it look like to be a hero? Is this label truly of any higher significance, or is it truly different from being simply an absurd man? Finally, what does this all mean for, not the conceptual absurd man, but the absurd man of reality? As stated during the introduction, I have neither intentions nor expectations of exhaustively answering such questions to the level of satisfaction that I had hoped from Camus. I merely wish to build off the very special foundation that he laid for existential vagabonds to try and find their way.

I will begin the inquiry with this notion of "hero." Disciplines ranging from mythology and psychology to literature and even pop culture each seem to possess their own distinct conception of how a hero is defined. As I do not wish to belabor this point and divert the focus of this section, I will offer a general definition of heroism that should comfortably fit within virtually any preexisting one: An individual who is elevated into the extraordinary in order to combat an adversary toward some goal, and who inspires a sense of awe and wonder in the ordinary majority. Thus, one might define the absurd hero as, "one who embraces the absurd to combat the Elusive Unknown toward the goal of flourishing, which mystifies and inspires the rational and nostalgic majority." Concerning the distinction between the absurd man and the absurd hero, I would say that it is simply a matter of having fully realized the extent of one's absurdity and having reached absurd self-actualization. Thus, Don Juan, in addition to Sisyphus, are both absurd heroes because they have embraced the absurd in its entirety, becoming new and whole beings as a result thereof. Camus later notes in the appendix that Gregor Samsa falls just short of this accomplishment in the underlying hopeful sentiments of Kafka's writing. Finally, concerning what makes the "hero" label of higher significance is illustrated through the absurd hero's victory and happiness.

Before the feasibility of absurd victory can be established, we must first explore the ridiculous nature of Sisyphus' existence. This presence of ridiculousness in the absurd life is not something that Camus rejects, but

instead embraces.[19] Sisyphus defies the will of Zeus, outwits Hades, and overcomes Death by binding him in chains. He defies those Olympians who were never to be defied. Zeus, King of the Olympians, judged that no mortal should be allowed to conquer fate as Sisyphus had, for that right belonged only to the sovereigns. Thus, Sisyphus was sentenced to a fate much worse than bodily death — a vicious cycle of death to his spirit and expression.[20] In order for Sisyphus to achieve an absolute ridiculous victory; however, which absurd heroism calls for, an absolute ridiculous punishment must precede it. The reason for this is that, in finding something meaningful in a meaningless existence, Sisyphus has secured the last laugh which heralds the gods' defeat.

The underlying violence of Zeus' punishment is not aimed at seizing all of Sisyphus' experiences or even the possibilities thereof. It is ultimately aimed at the joy that those experiences and possibilities bring him. A proud and lucid acceptance of his condition allows Sisyphus to seize back that sense of ownership, of *mineness*, that the gods proudly believed could be taken from him. Sisyphus is a hero in that he disarms the gods' capacity to exercise their will over him, striking fear into these oppressors. Sisyphus' victory is not that he resigns himself from the game of absurd life, but rather that he scoffs at the impotent sovereigns who can no longer or touch his sprit or take from him.[21] In this, Sisyphus becomes his own sovereign, the master of his fate.

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[18] "You have already grasped that Sisyphus is the absurd hero. He is as much through his passions as through his torture. His scorn of the gods, his hatred of death, and his passions for life won him that unspeakable penalty in which the whole being is exerted towards accomplishing nothing." (Camus, p. 87)

[19] "All great deeds and all great thoughts have a ridiculous beginning. Great works are often born on a street-corner or in a restaurant's revolving door. So it is with absurdity. The absurd world more than others derives its nobility from that abject birth." (Camus, p. 10)

[20] "They had thought that there is no more dreadful punishment than futile and hopeless labour." (Camus, p. 86)

[21] "Sisyphus, proletarian of the gods, powerless and rebellious, knows the whole extent of his wretched condition; it is what he thinks of during his descent. The lucidity that was to constitute his torture at the same time crowns his victory. There is no fate that cannot be surmounted by scorn." (Camus, 87-88)

There are two motions through which mastering one's fate is realized: revolt and the happiness therein. Camus characterizes revolt as a relentless demanding for the universe to cease its elusive tendencies, while so remaining conscious as to not slip into hope.[22] The way this revolt is fully realized is through happiness, which Camus characterizes as not only a product of the absurd but a facilitator of it too.[23] How true, unadulterated happiness is possible for the absurd man boils down to removing his conditioned necessity for some constant or channel to achieve it. Concerning this, I believe Camus' emphasized attacks on nostalgia were for good reason. When musing over the past, one easily falls into the snare of seeking to recreate that which can no longer be. But nostalgia need not be in the past or to have actually happened. One can long for an ideal life that could have been or would be had events occured differently. The desire to have a home, career, family, health, passions and all other goods are rational wants. They each satisfy a unique role that makes their respective hardships worth pursuing. To achieve the greatest of happiness, the absurd man must tear out those rational coils from his brain. He must not be influenced by his surroundings or his circumstances but create them.

But there remains the question of happiness. The Stoics believed happiness was contentment within life's bare necessities, while the Buddhists believe a sort of happiness can be achieved through liberating the self from attachment to worldly pleasures. Others like Thomas Aquinas and Saint Augustine of Hippo believed that only unity with God and crafting one's self in his image brought the ultimate happiness. The happiness of Sisyphus and the absurd rejects these claims, embodying instead something malleable and unique. Sisyphus is not content with his circumstances, as if he is simply making the best of them. The absurd always demands more experience, prompting individuals to create it if they cannot find it. Sisyphus does not detach himself from his circumstances, but instead embraces them because he is altogether passionate for existence and existence alone. Sisyphus does not look to the absolute for his happiness, for he is absolute in himself, and his scoffing of the "sovereign absolutes" is what fuels his rebel spirit.

What makes absurd happiness possible is that it only requires a will that wills. Happiness is not achieved in freedom from being harmed, thus experiencing nothing. Nor is happiness achieved by living a narrow life, thus experiencing a single thing. Absurd happiness is found in any and all things at both their broadest and most minute levels. No experience is reliant on the past just as no experience determines the future. Sisyphus, a former king, does not regret his actions because in losing all that could be taken, he gains that which cannot. Sisyphus does not see a dreadful climb to a mountaintop,

but rather another opportunity for a complete and inspiring view, a view where he belongs to himself. We are not to regard our lives as one uniform life, where past and future intertwine, but rather as a series of momentary, isolated lives that each offer something new but equally meaningful.[24] If one can only regard life as worth living in a particular manner or in having certain attributes, existence is not whole *in itself*. Whatever matters is that which is real. That which is real is whatever exists in the pure and immediate. Sisyphus exists as one who rolls a boulder up a mountain, and he is happy because he does so in a way that even a god cannot understand.

The final matter in need of discussion is what this means for the absurd man of reality, specifically the 20th century man facing nihilism. Camus' purpose in making Sisyphus the face of his absurd venture was this: if one could conceive of someone absolutely void of possibility finding meaningfulness in a life what was meaningless, then the absurd of us with limited possibilities could do just the same. Fundamentally, *Sisyphus* is about coming to grips with the futility of life, the sovereignty of death, and man's response to those in either submission or revolt. The deeper, existential realization that we are finite and what we do in our lives might not ultimately matter is crushing. Hope and faith is philosophical suicide, it is in itself a

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[22] "It is a constant confrontation between man and his own obscurity. It is an insistence upon an impossible transparency. It challenges the world anew every second…It is not aspiration, for it is devoid of hope. That revolt is the certainty of a crushing fate, without the resignation that ought to accompany it." (Camus, 39)

[23] "Happiness and the absurd are two sons of the same earth. They are inseparable. It would be a mistake to say that happiness necessarily springs from absurd discovery. It happens as well that the feeling of the absurd springs from happiness." (Camus, 88).

[24] "Each atom of that stone, each mineral flake of that mountain filled with darkness, in its singularity constitutes a world." (Camus, 89)

death, because it is contingent on something higher and beyond our control, forging a back door away from our human condition. Sisyphus is not a hero who can save us from our inevitable death, but he is one that we can model ourselves after to master our fate.

Conclusion

Absurdism in Progress

What makes absurdism a rare and special philosophy is that it cannot be fully understood through scholarly endeavors alone. It is a philosophy that is intimately tied to the individual, manifesting differently in each person, and thus must be lived out in order to be mastered. What likewise makes absurdism so rare and special is that it is a philosophy which can be learned through the eyes of others. What does the absurd man learn from Gregor Samsa? He learns the motions involved in progressively losing the entirety of his world and himself. What does the absurd man learn from Don Juan? He learns that life is not fearfully narrow and contingent on anything but his immediate passion for newness. What does the absurd man learn from Sisyphus? He learns that happiness and victory go to the man who has everything, yet nothing can be taken from him. Absurdism is a philosophy forever in progress, growing from the insights and experiences of those who feel they experience the very same absurdity which inspired Camus to write his absurd treatise. A wider appreciation, understanding, and calling of the absurd should be fostered in the hearts of people carrying their rock and become as elucidated as that Elusive Unknown, which everyone has at some point in their life wrestled with, will allow.

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Patrick Stewart

Yeast: A Religious History

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Abstract

Yeast: A Religious History, delves into the idea that societal changes can arise from from the smallest, most unlikely of places. Beginning with an exploration into what exactly yeast is and how it it is used in bread, this article discusses how such a small microbe had such a huge impact on religion. The first mark of religious yeast is with the Jewish faith, where unleavened bread is the staple to a pious life. Later, Romans would use bread in religious celebrations and offerings. Eventually barbaric leavens were incorporated by the rising faith of Christianity. Leavened bread eventually became the bread of Christian Europe, rather than the Church, and was a symbol of Europeans during the Crusades. As with many ideas of faith, the Enlightenment began to remove the mysticism from yeast, and with the turn of the 20th century, the idea of religious yeast was all but dead. While artisanal breads have renewed interest in yeast today, the fervor behind it is gone.

