

What Makes Satires Satirical? Discover Patterns from French Revolution Media with Deep Learning

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(Duplicated from Figure 5) The GAN is a powerful deep learning tool that extracts representative features from images ((a) to (c)) and reconstructs them into “fake” images ((d) to (f)) by logically re-combining body parts (correctly swapping upper and lower bodies, placing the tail, and adding or erasing subjects).

Abstract: *Satirical pamphlet drawings and political engravings were active forces during the French Revolution, when the political struggle was a heated competition to control public opinion. What visual strategies did these two forms of media adopt in order to enhance the*

delivery of ideas? In this study, I first analyzed important visual aspects of the two by comparing their composition of visual elements and construction of thematic motifs. I then utilized the Generative Adversarial Network (GAN), a powerful deep learning (DL) method to extract salient visual features from a dataset of 1,000 digital copies of revolution-era pictures. A GAN was built, which not only automatically classifies a given picture as either "satirical" or "non-satirical", but also synthesizes "fake" pictures that contain visual features typical for each class. The statistically significant visual features extracted by GAN support the argument that political engravings use wide and complex scenes to showcase political tension, meanwhile pamphlet pictures use simple metaphorical motifs to comment on political events and public figures.

1 Introduction

The French Revolution (1789-1814) (herein referred to as the Revolution) affected not only the course of France but also the history of the whole Europe. It was the first time in Western history when a civilization transcended culture, national, ethnic, social and racial boundaries by proclaiming the fundamental rights of human--freedom and equality.

During the Revolution, public opinion was a major battleground, where revolutionary parties competed to be the leaders of the French people. The Revolution crumbled the royal government's media censorship, and the special privileges granted to the propaganda producers (publishers).¹ Stimulated by the heated events of June-July 1789, revolutionary journalists and publishers quickly occupied the media front, creating diverse collections of newspapers and political pamphlets.² In terms of purposes and political tones, the newspapers reported key events in a more objective way, while pamphlets covered more diverse political topics, reflecting on

¹ Jeremy D. Popkin. "Journals: The New Face of News" in *Revolution in Print--The Press in France*. 1989

² Popkin, J

government and institutions and commenting on current affairs and public figures.³ Pictures (printed etchings and drawings) were widely used in both kinds of media, many of which were multi-color and were conveniently mass-reproduced by the two-strike commercial press.⁴ These illustrations supplemented the textual content, delivering powerful and intuitive revolutionary messages to the readers.

Visual compositions of printed engravings (herein used interchangeably with “pictures”) from the Revolution-era printed media largely varied. The first cause was their different purposes. For example, newspaper engravings aimed to record key political events such as the Royal Session of the Estates General, the Tennis Court oath, and the storming of the Bastille, etc., with limited exaggeration (regardless of the newspaper’s political standpoint). However, pamphlets were more free-minded and discussion-based, so they adopted much more hyperbolic rhetorics. In general, newspaper pictures were more realistic depictions of a given event--its people, scene, purpose, and possibly, political tension. On the other hand, pamphlets focused more on political tension, and thus their pictures were more abstract, simple, and to-the-point. The second cause was the technological constraint, namely the limited capability of *efficiently mass-producing* detailed and colorful pictures that describe very complex scenes. Therefore, most newspaper engravings were black-and-white etchings reproduced by wooden hand presses as it was technologically challenging to put colors to complex scenes describing hundreds and thousands of people, vast landscapes, or intricate architectures. However, illustrated pamphlets were more detailed and delicate, as their scenes were not nearly as complex as those of the

³ Antoine De Baecque. “Pamphlets: Libel and Political Mythology” in *Revolution in Print--The Press in France*. 1989

⁴ Pierre Casselle. “Printers and Municipal Politics” in *Revolution in Print--The Press in France*. 1989

newspapers: the lines and shapes were simple and abstract, allowing fast coloring and reproduction.