Introduction: From Textbooks to Bakeries

History is often judged on a large scale. We track the rise and fall of kingdoms, observe the effects of major catastrophes, and admire great shows of wealth. However, even in these wider trends, smaller, more subtle transitions occur. The word *religion*, for example, tends to evoke scenes of temples and churches, and priests performing all manner of formal religious procedures. Yet religious trends also occur in smaller more unlikely settings, such as bakeries. Here, religion takes place not only on the practical, visible level, but also on a microscopic level.

Yeast has had great influence over civilization, and it is therefore instrumental to look at the domestication and spread of grains. Poaceae, or grains, are grasses that are digestible by human beings. Grains were first domesticated somewhere in the Fertile Crescent around 9000 B.C.E,[1] when they were modified to prevent the seeds from spreading to the winds. The majority of these grains contain gluten, a protein that enables dough to be elastic. More importantly, grains contain sugars, which are the primary food source for a certain kind of fungus.

Saccharomyces cerevisiae, also known as both baker's and brewer's yeast depending on the strain, metabolizes sugar for energy, creating a byproduct of alcohol and carbon dioxide. The rate of this conversion depends on the strain, but is usually one glucose sugar per two molecules of alcohol and two molecules of carbon dioxide.[2] Wild yeast of this variety can be found everywhere, and is normally found on the skins of grapes.[3] The foam at the top of many alcoholic products, also known as barm, was used to incorporate the yeast into bread as a leavening agent.

The difference in these two products, booze and bread, is their constitution. In wine and other alcoholic beverages, the carbon dioxide escapes during fermentation, leaving only the alcohol and flavoring behind. In bread, the gluten in the dough traps both, expelling them as heat is applied.[4] As it does so, the carbon dioxide forces tiny bubbles in the dough to expand, weakening the "network of gluten and starch granules."[5] The end result is a light and soft bread that is finer, more tender, and easier to digest. This is due in large part to the yeast and other bacteria pre-digesting the bread before it is consumed by people.[6]

The act of leavening bread and the results it induces on grains is what leads to some grains being regarded more highly. Sorghum, rice, and other grains that lack gluten do not rise as easily, making them ill-suited to leavens. This lack of a gluten sheet makes the resulting breads denser than wheat varieties. Lighter grains were considered cleaner compared to their darker

cousins, as more of the impurities could be removed.[7] It is these two components, color and elasticity, that makes wheat the the grain of the elite in many civilizations, while inferior grains such as millet and barley were relegated to the peasantry, or even animals. This was the case in Mediterranean cultures, including Hellenistic and early Middle Eastern civilizations. Other parts of the world (China and Japan for example) favored rice over leavenable grains.

Bread in the Cradle: Leavening in Egypt and the Fertile Crescent

Bread originates from very early periods in human history.[8] In fact, a site was discovered in Jordan with bread that dates back 14,000 years ago.[9] Judging from the porous surface, it is possible that the bread was leavened, but it is unconfirmed whether or not yeast was involved.

The Neolithic was also the period in which the first sourdough starters might have been developed. Starters of this kind are leavens that involve mixing a dough together over several days before adding a portion of the starter to the bread dough. Because the microorganisms that cause the bread to rise in this case are not usually yeast, (lactobacilli being one such example) the flavor often results in a sour taste. This method would be the primary means of leavening until yeast became domesticated.

The process of leavening spread across the Levant and into the Middle East. Mesopotamia immortalizes this in the Epic of Gilgamesh on Tablet XI.[12] The bread that he describes is much more decayed than any unleavened bread would be, indicating that it is most likely leavend. At the time of the story, bread was a mark of civilized folk; the story indicates that wild man Enkidu becomes civilized when he is able to make bread.[13]

Yeast was officially domesticated around 1500 B.C.E. in Egypt. Although, it is still unclear exactly how the Egyptians first domesticated yeast, some bakery models from the period provide clues. The model from the Tomb of Meketre shows a sort of assembly line, where dough would travel from one station to the next. Several of these stations appear to be made out of stone, which indicates they had multiple uses, possibly over multiple lifetimes. As yeast can live in a dormant state for roughly six months, and in an active state for two to three weeks, it is likely there was some left on the tools after each bread production. Additionally, each yeast cell can have anywhere between twenty to thirty daughters,[14] ensuring an increased population of cells.

Beer appears at almost the same time as leavened bread, and is just as important in the discussion of such bread. Alcohol provided a way for

people to have access to a cleaner beverage. The alcohol produced by yeast is caustic to other microorganisms and, in large enough quantities, even the yeast itself. This caused many disease-causing bacteria and parasites to be killed off before it was ingested.

With the production of beer came barm, which acted as a leavening agent for bread in a few places in the world, including Mesopotamia, Gaul (modern-day France), and eventually all of Europe during the Middle Ages. Because of this, leavened bread tends to appear in higher numbers after beer begins appearing. Each of these products also are time reliant. The shortest period of time it takes to manufacture beer is around two weeks. Leavening can take several hours to allow the bread to rise before it is baked.

The time it took to make both alcohol and leavened bread gave the products an inherent value. This value transitions into what it takes to purchase such a product, or on some occasions what can be purchased with it. In fact, the earliest recorded forms of organized pay was in both beer[15] and bread,[16] showing the beginnings of yeast's growing power. This rise in yeast's influence cannot be considered solely in a secular context. In Egypt, the head of state, the pharaoh, was seen as a living god, while in Mesopotamia, kings had specific religious duties and ruled by divine right.

Early Monotheism: Zoroastrianism and Judaism

Around the time of the priest-kings of Egypt and Mesopotamia, monotheistic religions of the area had their own interpretation of holy bread. Judaism, founded c. 1812 B.C.E., was one of the world's first recorded monotheistic religions. Their idea of sacredness came from purity and wholeness, particularly in a social context. Mary Douglas, a 20th century anthropologist, hypothesized that many Jewish dietary restrictions, while having a practical base, were formulated on the grounds of religious cleanliness.[17] In early Judaeism, fermented foods "corrupted" the original substance, making it inferior to the pure product.[18] Because of this, leavened bread had a lesser station in the religious hierarchy, especially in comparison to matzo, an unleavened bread eaten during Passover. During that celebration, unleavened bread was eaten as a "sign of sadness." [19]

This dietary restriction was normally only during the period of Passover, so yeast-filled breads were still enjoyed at other times. Leavened bread also served a very particular religious function during the Feast of the Firstfruits.[20] Here, offerings were made to God by way of the priests, and were usually composed of the first of the harvest.

The religion of Persia during the Achaemenid Empire was Zoroastrianism, which was similar to Judaism with regards to holy bread. Dron was a ritual bread used in religious offerings, made clean and pure in all ways: from the quality of the pure wheat flour, to the cleanliness of the water, to even the removal of leaven.[21] However, the prohibition against yeast in religious ceremonies did not extend to common consumption of bread. There are over thirty different varieties of "ethnic and traditional bread," in Persia and Iranian cuisine.[22] The similarities between Judaeism and Zoroastrianism are very clear. Both distinguished unleavened products as pious, and deemed fermented products to be profane.

Orphic and Chthonic Figures: Bread and the Greek Underworld

While Persia relegated leavened bread to the profane world, the Greek conception of yeast appears to have revolved around chthonic figures, or entities closely associated with the underworld. Again, the two products that use yeast are bread and alcohol. In Greece, each of these products had a god associated with them: Demeter and Dionysus. When examining Demeter, one need look no further than her connection with the Eleusinian Mysteries, an agrarian cult that treated her connection to Persephone, and by proxy Hades, as part of cycle of death and rebirth.[23] Dionysus has his connection through his cult from Mycenaean Greece. Here, he is shown to be a god of death and rebirth, and it was said that by drinking wine, one could tap into some aspect of his divine power.[24] Interestingly, the converting of grapes into wine also carried symbolic elements of the transformative rebirth Dionysus was supposed to have undergone.

The association of yeast with death and rebirth may have contributed to a stigma against leavened bread, which was not widely consumed in Greece. While a pragmatic explanation for this is that leavening bread took more time and better ingredients, making it more expensive,[25] it is also likely that the chthonic connection drove people away from consuming it. By the time Hellenistic Greece entered the scene, underworld gods such as Hades were treated with fearful respect. Their attention would not be invited if it could be helped, for fear of hastening one's own demise. Therefore, eating bread associated with chthonic travel to the underworld may have been seen as unwise. Solon, the Athenian lawgiver, forbade the consumption of leavened bread outside of feast days, which were often considered sacred.[26] This is evidence of a clear distinction between (profane) flatbreads and (revered) leavened ones.

If leavened bread is found to be the example of sanctified moderation, wine was the example of worship in excess. Marginalized groups, such as slaves, women, and the lower class, joined the Cult of Dionysus which incorporated alcohol in its ceremonies because drunkenness dissolved social boundaries. The aristocracy then reinvented the cult over several hundred years by diminishing associations between alcohol and Dionysus' attributes of madness and viciousness. Instead, these were replaced with parties and the harmless drunk. After this, Dionysus was adopted into the major pantheon, making the faith of alcohol a public tradition.

Yeast in the Roman State and Norse Countries

The Romans would inherit much from their Greek counterparts, including religion. While stylistically they were the same, they differed in practical application. One example of this is the mentality of religious followers. In Greece, adherence to and belief in the gods was not only condoned, in some cases it was required. One of the crimes leveled against Socrates was promoting impiety.[27] Romans viewed worship, especially during festivals, as a public obligation.[28] In fact the Latin word *religio*, refers not to the gods or faith, but to piety and superstition. In other words, it was viewed as better to perform the proper rituals when the gods don't exist, than to fail to meet these obligations in case they do.

Because of the differences between both the Greek and Roman religious systems, the cult of bread was divided in two directions: one that flourishes within secular powers, and the other that slows in religious circles. In the secular case, bread was divided into a symbol of both political clout and medicinal treatment. In medicine, the second century author and physician Galen prescribed different levels of leaven depending on an individual's daily routine. For example, athletes were to eat only slightly leavened bread, while ordinary people who were not training and the elderly could eat more heavily leavened breads.[29] Additionally, unleavened breads were unfit for everyone, except maybe animals.

Regardless of the variety, bread was still the staple in many Roman diets. Because of this, control of bread and grain supplies became of major concern in the political spectrum. Both the Senate and several emperors instituted dozens of reforms to feed the masses, including making the people of Rome eligible for free grain in a system known as the annona. At first this system gave city dwellers the means to make bread, but otherwise left them autonomous. That changed with Emperor Aurelian, who changed the dole to include premade bread,[30] increasing the dole's overall value and saving citizens time in production. In addition, Aurelian standardized the

minimum size of bread that could be sold.[31] These two outwardly minor reforms changed much, as the State was taking a role in defining what bread was. In the annona, the State choose how much grain was used, what the bread was cooked in, and how much yeast was used. The bread resulting from Aurelian's reforms became the standard by which all bread was judged.

Finally, in the sphere of religion, there are two things of note. First, the Ancient Roman priests of Jupiter were not allowed to touch fermented bread.[32] Second, bread had major ties to the Temple of Vesta and the Vestal Virgins. Vesta, as goddess of the hearth, was in charge of those who baked bread for the family, making the Vestal Virgins, her priestesses, the matrons of the city and bakers of the empire. This connection was seen in the *mola salsa*, a type of ground meal the vestals would make to be sacrificed, or used in conjunction with other offerings.[33] Through *mola salsa*, grain was used in every major religious festival in the city of Rome.

For the priests of Jupiter, the prohibition of yeast may have been an exception, rather than an organized belief in yeast's uncleanliness. No other priests have this restriction, and it may have been related to aspects of Jupiter himself in connection to yeast. One idea could be that the restriction was a holdover from the Mycenaean period. Jupiter, as a sky god, would have no want or need of something with chthonic aspects, such as yeast. So it could be said that yeast neither lost nor gained any significant presence in religion during the Roman Empire.

Although there is no specific evidence for or against yeast's sacredness, there are clues. For instance, the Arch of Titus shows a shew table being carried off with other temple treasures. Instead of treasure, chests, or gold, the Arch depicts the table upon which bread was offered to God.[34] This shows that while they may not be Jewish, the Romans understood the value of objects involved in the worship of bread. What is also interesting is that Galen prescribed that unleavened bread was unfit for everyone. If this were true, it would be unseemly to offer the gods things that were seen as inadequate for people to eat as well. Many ideas of Graeco-Roman offerings were based on the idea of sacrificing what was best, not that which was substandard.

The Abrahamic and Hellenistic worlds were not the only ones involved in making yeast sacred. Germanic and Slavic traditions were also involved, and both practiced leavening in some instances. These instances did not necessarily hold religious connotations, but were spiritually driven nonetheless. For example, the Slavic bread and salt ceremony involves korovai, a heavily leavened bread, and was seen as magical.[35] Germans, both in Germany proper and in Northern Europe, used barm from their beer

production to craft their bread. This bread also undergoes purification rituals, including the ærcerbot, a process by which grain fields were cleansed when they yielded poorly.[36] Unlike the stricter uses of yeast found in Abrahamic or Jewish traditions, Northern and Eastern Europeans had no qualms about the use of yeast in their bread products. Rather they hold yeast in high regard, treating it as a pure object, rather than a representation of sin.

The Body of Christ: Yeast and Christianity

With the beginnings of Christendom, sacred yeast and leavened bread was suddenly on the rise. Christians used fermented bread to disassociate themselves with Jewish matzo. In fact, barbarian bread traditions may have influenced the earlier trends of the Church, particularly in their attempts to distance themselves from what Christians of the time considered to be Jewish heretics and Roman oppressors. However, the Roman Catholics returned to the use of unleavened wafers for communion, citing several specific passages from the Gospel of Matthew for this.[37] St. Augustine referred to men as the "bread of God" and encouraged them to cultivate their lives properly as one would in the making of bread.[38] In Augustine's opinion, the only way to cultivate body, soul, and bread was through the removal of yeast, both figuratively and literally. Therefore, removing yeast symbolized removing sin from one's life.

The Catholics' return to unleavened bread struck a chord with traditionalists in the growing faith. After all, both the Body and Blood of Christ used yeast, and yeast was seen as fundamental in the production of a God made flesh. In 1054 C.E., the Eastern Orthodox Church broke away from the Catholic Church. While they had many reasons, they specifically mention three: the Primacy of Peter, the inclusion of the Holy Ghost, and the leavening of bread.[39] That the use of yeast in one's bread is such an important statement that an entire group of people were willing to break away from a religious faith illustrates how integral yeast was to the religious practice.

The Libels: Christian Accusations Against Jewish Bread

The Gospel of Matthew was also interpreted by medieval Christian theologians as the Jews confessing to the crime of crucifying Christ.[40] The Gospel of John also claims several times that Jewish people desired to kill Christ.[41] Even Martin Luther, who was regarded as sympathetic to Jews in his earlier life, wrote a treatise in which he claimed, "You could not learn anything from them [the Jews], except how to disobey the commandments."[42]

Through these misinterpretations of the text and blatant anti-semitism, "the Jew" became something of a boogeyman — wicked and evil. As such, many grand conspiracies emerged asserting that Jews were slowly undermining Christian values and ways of life. Among them was the blood libel — the accusation that Jews would kidnap Christian children to use them in gory rituals. These rituals included, but were not limited to, recreating the Crucifixion or making matzo crackers out of the children's blood (though the latter probably only emerged in the 19th century). This was exemplified in the Tiszaeszlár affair, an accusation that the Jewish community in Tiszaeszlár murdered and beheaded a young girl in order to use her blood.[43] It is a flawed notion in part because kosher law prohibits the consumption of blood.

Accusations were also made about the bread of the Eucharist to Catholics, the eucharist becomes the sacred body of Christ through transubstantiation. As such, any act made that was not respectful to the communion wafer was considered a damnable offense since this would profane Christ himself. Catholics claimed that Jews would break into churches to steal the eucharist, later burning or stabbing the bread,[44] in effect torturing Christ's body. The irony of this claim is that both the matzo and eucharist were in large part the same product. Both were unleavened bread for the purposes of being symbolically free of sin. It is interesting to consider then what makes the two distinct for Europeans of the period.

From Churches to Mosques: Bread during the Crusades

Islam was in its Classical Period during this time. The debate by the disciples of Mohammed over whether or not leavened bread is halal or haraam (permitted or forbidden respectively), is one that had been argued since the founding. Some argued that bread using yeast still maintained around 35% alcohol content, and was therefore haraam.[45] Others claimed that bread, leavened or otherwise, was incapable of intoxicating those who ingested it and was therefore perfectly acceptable to consume.[46] This argument lead to a few references from the Classical Period as to whether or not yeast was commonly used in bread. One mention of a "well leavened" grain product refers to a kind of stuffing used in *tharid*, a sort of soup.[47] Other than *tharid*, leavened bread is rarely mentioned, and while some yeast-ridden bread may have been present at the time, it is unlikely to have been a mainstay of the diet.

By the start of the Crusades, the Umayyad Caliphate had expanded through North Africa and into Spain, cutting off the southern Mediterranean from the rest of Europe. Given religious prohibitions, wine and yeast-filled bread were no longer the cultural foods of the Mediterranean, but of Chris-

tian Europe instead. In 1095 C.E., many crusaders demonized the bread of their enemies, calling it "poorly cooked flatbread [...] that hardly deserve the name bread."[48] Armed with yeast-filled products, they charged into the Holy Land for glory, gold and faith.

Non-Western Cultures: Yeast in Asia, Australia, and the Americas

In non-Western parts of the world, leavened bread tends to be scarce. The leavened products of Northern China, are used as both an offering in folklore origin,[49] and as a medicine for those suffering from indigestion and diarrhea.[50] In North America, the Zuni tribe are described as using "lime-yeast" to leaven their bread products.[51] With very few exceptions, though, ceremonial uses of yeast remain a largely Western concern.

Other parts of the world do not have as rich a tradition when it comes to leavened bread until after European contact. This is likely due to the lack of leavenable grains, or preference for other grains, such as rice. However, yeast is clearly religious in another medium: alcohol. Saké, which is often called a Japanese rice wine, and chicha, a South American corn beer, are two such examples. Early productions of both beverages were produced via communal spitting. Women would gather around a pot and chew either rice or corn, before spitting it into a large pot.[52], [53] This process forged a sense of community, because after fermentation there is a product that has some of everyone in it, both figuratively and literally. In modern Japan, in fact, there is a sense of competitiveness when it comes to whose province has a better saké.[54] From the religious angle, both saké and chicha were considered ritualistically pure. In fact, saké is still used in Shinto purification rituals in Japan.[55] Chicha on the other hand, had strong ties to the Peruvian gods, and was featured in religious offerings.[56] It is possible that the reverence arose from worship of the community, and that spirits (or yeast) would only come if everyone involved participated in the production within the traditional parameters.

It was widely believed that the Australian aborigines did not use yeast at all, whether to leaven their bread or to produce alcohol. However, recent research has revealed that aborigines may have produced a form of alcohol precontact. This brew would have been produced by fermenting sap from eucalyptus trees.[57] The precise cultural function is not yet known, and was possibly lost after European colonization. It is enough to know that yeast was being used there independent of the Western narrative.