Thematic motifs present in Revolution-era printed engravings differed as well. As newspapers aimed to describe political events, recurring motifs include the location (foreground architectures and background landscapes), the people (occupations, clothing, and postures), and the activity (tools, weapons, fire, etc). For pamphlet pictures, the motifs were more metaphorical, as they typically utilized very minimal landscape or architectural background and only a few characters morphed in highly abstract and unrealistic shapes (such as exaggerated body parts, animal features on humans, exaggerated body postures etc). Additionally, pamphlet pictures focused more on the interactive relationships between the characters, such as rivalry, suppression, support, or contrast.

However, is this observation *statistically significant* (is it the actual pattern for most Revolution-era imageries), or is it due to subjective artistic intuitions which vary from person to person? In this study, I will answer this question by using the Generative Adversarial Network (GAN) to extract salient image features from a dataset of 1,000 digital copies of Revolution-era newspaper and pamphlet engravings. The GAN is a powerful deep learning (DL) method that is able to not only automatically classify images, but also (more importantly for this study) generate synthetic images of each class using the extracted, class-specific image features. By studying the generated images of each class (“satirical” and “non-satirical”), we can infer the statistically significant attributes of each image category. For example, if the majority of synthesized non-satirical pictures contain lots of people, large buildings, and open landscapes,

then we can conclude that these visual features are statistically significant for newspaper pictures. Similarly, if most synthesized satirical pictures contain only a few characters, have exaggerated and unrealistic forms, or have more vibrant colors, we conclude that these features are statistically significant for the real pamphlet pictures.

This paper is organized as follows: in Section 2, I will provide a detailed historical context of the Revolution-era media development and discuss the the different connotations of printed pictures in terms of visual composition and thematic construction through concrete examples; in Section 3, I will discuss the background of deep learning and GAN in an intuitive fashion and propose my methodology for this study, and then explain the experiment procedures, present the results, and provide analyses; in Section 4, I will discuss the findings and propose future research directions.

2 Historical analysis of Revolution-era media

After the fall of the Old Regime, public opinion became a major battleground, where revolutionary parties competed to lead the political discourse. However, in the beginning, only a few revolutionary leaders recognized the significant potential of the printing press. Among the revolutionaries, journalist and politician J.-P. Brissot firmly believed in “the necessity to render the press, and especially political periodicals, free from this moment on”⁵ and later became one of the most influential forces in the development of free media. J.-P. Brissot was eventually proven correct, as the print press served as a bi-directional communication channel between the common people and the intellectual leaders: newspapers and pamphlets were the platforms of

⁵ Popkin, J

nation-scale public debates, which transferred public opinions to intellectuals, meanwhile enlightenment ideas such as reason, freedom, and equality were fed back to the general public.

The movement of the free printing press and media had a large momentum: it was particularly hard to start, yet it grew exponentially due to the self-propelling *network effect* and eventually became a non-stoppable force of the Revolution. There were two major obstacles: first, the initially crippled printing press industry and media environment due to the totalitarian control of the Old Regime royal government, and second, the technological constraints that forbid mass printing.

Due to long oppression of free media, prior to 1789, Paris only had one daily newspaper, the *Journal de Paris*, which was rather cultural than political. It only focused on reporting literary news, evening shows and other cultural events at the time. Additionally, it featured basic daily information including lottery results, weather reports and local disease warnings.⁶ However, as the Revolution events took place, more and more people from various backgrounds started to submit letters to the editors of *Journal de Paris*. These letters included feelings about the shared urban public space, concerns about the social welfare of the community, and scientific innovations that potentially improve people's lives.⁷ These initially fragmented ideas gradually formed a trend of debates that touched most profoundly on how Enlightenment ideas inspired daily actions. It was exactly through these debates that Frenchmen realized the demand for greater freedom of the press. Because in any economic system, higher demand spur higher

⁶ Kasi Bumgarner, "The first French daily: Journal de Paris". url: <http://historyofjournalism.onmason.com/2014/10/07/the-first-french-daily-journal-de-paris/>