From Secular to Artisanal: Leavening Practices in the Modern Age

The idea of religious yeast maintained strength in the Renaissance, but began to slowly degrade after the Enlightenment (as did many ideas of faith). By the mid-19th century, the rise of secularism and industrialization drove bread production to become focused on preservation rather than taste or texture. The irony cannot be lost on how the primary ingredient removed for this to occur is yeast, the most religious inclusion. Microbes damaged the structural integrity and consumed portions of the bread, pre-digesting it for us; yeast bread degrades much more quickly than matzo crackers or hardtack, a sea biscuit developed in the 1500's that can be stored for up to ten years.[58] The push for industrial bread can also be seen in literature of the period. In Dickens' *A Christmas Carol*, the Ghost of Christmas Present heavily criticized the Church for closing bakeries on the Sabbath.[59] Here, priests are shown as barriers to progress, directly responsible for the hunger of the masses.

The sacrifice of yeast in the name of progress was more readily accepted in America, where secularism was the mainstay, as opposed to nations such as France and Italy, where buying fresh bread everyday was not just tradition, it was a way of life.[60] Even when leavening bread returned to popularity, Americans had begun leavening it with artificial compounds such as baking powder or baking soda.[61] The focus on preservation assisted with this transition, as now it was possible to store leavens for months, or even years, in small, evenly portioned packets.

In the 1960's there was a sudden resurgence in whole wheat bread in America, due in large part to the counterculture "hippie" movement. This revolution was sparked by a resistance to established American ideals. Included in this was pure white, genetically altered, sifted wheat bread. This made whole wheat unappealing, as the loaves were little better than bricks. With the assistance of a Zen Buddhist monk named Edward Espe Brown, the whole wheat movement finally received traction.[62] Whole grains are typically harder to leaven and bake due to impurities absorbing moisture, often making the final product either dense or crumbly. With Brown's contribution, brown breads and artisanal breads become much more viable.

Conclusion: What Yeast Means Today

In the 21st century, bread is experiencing the beginnings of a yeast renaissance. More and more home cooks and bakery businesses are returning to traditional methods of preparing bread and using yeast.[63] Even organic

farming has marked a rise in microbes, both in decomposing fungi and yeast.[64], [65] However, this movement is largely secular since Americans produced commercial yeast as early as 1868.[66] This secularization comes in the face of attacks against bread. In fact, bread sales have dropped by 11% as of 2013,[67] due in large part to increasing suspicion in bread's nutritional value.[68]

That is not to say, however, that the modern movements are completely devoid of what could be seen as religious fervor associated with yeast. Fad diets are the latest to ask whether bread should be leavened or not, and in some cases eaten. These diets are stringently followed by some, to blind devotion in rare cases. Even the old religions of the past are still debating the question of bread. Islam has yet to come to a consensus on what is halal or haraam with regard to yeast. In the Catholic church in 2008, there was a well documented incident involving a University of Minnesota professor desecrating the host to the the ire of many Catholics who still hold the bread in esteem.

The sacred associations with yeast were lost in large part due to industrialization, and it is a long road to reacquire them. Yeast has played a striking role religious history, from prohibitions to sacred rites, and from warring bands to clerical disputes. Yeast is by far the most important ingredient in modern bread-baking. Even if it is not the most popular ingredient, it is a critical component in religous practice throughout history.

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Coming Out on YouTube: Self Disclosure in Online Spaces

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Abstract

Coming out, the act of disclosing a queer identity by an individual, is a new phenomenon that both brings awareness to a marginalized community and allows individuals to self-accept. With the rise of media, coming out has become a more public act where individuals are self-disclosing their identities to mass audiences – especially in online spaces. This research is focused on YouTube users' self-disclosure of identity and how viewers respond. Within the queer community, a disparity between gay and transgender individuals persists, and treatment of these individuals once "out" has differed as well. With YouTube as a highly active platform, the presence of anti-queer language appears on this site, especially in the comment sections. Therefore, with the threat of anti-queer language in mind, a textual analysis was conducted in these online spaces to determine the difference in responses to gay and transgender online self-disclosures.

Introduction

Coming Out Televised

Coming out is a monumental step for authenticating marginalized identities within the queer community. "Queer" is a reclaimed term referring to any individual with an identity that deviates from heterosexual and/or cisgender. It wasn't until the rise of electronic media (social media, television, and movies) that coming out transitioned into a public act where people began self-disclosing their personal identities to mass audiences. Coming out is the act of disclosing a queer identity to another person or a collective group of people. In 1997, Ellen DeGeneres played the first major character on television to identify as openly gay. As she recounts these events, she states "This was before Facebook, so if you wanted to announce something, you had to get a sitcom" (TheEllenShow, 00:0:35 – 00:0:42). DeGeneres' coming out was a monumental moment in American television history and greatly progressed queer acceptance. Ellen's coming out showed that representation can lead to awareness and understanding of difference. Bobker states that "one by one, gays and lesbians could easily defeat intolerance, if only brave enough and honest enough with themselves and others" (34).

Coming out is a political act, an act of disclosure that demands changes for a marginalized and un-privileged group, because it not only allows queer people to acknowledge and fully embrace their identities, but it also helps normalize all queer identities as well. Since Ellen's coming out, many shows involving queer characters have taken media by storm, increasing visibility of the community and calling for more understanding. *Glee*, a monumental show for queer visibility, broke down social barriers. Many viewers remember Kurt unabashedly standing before his dad and claiming "What I am is ... I'm gay" ("Preggers"). Television viewers are put right in the middle of an intimate conversation between a father and his son which makes this scene memorable and significant for queer viewers. Caitlyn Jenner's hour-long video interview with Diane Sawyer introduced many viewers to the transgender experience. In this interview, Caitlyn proclaims, "My brain is much more female than it is male. It is hard for people to understand that, but that is what my soul is" (Sawyer). While media presence is increasing and is important, especially for the queer movement, the issue of authentic representation and overall presence for all queer identities remains an issue.

Ang, Bobrowicz, and Green argue that the transgender community continues to lack representation, especially compared to the presence of white gay men depicted in television (609-610). For white, cisgender gay men, representation is available and increasing; however, the presence of

lesbian, bisexual, and transgender individuals (especially people of color) is lacking. While gay people are becoming more accepted into mainstream society, transgender individuals are not as widely understood and often receive more negative treatment. Even with a disparity, representation is lacking for the entire queer community. Queer people are moving towards online spaces to seek out representation. Fox and Ralston show that the differences in treatment as well as the overall lack of representation that has persisted in television media has led queer individuals onto online spaces not only in search of representation but also community, information, and spaces for self-disclosure (636). Further research needs to be conducted to establish the major effects that these spaces can have on queer individuals.

Issues of homophobia and transphobia exist in these online spaces which can have negative effects for queer users. Queer users are exposed to negative treatment in online spaces; however, social media, and specific sites such as YouTube, are advertised as "safe spaces" for the queer community to "come out," find community, and gather information on queer topics and issues. Acts of homophobia and transphobia in online spaces can include hateful comments and videos depicting violence and threatening language. For the YouTube site, users can respond textually to videos posted on the site in the comment section of each individual video. The comment section serves as an online space where viewers can interact with the YouTuber as well as other viewers.

YouTube and the Coming Out Narrative

Aside from television media, social media sites such as Tumblr, Facebook, and YouTube are frequently used by queer people in search of representation. For this research, the focus will be on computer-mediated communication (CMC) sites, which I define as any online space where communication through technological devices occurs. Specifically, YouTube is frequently used by queer people in search of authentic representation in video content. I define a "YouTuber" as an individual who has a YouTube channel and posts regular videos there. A "viewer" refers to those who watch a YouTuber's channel. YouTubers often have a stable viewership: an audience of regular viewers who typically watch the YouTuber's videos as they are posted. Videos on YouTube often come in the form of video blogs, or vlogs. Vlogs typically consist of a narration of daily experiences in a confessional setting. This often includes personal disclosures in safe spaces such as family living rooms and individual bedrooms. The confessional setting gives the viewer glimpses into the personal lives of others. The intimate spaces and the personal language used helps create a queer experience that can be more realistic than queer experiences depicted in fictional media.

Szulc and Dhoest do not specifically discuss the trans experience; however, their research, discusses the importance of "authenticity of online LGB representation." Authentic LGB representation includes content that "is not only about a specific minority group but also created by the group" (351). They also note that the confessional format that is often used by queer YouTubers to come out online creates an authenticity that is more impactful on the viewers because it is created by queer YouTubers. While televised coming out moments are often fictionalized or scripted, YouTube videos are more accessible and provide more authentic people and narratives to serve as representation for the viewers.

YouTube creates an online space where users can share private information to a massive public audience. Therefore, with this access readily available to anyone with a webcam and the internet, television media is no longer needed to make public proclamations or provide representation for marginalized communities. Caroline Dadas refers to this as "publically private" (64), implying that CMC sites blur the lines of offline and online spaces where people can communicate with others and reach mass audiences without leaving the comfort of their own bedrooms. YouTube is an ideal place for queer users to come out since the website can be used to communicate to a larger viewership.

The transition to online spaces becomes clear when looking at the past five years alone. Recently, there has been an increase of well-known people using their YouTube platforms to come out. These users include Joey Graceffa, Ingrid Nelson, Shane Dawson, Tom Daley, Troye Sivan, and Gigi Gorgeous. They all structured their YouTube coming out videos as described by Alexander and Losh:

> ... an unmediated truth by a confessing subject who seems to be offering a moment of intimate disclosure of an authentic identity hidden by a social mask [and] also emphasizing how gender and sexuality are performed for the camera much as they are staged in offline environments. (25)

Their research highlights the use of video journals for performing gender and sexual identity and indicates that there is a predictable structure to these types of self-disclosure videos.

YouTubers use common narrative structures when disclosing their personal coming out journey via YouTube. Alexander and Losh focus on the narrative structure of coming out stories by examining common components that are frequently found in these narratives. For example, the YouTuber must be able to "supply ... narrative context for this act of disclosure" (24).

This means that the reasoning for coming out must be legitimized by the individual. To do so, YouTubers claim that they no longer want to hide their identities from their viewership. They want to diminish the anonymity that social media often provides users. This exhibits a desire for authenticity not only from the viewers but also from the YouTuber.

Normalizing the queer identity is another common feature within the coming out narratives. YouTubers encourage other users to disclose their identity by normalizing it through their own narrative. In addition, YouTubers often "situate [their] rhetoric within an entire community of similar content-creator[s]" (Alexander and Losh 26). Coming out videos work in a pay-it-forward method where YouTubers acknowledge other users who have come out before them. The acknowledgement of others who have gone through similar experiences further creates community showing viewers that they are not alone. Coming out videos have the ability to not only bring forth more authentic representation, but also bring awareness and normalize marginalized identities.

Previous Research

The Use of Online Spaces for Information Gathering

For queer users, especially youth, online spaces (social media, websites, online chats) are used for learning and gathering information on queer topics. Fox and Ralston explain the three stages of the coming out process: (1) "the sensitization stage," (2) "the assumption stage," and (3) "the commitment stage" to establish the significance that online usage can have throughout the self-identification process (635). During the sensitization stage, queer individuals question their identities. In the assumption stage, queer youth seek information regarding queer identities, and finally, in the commitment stage, they self-disclose and seek out same-identified individuals. Therefore, coming out is a journey as opposed to a singular act of self-disclosure. Online access is important during the coming out process because it provides "access to information [as well as] the informal learning that occurs via day-to-day interactions online ... with others on social media" (636). Examples of informal learning include viewers seeking out online role models they can observe and mimic as they learn about their own identities. For example, users learn "from the modeled behavior of their face-to-face friends, online friends, celebrities, and unknown LGBTQ individuals," and this form of learning most frequently occurs during the "sensitization and assumption" stages where individuals first recognize their difference and seek out more information (640-641). Online spaces can be used by queer users both to perform their identities and to observe the performance of others, both

critical parts of the coming out process.

YouTube serves as an online space where the three steps of the coming out journey can be taken. Fox and Ralston describe YouTube videos as "particularly useful because they provide rich video content and their searchability makes it easy to identify relevant content" (639). With YouTube videos, users can easily view content that focuses on queer topics and find queer YouTubers from which to learn and model behavior. This idea of learning online further impacts the potential use of these spaces for queer people. By performing and self-disclosing queer identity, queer users are embracing their own identities in addition to providing content that could help other users self-identify. In these spaces, users can take what they learn online and apply it to themselves offline. Fox and Raston present the following testimony from a transgender man:

> Somebody showed me this collaboration of trans men on YouTube and they were all on testosterone and I was like 'Oh my god, I can live a normal life'.... I was afraid I was going to have to be a sex worker, or just be this oddity and go into porn ... And there were all these normal guys [on YouTube] who you couldn't even tell were trans. (Fox and Raston 639)

This personal story exemplifies how online representation serves as a performance that the viewer can reflect on and learn from.

Spaces for Community Building

Queer users can also use online spaces during the coming out process to build community. Websites are frequently viewed as safe spaces where individuals are free to explore different identities. During this process of exploration, users often interact with one another. Both, Fox and Ralston and Szulc and Dhoest studied the significance of community-building in online spaces. According to Fox and Ralston, "during the assumption stage," queer users "seek out similarly-identified acquaintances, social ties, and role models to learn how to enact their identity" (635). From this, seeking out community online is significant to the queer individual in order to understand their own identity and normalize it. Researchers have shown that queer users are more likely than heterosexual users to use online spaces. According to Szulc and Dhoest, queer youth are most likely to go online to seek information and social connection. Out of the 761 respondents in their data, "60.1% ... visit social network sites" and "42.6%" use the internet to seek "contact with other LGBs" (354-355). Furthermore, they found that internet access for LGB youth is vital for having online friends who have similar identities. One user accounts a desire to "just to be able to talk to

somebody who is experiencing the same thing" (356). Online spaces also erase geographic barriers for queer people seeking out community (349). Queer youth can seek out the experiences of others and compare them to their own internal experiences which helps eliminate the feeling of isolation that many queer people face (Szulc and Dhoest 350). Building individual relationships as well as communities assist in the coming out journey of the user and eliminate isolating feelings that queer identities can inflict.

Similarly, Michaelsen discusses community by examining the video campaign, *It Gets Better*. The *It Gets Better* project was started by a video blog (vlog) uploaded to YouTube by Dan Savage and his partner Terry Miller in response to "homophobic violence, in particular bullying in a high-school context" (144). A vlog is a type of video journal in which users record aspects of their day or recount events in a confessional setting. The original video was formatted as a narrative by two YouTubers, Savage and Miller, who recounted their experiences as gay men. The video called for a better future for all queer people and created a space in the online world that inspired others to post similar narratives using the #ItGetsBetter hashtag. The video also began a trend on multiple formats of social media but specifically on YouTube. Michaelsen notes that the campaign provides queer viewers "the promise of both non-aloneness and of a better future" to queer viewers (145). This campaign is significant because queer identities are framed and shared in a positive light.

Unfortunately, while the intent of the campaign is clear, the promise of non-aloneness and better futures cannot always be met, especially for those identifying amongst the transgender and genderqueer communities.

> Lots of folks, particularly the gender nonconforming and/or trans, never 'grow out' of the kinds of social reprisals for being physically different ... lots of people's families of origin never accept them, or are too damaged and fucked up for anyone to want to go back, even if they could. (Michaelsen 147)

This quote highlights the danger of promising a better future when looking at the disparity specifically within the queer community. Homonormativity implies that gay people are more privileged within the queer community than those identifying as genderqueer or transgender. This disparity could be due to the difference in representation that exists for these communities. This difference between gay and transgender individuals is important when looking at the experiences of queer individuals because, while they are all encompassed into one community, the rate of societal acceptance and actual experiences are not the same. The realities of homophobia and transpho-

bia, and overall negative experiences of queer users online remains while "the internet and particularly social media [are depicted] as 'safe' spaces, providing the means to overcome the dangers and the violence that lurk in the 'outside' world" (Michaelsen 145). Even with the presence of hostility online, the attainment of community and social interaction in online spaces remains vital for queer users "because aloneness is one of the affective experiences of being collectively, structurally unprivileged" (148). Queer users are using spaces to build community and gather information where anti-queer behavior persists.

Anonymity Online

The effects of anonymity online must be addressed when discussing the use of online spaces, especially websites where communication and information-sharing between users is prevalent. Hollenbaugh and Everett compare anonymity in online blogs "to the 'stranger on a train' phenomenon, wherein people share intimate self-disclosures with strangers they may never see again" (283). The authors highlight visual anonymity, which is "the extent to which people can be seen and/or heard" (286). The blogger, or the one writing and posting the content, is often the one forfeiting visual anonymity to their audiences. Viewers or commenters, on the other hand, often maintain their visual anonymity since they have the ability to exist in online spaces behind ambiguous usernames and blank profile pictures. The impact that visual anonymity can have on a user needs to be considered when looking further at the information that is self-disclosed by all users.

Hollenbaugh and Everett elaborate on bloggers' willingness to self-disclose personal information despite a lack of visual anonymity. The authors state that this is "likely due to the blogger's motivations for maintaining their blogs," and that, "people are motivated to archive and organize their thoughts, to help others, for social connection, to get feedback, to express creativity, and to entertain others" (285).

Users are more willing to disclose personal information and remove visual anonymity for a particular audience, or viewership. Viewers feel a personal connection to the blogger based on the information disclosed and the blogger's visibility even though the interaction does not occur physically face-to-face. The results from the research also show that "participants who were more visually identified (including pictures of people in their profiles), disclosed a larger amount of private information in their blog entries" (Hollenbaugh and Everett 290). Therefore, if YouTubers can be seen by their viewers, they are likely to self-disclose more information.

However, in these online spaces, the viewers, or users consuming

the content, are often presented more anonymously online than face-to-face. While they have the liberty to possess visual anonymity, these users also have "discursive anonymity," which is "when a message cannot be linked to a specific source" (Hollenbaugh and Everett 285). Viewers can then comment or respond with little to no consequence. Lapidot-Lefler and Barak show how the possession of anonymity allows users to act without consequence. They state that "the psychological restraints that often serve to block or conceal emotions and undisclosed needs are found to be lowered in cyberspace in various online interpersonal behaviors" (434). Lapidot-Lefler and Barak also explain the term "negative online disinhibition effect ... [which is] usually manifested in aggressive behaviors that apparently would not be exhibited in a similar scenario in the 'real world'" (434). While anonymity can potentially allow queer youth to find community and information during their coming out journey, anonymity also grants users the ability to express hate online. In these online spaces of self-disclosure, the actions and language used are not met with the same reaction as they would in physical spaces. Aggressive behaviors can be found in "online gaming sites, hate sites, ... cyberbullying, [and] comments on YouTube" (434). Therefore, the presence of hate in these spaces puts queer users at risk. Due to anonymity, users often receive no repercussions for these actions, and there are few restrictions for anti-queer content.

Homophobia and Transphobia Online

Recent research has proven that the overall support for the queer community has increased; however, the problem of bullying and overall hostility against the queer community persists, especially those identifying in the transgender community as shown by Kosciw et al. (10). Bullying, in this sense, includes "verbal and physical harassment and assault, and social exclusion and isolation" (10). A study by Kull et al. found that "LGBT youth commonly feel unsafe in their schools due to high rates of peer victimization ... with over 85% experiencing bullying or harassment in school" (407). While LGBT+ youth are experiencing fear, harassment, and isolation, Christopher Pullen demonstrates how this issue of bullying and harassment can lead to the physical harm of queer people.