⁷ Elizabeth Andrews, "Between Auteurs and Abonnés: Reading the *Journal de Paris*, 1787–1789". url: <http://hdl.handle.net/2027/spo.0642292.0037.009>.

supply,⁸ the demand for more accessible public information triggers the birth of the new French printing press industry. Many events in the early 1789 accelerated the breakdown of governmental censorship, marked by the Book Guild of Toulouse's revolt against the central administration and a series of resignations of inspectors.⁹ By August of 1789, the censorship system crumbled as a result of a series of protests by major presses and publishers who revoked pensions to the censors.¹⁰ During the year of 1789 (the start of the Revolutions), the press runs of major daily newspapers exceeded ten thousand,¹¹ and among them, the extremely radical *Le Père Duchesne* (edited by Jacques Hébert) had even higher numbers of press runs, because it was heavily subsidized by revolutionary authorities.¹² In short, the development of free printing presses and political events during the Revolution formed a *positive feedback loop*, in which both parts stimulated the upward growth of the other.

The burgeoning printing press industry soon ran into technological bottlenecks, as the industrial foundation necessary for mass printing was lacking in the early years of the Revolution. As the number of press runs increased exponentially, printing shop operations became more complicated, as the same copy had to be prepared several times to parallelize the printing, and night shifts became more popular in order to increase the printing throughput.¹³ Towards the end of 1789, the economic environment gradually became more friendly for the development of the printing press industry, as the ever-increasing demands for free media drove

⁸ Adam Smith, *The Wealth of Nations*. Retrieved from the Library of Congress, <https://lccn.loc.gov/2002564559>.

⁹ Carla Hesse, "Economic Upheavals in Publishing" in *Revolution in Print--The Press in France*. 1989. Page 165-166.

¹⁰ Hesse, C

¹¹ Claude Labrosse, Pierre Rétat, *La diffusion de journal en France en 1789*, La Diffusion et la Lecture des Journaux de Langue Française sous L'Ancien Régime (translated by Google)

¹² Labrosse, C and Rétat, P

¹³ Popkin, J

up the prices for printed goods, which in turn increased press workers' salaries.¹⁴ Despite the increased printing efficiency (thanks to more organized business and operational management¹⁵), the existing dependence of printed goods on wooden hand presses was the main reason the Revolution printing press industry never evolved to a mass press, which explained why the business formation of Revolution-era printing presses were decentralized, independent, and highly variable, and why the printed media produced then were so diverse.

In the following sections, I aim to discover patterns from these highly variable forms of visual media with the help of deep learning. Specifically, I will study an important subset of these forms--the satirical pictures printed on political pamphlets or periodicals--and eventually answer the question, “what makes satires satirical?” i.e., “what artistic and rhetoric tools did Revolution-era political thinkers, journalists, and printing presses use to deliver Revolutionary messages in their printed engravings?”

3 Discover satirical patterns through Deep Learning

3.1 Satirical visual features

The discernible visual features in Revolution-era satirical pictures exist on two levels: the artistic composition (of visual elements) and the rhetoric organization (of thematic motifs). Artistic composition is the most direct visual perception of a given picture--its colors, shape, lines, texture, background and foreground layers, etc. Rhetoric organization, on the other hand, is the arrangement of thematic motifs significant in a specific historical context. For example, the mitre (“Pope's hat”) was a Revolutionary motif that symbolized the clergy, the tricorne

¹⁴ Popkin, J

¹⁵ Popkin, J

symbolized governmental armed forces (such as the National Guard) or the noble class, and the depiction of a feeble man typically represented the Third Estate (Figure).

Artistic composition is the carrier of the deeper rhetorical or satirical meanings. Thus, Revolution-era newspaper broadsides are visually discernible from the contemporary pictures in satirical pamphlets. Non-satirical pictures typically served to describe scenes, whereas satirical pictures served to deliver ideas. Non-satirical scenes contain three important visual elements: the location (foreground architectures and background landscapes), the people (occupations, clothing, and postures), and the activity (tools, weapons, fire, etc). On the other hand, satirical pictures avoided complex scenes and only focused on depicting the relationship between the characters (tension, rivalry, oppression, support, etc).