Lawrence King, a queer student, was shot during class by a straight, cisgender male classmate after King asked to be his Valentine. Lawrence King identified as genderqueer and was often misgendered by his classmates and faculty. Misgendering is the act of using a pronoun or name to address an individual – typically a transgender individual – that does not accurately reflect that individual's preferred gender identity. This hate crime adds to a

lack of safety that queer people feel in physical spaces which demonstrates why LGBT+ youth are capitalizing on online spaces. There is need for safety and security; however, even though online spaces are depicted as a solution, anti-queer language and behavior still exists in these spaces.

Recently, research conducted by the Gay, Lesbian and Straight Education Network, one of the leading researchers for queer youth, has established that LGBT+ youth are spending more time online compared to their heterosexual, cisgender peers. On average, queer youth spend 45 more minutes online than non-queer youth (GLSEN 17). This is because queer people are using spaces and social media sites online "to build self-esteem, gain emotional and motivational support, and decrease feelings of isolation" (Braquet and Mehra) Queer youth are using online spaces to affirm and establish their identities which makes online spaces vital to the coming out journey for many youth. The existence of homophobia and transphobia in these spaces, however, remains an issue. GLSEN show that LGBT+ youth are more frequently bullied than non-LGBT+ people in both online and offline spaces (GLSEN 8). "LGBT youth were nearly three times as likely as non-LGBT youth to say they had been bullied or harassed online" (8). With the existence of bullying, in both face-to-face and digital spaces, the effects of negative comments and cyberbullying on queer users need to be explored further.

Previous research shows that the psychological effects can be severe and have long-term effects on an individual even though users are not physically at risk within these spaces. Kull et al. found that the impact for bullying can lead to lower academic achievement, lower self-esteem, and higher depression in comparison to individuals who did not endure discrimination based on gender and sexuality (407). Not only are youth prone to academic and emotional damage, McDermott and Roen note that these youths have "a greater likelihood of suicidal feelings and self-harm," and that the environment in which queer individuals exist makes them at-risk of self-harm and suicidal thoughts (4). The need for current policies to combat this behavior is demanding with this evident reality of cyber-bullying towards queer users.

Kull et al. identify the emergence of sexual-orientation-inclusive and gender identity/expression inclusive (SOGIE) policies implemented by schools to combat the negative behaviors that exist in these spaces and promote positive environments for students. The presence of anti-bullying policies that use LGBT+ language increases the sense of safety that students feel in their school spaces (408). Students in schools with these existing policies also "reported lower rates of victimization and hearing biased remarks compared to students without such policies" (408). In offline spaces,

specific LGBT+ policies can be effective in decreasing homophobic and transphobic acts and language as well as promoting the overall well-being of queer individuals.

While Kull et al. focus on bullying and discrimination in *offline spaces*, there are also current policies in place regarding cyberbullying in digital spaces such as YouTube. YouTube's policies include regulations for video content and comments:

> Hate speech refers to content that promotes violence against or has the primary purpose of inciting hatred against individuals or groups based on certain attributes, such as: Race or ethnic origin, Religion, Disability, Gender, Age, Veteran status, and Sexual orientation/gender identity. (YouTube)

YouTubers can report comments that violate the anti-bullying and discrimination policies, and viewers have the ability to report videos for inappropriate content. YouTube specifically bans discriminatory action and language used against the queer community. While the policy is in place, the overwhelming number of comments and videos posted on YouTube are difficult to regulate. Due to the overwhelming amount of content, homophobia and transphobia remain present on the site.

#ProudToBe shows how the comment sections of YouTube videos can be a toxic environment for queer users. A YouTube-sponsored channel in 2016 released a video titled "#ProudToBe: Coming Out Together to Celebrate Identity." The purpose of the video was to highlight the use of YouTube as a coming out platform. The channel provides a two-minute video that consists of short clips of YouTubers coming out via video. This video was a reaction to the mass shooting that occurred at a gay nightclub in 2016. Forty-nine lives were ended and fifty-three people were wounded. It was labeled as "the deadliest mass shooting by one person in United States history." The shooter behind this tragic event was Omar Mateen, and his motives remain unclear. Mateen's father speculates that he "was incensed by the sight of two men kissing in front of his young son" (Barry et al.).

Within two years the #ProudToBe video received close to 10 million views, with 230,000 likes and 298,000 dislikes. Carpenter highlights comments posted in response to this video including: "you're all freaks of society," "So this is what our troops fight for ... disgusting," and "there is only three gender(s) 1. Man 2. Female 3. Mental disturbed" (2). Due to the overwhelming amount of negativity that this video received, the comment section was permanently disabled. However, YouTube still describes itself as:

> A place where anyone can belong no matter who they are or who they love. That is why today we want to help people honor and celebrate who they're #ProudToBe. (YouTube)

This campaign shows not only how homophobia and transphobia exist in the comment sections of YouTube, but also how these behaviors can be blatantly disregarded by the site on which they occur.

The Analysis of YouTube Comments

Previous research has focused on the viewers' responses to online video posts. Bell's study, for example, looks at messages posted to the comments section of videos focusing on self-injury. While Bell's article does not focus on identity narratives specifically, the focus remains on self-disclosure in an online setting. Bell studied the comment section on YouTube to get a better understanding of the impact these videos can have on viewers. The research focused specifically on YouTube because it was "the third most popular web site world wide" at the time of the study (381). The data collection followed two coding rubrics. The first rubric divided comments into the following categories: 1) self-disclosure, 2) feedback directed toward the person who uploaded the video, 3) factual information, 4) help-related comments, 5) NSSI [non-suicidal self-injury] method and strategies, 6) non-engagement, 7) triggers, and 8) indecipherable (382). Once the comments were categorized, the second rubric was used to determine which type of comment was most frequently used in reaction to the video. Results showed that self-disclosure was the most frequent type of response. The research suggests that "individuals may self-disclose NSSI online to receive validation and acceptance for these experiences ... as well as to get peer support from others who self-injure (384). The research used a bottom-up approach linking the findings in the comment section to more global issues of recovery. This research validates the use of the comment section as a data pool and shows how the response comments can reflect bigger, societal issues to be addressed.

Dinakar, Reichart, and Lieberman focus on the negativity present in YouTube comment sections. The researchers used "a corpus of comments from YouTube videos involving sensitive topics ... [such as] aspects that people cannot change about themselves" (11). For their dataset, they treated each comment independently because "while some of the comments were made as responses to previously posted ones, there were no clear patterns of dialogue in the corpus" (12). The comments they collected were divided into four categories according to topic as follows: physical appearance,

sexuality, race and culture, and intelligence (13). Some of the comments were easy to classify as negative in instances of "abuse or profanity or expressions connoting negativity" (14). For example, one comment stated, "as long as fags don't bother me let them do what they want" (15). While this comment possesses a slight form of acceptance in the phrase "let them do what they want", the slur "fags" also implies hostility and a true lack of understanding and sensitivity. The research acknowledges the severity of this language when stating that "comments or posts involving sensitive topics that are personal to an individual are more likely to be internalized by a victim, often resulting in tragic outcomes" (11). With this in mind, the researchers also acknowledge the difficulty in labeling something as negative. Since comments are textual, certain inflections (the usage of sarcasm and euphemisms that are often marked by tone of voice, for example) can be lost through the translation. This research also acknowledges the complexities of categorizing comments by recognizing that the intent of the commenter is not always clear to the researcher. While acknowledging the difficulties when dealing with this type of dataset, the comment section can still give a picture of the struggles, or negative harassment that the queer community faces in online spaces.

Previous research shows an increase of queer users using online spaces to assist in their coming out journeys. Online spaces have shown to help queer users find authentic representation, seek information, and disclose identities. Online spaces also allow users to participate in their coming out journey behind anonymous profiles. Although these positive qualities are present in online spaces, homophobia and transphobia exist in these spaces as well. The disclosures of gay and transgender identities in online spaces will be explored in this research. Comments from viewers will be collected and analyzed to determine the types of disapproval queer users face online, and how these disclosures can assist queer users in their own coming out journeys.

Data and Methodology

The Videos

This research will focus on two coming out videos posted via YouTube and their corresponding comment sections to analyze the ways in which queer users disclose their minority identities and the ways in which other users respond to the disclosure. Two YouTubers, Gigi Gorgeous and Troye Sivan, were selected based on similarities in the format, year posted, and demographics of their coming out videos. Both identify as queer, with Gigi

identifying as a Transgender woman, and Troye as a gay cisgender man. Both identify as White or Caucasian. Troye was born in South Africa, and Gigi Gorgeous was born in Canada. At the time their coming out videos were posted, Troye Sivan was 18-years old and Gigi was 21-years old.

Troye Sivan's "Coming Out" and Gigi's "I am Transgender" were both posted to YouTube in 2014. By 2018, Troye Sivan had received 7.8 million views for his video, and Gigi Gorgeous had received 3.8 million views. Troye Sivan had 6 million subscribers, and Gigi had 2.7 million subscribers. While the 3.3 million difference is significant, both YouTubers have a large viewership which contributes to a wide variety of commentary from the viewers. Since their coming out videos were posted, both YouTubers obtained an element of celebrity status: Gigi starred in her own documentary "This is Everything," and Troye established a successful music career. When looking at their coming out videos, both are relatively short, with Troye's being 8 minutes and 18 seconds long and Gigi's lasting 4 minutes and 9 seconds long. At the time of this study, Gigi's video had received 87,000 likes compared to 4,500 dislikes. Troye had received 520,000 likes and 5,300 dislikes. The comment analysis will further examine the reactions to these videos of self-disclosure.

The Comments

One-hundred fifty comments were pulled from each video. A qualitative analysis was conducted to analyze the ways in which people respond to coming out narratives in online spaces. Comments were divided into three categories: biology, religion, and approval. Within these categories, comments were separated into two sub-categories: individual and general. Comments categorized under "biology" regard the biological state or physical state of the YouTuber. Comments categorized under "religion" make religious references to support their criticism or comment the state of the YouTuber's spiritual soul. Comments categorized under "approval" are those that disclose identities, tell stories, and show support for the YouTuber's identity-disclosure or support for the overall community.

Commenters often react with a focus on either the individual or global aspects. Comments categorized as "individual" are comments that tend to focus on personal one-on-one relationships. Often, the language used directly addresses the YouTuber. Commenters were often found to disclose their own individual identities as well. Comments categorized as "general" tended to focus a more global reaction to sexual and gender identities. The language used calls to a general population or attempts to build community. All comments were categorized once pulled from their respective

videos. Comments that did not appropriately fit into any of the categories were categorized as Indecipherable. These comments include spam, self-promotions, or comments with topics completely unrelated to the specific YouTube video or channel.

Analysis

Biology – Individual

Gigi received a significant number of comments pertaining to this category. A trend of commenters using biology to criticize Gigi's gender identity was found in the data. Commenters show the importance that gender expression and biological anatomy plays in one's identity.

> Ex. 1. I feel like I am trans cause all I want is boobs and long hair and nails and everything a gurl has all I want!!!!

With this message, the commenter expresses a personal consideration of what would make the commenter more female, including "boobs and long hair and nails." These factors include both forms of traditional feminine expression and female anatomy.

Within the dataset, Gigi's anatomy was frequently mentioned, questioned, or used to argue or criticize her identity.

> Ex. 2. did you cut your .... or u still have it

This comment is an example of the importance that is placed on biological markers in relation to gender identity. Further comments show the interest or focus on biology that Gigi receives in her comments.

> Ex. 3. Jesus Christ it's a trap

This comment includes powerful language that lead to implications regarding Gigi's transgender identity. First, the commenter refers to Gigi as an "it" instead of her preferred pronoun "she." This pronoun usage shows how the viewer perceives Gigi as an individual. The commenter also uses the word "trap." This is a slang term used against transgender women. A "trap" in this instance is an individual who dresses as another gender in order to trick people. The term is derogatory and invalidates the gender identity of the individual. Examples 2 and 3 further demonstrate the significance that biological markers play in the validation of gender identity.

Many commenters expressed that anatomy and biological functions that are associated with the traditional female body are most important in regards to gender identity. Many comments demonstrate an attack or deconstruction of the gender identity that Gigi is claiming in her video.

> Ex. 4. Just because you decided to dress up and put make up on your face and play Barbie does NOT make you more women than me.

This comment serves as a direct statement to Gigi. In the video, Gigi stated "My choice to be a woman makes me more woman than most women" (Gorgeous 00:2:45 - 00:2:50). The viewer's comment, while directed specifically towards the YouTuber, attempts to invalidate Gigi's disclosure. Gender expression, "decid[ing] to dress up and put make up on your face and play Barbie," does not then validate Gigi's identity according to this commenter.

Specifically, Gigi's gender identity is also referenced as a choice as opposed to a biological identity.

> Ex. 5. Your CHOICE doesn't freaking make you a woman, and doesn't change the fact that you think, and act as a MAN.

With this comment, the poster again addresses Gigi specifically. The commenter describes Gigi's transgender identity as a "choice" as opposed to something she is born as. Within the comment, the words "CHOICE" and "MAN" are specifically written in all capital letters by the commenter who insists that gender is not a choice and that Gigi is biologically a man regardless of womanly gender-expression. Further comments also exemplify these beliefs.

> Ex. 6. No hun..you aren't more woman than people actually born woman

Again, Gigi's identity as a woman is seen as lesser than through the phrase "you aren't more woman than." This comment creates a hierarchy of womanhood where Gigi is placed below women who are biologically born with female anatomy. Through these comments, Gigi's disclosed identity and womanhood are individually addressed and then denied.

To further demote Gigi's identity, one commenter also used an incorrect name.

> Ex. 7. I can also say "Oh I choose to be black so now I'm more black than you" that's not how things work Gregory.

Gregory was the name Gigi received at birth. Gigi is her preferred name. This commenter disregards that preferred name while simultaneously discounting the credibility of Gigi's female identity. Misgendering is considered harmful because it denounces the claimed gender identity of the individual.

A trend also rose in the comments where commenters referenced women they knew in their lives. This was done to provide an example of a real woman to further criticize Gigi's identity.

> Ex. 8. You're "more woman" than let's say my sister who just gave birth because you like makeup and she doesn't?

This viewer compares Gigi to the viewer's sister in this comment. The viewer makes the argument that his or her sister can give birth. This biological marker, according to the commenter, validates the gender identity of the sister and takes away the validity of Gigi's identity.

Biology – General

While many comments within the biology category showed commenters invalidating Gigi's specific gender identity, many viewers also commented in order to establish more general constructs of womanhood that have societal implications.

> Ex. 9. "My choice to be a woman makes me more woman than most women" How offensive to all the women out there.. Give birth to a child and then say you are more women than me

The comment, "how offensive to all the women out there," references women as a collective group. Womanhood is then validated with the act of giving birth, a validation previously made in Example 8. Here, womanhood is constructed not as a form of expression but a biological performance.

Another comment follows this trend of constructing a general identity of womanhood.

Ex. 10. Will you be able to provide motherly love, breastfeed your child, do you have the motherly instincts that triggers in a woman with her baby?

Ex. 11. However Women have Wombs, Ovaries and monthly periods, Most woman are able to give birth and bare the pain of Birth.

Example 10 lists biological performances such as emotional abilities, the act of breastfeeding, and a "motherly instinct" as necessary in regards to the female identity, and Example 11 includes biological markers such as wombs and monthly periods. While these comments are addressed to the individual YouTuber, both comments feed into a global expectation of female identity.

A few comments within this category used specific language to frame individual opinions as general facts.

Ex. 12. Lmfaooooo have you ever opened a book of biology?

Ex. 13. your genetic code and every single chromosome in your body is that of a male. That's a fact.

Ex. 14. I am offended that these guys consider themselves to be like our Mothers. This can never be.

Within Examples 12-14, the phrases "book of biology," "that's a fact," and "this can never be" are all used to relate individual opinion to global ideas regarding transgender identities. The use of these phrases shows an attempt to strengthen their arguments by tethering them to established, general facts. The trend shows viewers shifting from individual opinion to global norms.

Religion – Individual

Both Gigi and Troye received comments categorized as "Religion," and comments from both of their datasets will be analyzed for this section. Within this category, a few comments referred to the YouTuber's soul and condemnation of the soul. Two commenters from Gigi's dataset exemplify this.

Ex. 15. I hope you go hell SLOWLY

Ex. 16. you and ur stupid logic, ur fans wont save u when u face death

Both comments in a way criticize Gigi's gender identity. However, they do not make assumptions regarding her biological markers, but instead, they regard her soul. Through religion, they directly disapprove of the YouTuber's identity. An example of this is also pulled from Troye's dataset.

Ex. 17. please take him already god, please

Examples 15-17 all show a disapproval for the individual identity of the two YouTubers. As opposed to a general disagreement against a whole community, the comments establish a personal connection between the viewer and the YouTuber. The comments clearly communicate a condemnation of Troye's and Gigi's soul and reference the death of the individual. From the comments pulled, the spirituality of the individual is put into question and completely disregarded by the commenters. Regardless of the YouTuber's personal religious beliefs, the comments assume either that Gigi and Troye are not religious or that their queer identities equate to a state of immorality.

Other commenters are using this space to disclose their individual religious beliefs. While previous examples have demonstrated a disapproval for YouTuber's queer identities, other comments express more positive viewpoints regarding queer individuals.

Ex. 18. I'm Christian and I don't see why people discriminate against gays so much

Within this example, the commenter first establishes her religious identity before expressing her opinion regarding the gay community. While religion has been shown to demean queer YouTubers, this commenter discloses religious beliefs first to contrast it with a not-so-common opinion about the gay community.

Another trend within this category shows a reccurrence of commenters mentioning individuals in their personal lives who identify as religious. The religious individual, whom they mention, tends to have an impact in the commenter's personal coming out journey.

Ex. 19. I recently came out to all of my friends and all of them accepted the fact that I'm gay. My family is pretty bound to traditions because we're Jewish, so this is gonna be a hard nut to crack...I've never been this scared and I fear rejection from my mom.

The commenter, while disclosing his own identity in this message, references his Jewish family and his fears of disclosing his queer identity to them. This fear that the commenter has towards his religious family shows the common association with religion and disapproval towards the queer community. Other comments further explain instances where queer individuals actually disclosed their identities to their religious family.

Ex. 20. I once told my very christian aunt that I'm attracted towards females and she just laughed and thought that I was joking or purposefully saying that just to get attention, because apparently I'm not "one of those".

Here, the viewer recounts her own coming out journey and the specific experience of disclosing her identity to her religious aunt. The comment clearly notes the religious identity of the aunt as "very Christian" which, once again, contrasts with the commenter's identity as queer. The commenter is shown in this instance sharing a very personal, one-on-one interaction with a family member. This shows individual coming out journeys being shared in general, communal online spaces.

Religion – General

While some comments specifically showed disapproval for the individual YouTubers, other comments move towards a disapproval for entire communities of people. In a reaction to the coming out video, commenters use this online space as a space to disclose their own disapproval for a community using religion to validate their criticism.

Ex. 21. WTF all the gays and lesbians are disgusting god create the man for the women to women and men to men so disgusting

This commenter is proclaiming a dislike for "all the gays and lesbians" and therefore moving away from a specific dislike for Troye or Gigi and towards a general dislike for the entire gay and lesbian community. He also validates his argument with the creation story, a biblical reference, by stating "god create the man for the women." While this comment does, in a sense, disapprove of Troye's individual coming out video, this comment has a

much larger implication for the community, as a whole. This message sends a clear criticism to the whole gay and lesbian community. As the comment is a reference to Troye's coming out video, the commenter only addresses sexual identities and does not include gender identities within the comment.