3.2 Extract visual features with Deep Learning

Computer vision (CV) is a field that studies how computers can gain high-level understanding from digital images or videos.¹⁶ Deep Learning (DL) has helped tremendously in extracting and analyzing visual features. Recent DL developments such as the Convolutional Neural Network (CNN) and the Generative Adversarial Network (GAN) are powerful tools for extracting high-level features from images. The GAN was first introduced by Goodfellow et al.,¹⁷ which is a generative model that synthesizes new data from the existing data. The GAN framework is composed of two networks (the Discriminator and the Generator), which resemble two players who compete to get the better of each other (Figure 2). Specifically, the Generator automatically counterfeits realistic-looking images, and the Discriminator has to discern whether

¹⁶ Computer Vision. https://en.wikipedia.org/wiki/Computer_vision

¹⁷ Ian Goodfellow, "Nips 2016 tutorial: Generative adversarial networks". arXiv preprint arXiv:1701.00160. 2016.

a randomly given image is real or fake. Through the intra-competition between the two parties, they will each get stronger in their respective tasks.

Ideally, training is terminated at the Nash Equilibrium. At this point, the Generator will eventually make highly realistic-looking images that completely fool the Discriminator. Although fake, these images contain significant visual features of the real images. One can think of these fake images as the super condensed, conglomerate features inferred from *all the real images*. By analyzing the generated images, one can infer the most salient visual features for a given image class.

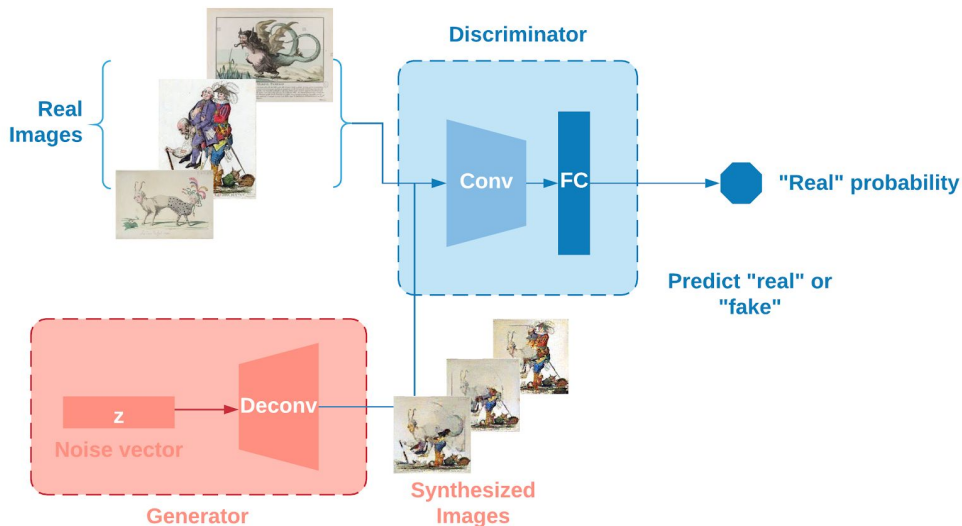


Figure 1. The architecture of unsupervised GAN. The Generator and Discriminator and two neural networks that compete with each other. Throughout training, the Discriminator gradually gets better at differentiating “fake” images from “real” images, meanwhile the Generator gradually gets better at generating realistic-looking images that “fool” the Discriminator.

3.2 Experiments

In this study, I built and trained an unsupervised GAN¹⁸ on two datasets, each containing 550 digital copies of Revolution-era newspapers and pamphlet engravings downloaded from Google Image searches. One dataset contains satirical images, while the other contains non-satirical ones.

For each dataset, the GAN is trained for 5,000 epochs, where one “epoch” means that the GAN goes through all real images *for one time* to learn their features--the GAN has thus gone through the real data 10,000 times for each type of images (satirical and non-satirical). Once the training is completed, I selected the best Generator configuration (the configuration which produces images that most successfully fooled the Discriminator) to produce fake images.