Other commenters use the online space to disclose their opinions regarding the queer community and use religion to both dispute these identities and strengthen their arguments by connecting their opinions to an established set of religious beliefs.

Ex. 22. that's gross, transgender people are disgusting, they make me want to puke #christianvalues

The viewer expresses an individual opinion; however, the comment regards "transgender people" as a collective group, making a generalization. The hashtag "#christianvalues" is an attempt to associate an individual opinion with a set of "values" supported by a religious group. This both conveys a disapproval that is directed to an individual, Gigi, while also making a general comment against a whole community of people.

Approval – Individual

Many posters utilize the comment section to establish a personal relationship with an individual YouTuber. Comments from both Gigi's and Troye's YouTube channels were pulled for this analysis. Example 23 is a comment addressed to Gigi, and Example 24 is addressed to Troye.

Ex. 23. omg u slay girl ... ur the most beautiful girl by looks and personality

Ex. 24. you are brave, cute, and have a lot of charisma

These comments show a relationship attempting to be established between the viewer and the YouTuber. The viewers both use positive, complimentary language to do so. One viewer compliments Gigi's physical appearance writing "ur the most beautiful girl by looks and personality." Another viewer refers to Troye as "brave, cute, and charisma[tic]." This shows viewers using an online space to seek out representation and establishing a personal connection through approval and positive affirmation.

Online spaces can serve as spaces for queer individuals to seek out authentic representation and personal connections, as shown in the previous two comments. Specifically, viewers are sharing their own coming out journeys in these messages. These journey disclosures exhibited a common

pattern: commenters first expressed approval for the YouTuber, disclosed their own queer identity, and then asked for help or simply created a space for response.

> Ex. 25. Hi Gigi. I love your videos! I'm sixteen and I am just coming to terms in my own heart and mind that I myself am transgender (male to female, like you) ... I was wondering if you might have any advice for me? I don't know what to do

With this example, the viewer follows the pattern of approval, disclosure, and open-response. Approval is established by stating, "Hi Gigi. I love your videos!" The commenter then discloses their own queer identity as transgender. The commenter reports being currently on a coming out journey by stating "I am just coming to terms in my own heart and mind." The commenter adds, "I don't know what to do." This last statement opens a space for a conversation between two individuals to occur. This allows other viewers, and Gigi herself, to respond to the self-disclosure.

This pattern also occurs within Troye's dataset. Within his comments, viewers were more likely to disclose sexual identities as opposed to gender identities which occurred more in Gigi's comments.

> Ex. 26. im so proud of you troye, you've come so far from here. Im pansexual but I haven't come out to my family yet, but I have come out to one of my closest friends. I plan to do it on may 24th (national pansexual day). Im not sure how to do it though, I don't think im ready. My parents are completely against LGBTQA+ and my mum literally cant even say the word gay. Ugh help me

Once again, we see the same pattern. The viewer affirms the YouTuber with "im so proud of you troye, you've come so far from here." After the affirmation, the viewer then discloses their own identity as pansexual. This is followed by a disclosure of the viewer's own coming out journey – as Troye did in his video. The comment then ends with "Ugh help me" once again opening the opportunity for response. While she is specifically addressing Troye, this allows for any viewer (as well as Troye) to respond. The viewer is establishing a relationship with the YouTuber while attempting to build a conversation. The coming out journey that viewer shares is an intimate one, but the viewer is willing to share it in a public, online space. With the anonymity that YouTube can provide its users, the viewer has the opportunity to disclose this information behind a pictureless profile.

Approval – General

For the comments categorized under "general," a similar pattern was followed; however, the commenter, instead of asking for help, states a global call to action or provides more general affirmation or advice for the community. This pattern showed up both with Gigi's and Troye's comments.

> Ex. 27. male...female...gay...straight...bisexual...pansexual... transgender... who cares? in the end we're all still human. and if you judge Gigi, or anyone else for that matter, you are wrong for doing that. we love you Gigi, male or female. <3

Here the viewer provides an affirmation, but it is less directed at Gigi. The viewer moves towards a more general affirmation towards all who identify within any gender and sexual identity. The viewer provides support for the individual but directs it at a general population. The viewer states, "if you judge Gigi, or anyone else for that matter, you are wrong for doing that." This type of comment also showed up for Troye.

> Ex. 28. Wow... What an incredible story. When my mom outed me before my dad, he almost killed me at that moment ... So I am very happy for Troye's story and I am sure that it will give an immense inspiration not just for my peers but those out there who are still in the closet ... there always will be at least someone who will support you!

This follows a similar pattern where the viewer affirms the YouTuber. The viewer then discloses their own coming out journey. But, instead of asking for help, the viewer provides an affirmation for anyone identifying as queer, "there always will be at least someone who will support you!" The commenter is speaking with an audience in mind and, therefore, is attempting to build community by addressing a general group. They are relating to anyone within this similar online space who may identify similarly to their coming out journey.

Another comment from Gigi's comment section shows the significance that coming out videos can have on a community of people who share similar experiences or identities.

> Ex. 29. nice to see a TRANSGENDER role model that has what it takes to better the world for trans people WE NEED YOU GIGI keep it up xxx

The viewer refers to Gigi as a "role model." This comment signifies the importance that representation can play for queer viewers in online spaces. Coming out videos do not just impact the individual's journey, but have the potential to "better the world for trans people." This comment shows a viewer recognizing a more global impact that self-disclosure can have for gender minorities as a community.

A comment within Troye's data shows a commenter calling for a more ideal world where people are more accepting.

> Ex. 30. At some point in their lives people make a choice of who they want to be and that choice should be respected.

As a reaction from Troye's coming out video, the viewer calls for an action for all people to respect the choices of others. Within this comment, the viewer is less individually impacted by Troye's self-disclosure. The viewer sees the potential for a more global impact to occur from Troye's coming out video.

Discussion

From my data analysis, a conclusion on whether a gay or transgender individual is received more positively on online spaces cannot be determined. However, the analyzed comments show a slight difference in how viewers respond to the self-disclosure based on the three categories: biology, religion, and approval. The fact that Gigi, the transgender, received more arguments regarding her biological make-up is not a surprise. The misalignment between Gigi's gender expression and identity with her own biological sex is an argument that has been made and researched previously. However, there is an interesting trend that exists which shows commenters evaluating or engaging with her biology. This is found in Examples 2 and 3 where there is a direct engagement with Gigi's biological markers. Within these comments, the viewer is moving away from a theoretical argument regarding the alignment of identity and biological sex towards a direct personal relationship with an individual. This movement from general to individual also shows up in the criticism based on religion.

Troye received the majority of comments that mentioned religion; however, both YouTubers received comments that used religion to criticize their act of disclosure. Religion, like biology, has been the basis of arguments used against all individuals within the queer community. The comments moved away from addressing a general audience, and instead showed a

personal connection between the viewer and YouTuber. This is seen in Example 15 where the viewer states "hope you go to hell SLOWLY." The viewer is transitioning towards a personal criticism against Gigi's gender identity. Example 17 shows a similar personal criticism which states, "please take him already god, please." Within this category, commenters are not only using this online space to make general comments about religious beliefs; instead, they are specifically directing their criticism towards a queer individual. These comments contain both elements of disapproval and condemnation.

Within the comments, trends in the data show an attempt to form both personal connections and to build communities among those with similar identities and coming out experiences. The data shows that, while people showed approval for the YouTuber, they were also seeking approval from others with their own coming out journey. In "Queer Identity Online," the researchers show that many queer individuals go online for both representation, information, and spaces of self-disclosure (Fox and Ralston 636). Within the data, viewers are shown seeking and affirming the YouTubers, who serve as a form of representation. Upon watching the video, viewers then replicate the coming out format within their own comments. Finally, they use the online space to disclose their own queer identity.

With this clear increase of queer individuals using online spaces to self-disclose identities, more research is needed to determine the major implications that the language used can have on both individual users as well as whole communities. Clear homophobia and transphobia continue to exist within these online spaces as collected in the data. With further research, more policies can be implemented to control or prevent discriminatory content in spaces that claim inclusivity and acceptance. While there is significant research regarding the treatment of queer people in physical spaces, a disparity remains for the treatment of queer people in online spaces in the research. Creating a safe space and further support for vulnerable teen populations, specifically those who are still within their coming out journey, is necessary. This identified need requires further study and research regarding implications on positive and negative interactions within these spaces.

There were limitations in this research. In my data, I selected two coming out videos based on the demographics and viewership of the YouTubers. More than two videos could be analyzed in further research to see how other YouTubers, specifically those with a smaller viewership, are received by their viewers. Also, further research could focus on YouTubers with different demographics. For example, both YouTubers I analyzed identify

as white. Future research could study how queer people of color are received in online spaces. The two YouTubers also identified as gay and transgender. Many other queer identities were not included in this research. Further research could focus on how varying queer identities are disclosed and received in online spaces. My overall data set was limited to a total of 300 comments. More data could be collected to see if the trends identified would be reinforced within a larger dataset. The comments pulled for my research focused on initial reactions to the video. This study did not focus on viewer-to-viewer interactions within the comments. Research that analyzed these interactions in the comment section could further reinforce how community is built in online spaces.

Conclusion

Coming out is a journey that queer people all experience. While the journey can seem like an individual experience, it is also a journey that people can experience collectively. With the increase of technology to self-disclose and share coming out narratives in online spaces, coming out no longer has a simple individual impact but a global impact on the queer community. Sharing an individual's coming out journey can impact a multitude of others to share their own identities and journeys. Online spaces break down the barriers of isolation that many queer people have faced in the past. Ellen's proclamation of her queer identity was a confession heard across a country, and now, every individual has the potential to make the same type of proclamation. Coming out videos have global effect because they provide representation, not just for queer people but for all people, to see and hear. While coming out videos can serve as intimate relationships between the viewer and YouTuber, the impact of the disclosure does not end there. The impact changes and shapes the way an entire society views a minority group and their experiences.

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