A gridview of the Generator output for both experiments is displayed in Figure 2. We handpicked visually similar Generator outputs corresponding to what appears to be the “guillotine scene” and the “clergyman-nobleman-peasant” illustration. With increasing epoch numbers (left to right, up to down), the Generator learns to output images with increasing clarity and realism.

¹⁸ “Unsupervised” means that the images are not labeled by humans in advance. Because I trained the GAN on two separate datasets (satirical images and non-satirical images), I analyzed the fake images from each dataset to study the visual features of both classes of images.

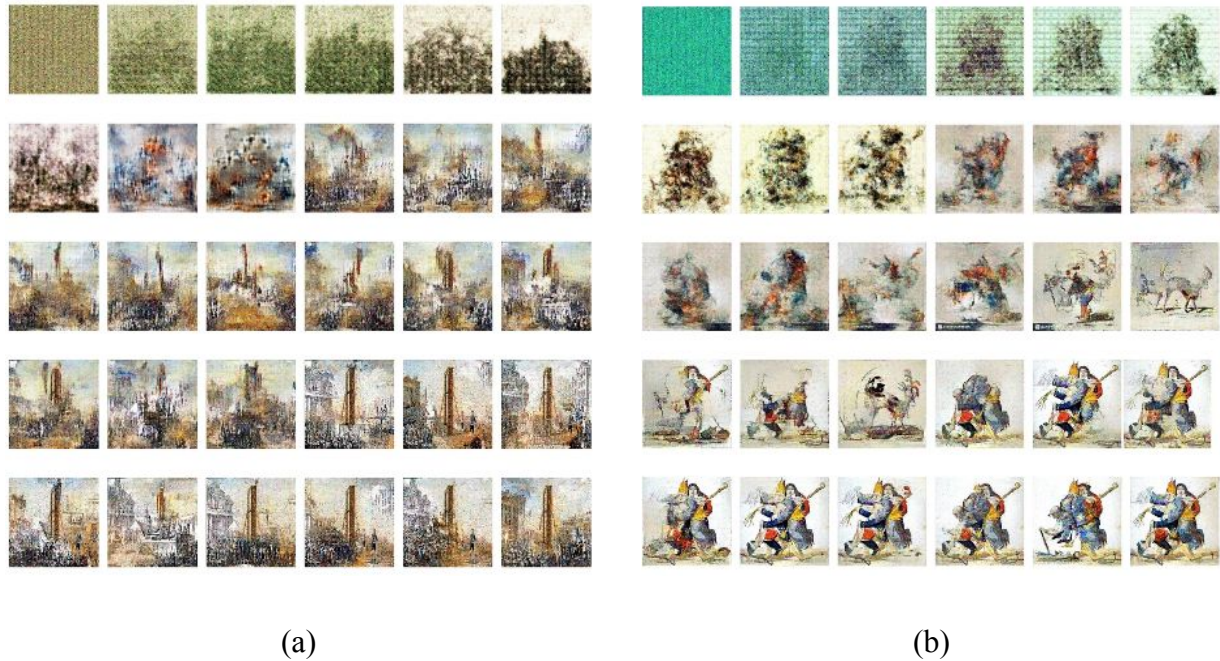
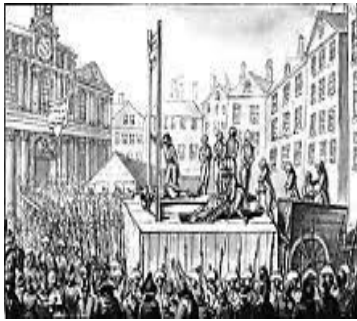


Figure 2. The evolution of Generator output for non-satirical scenes (a) and satirical images (b).

3.2 Analysis

I will conduct my analysis in aspects: visual composition and thematic arrangement. On both levels, the fake images support my argument that non-satirical images contain much larger and complex scenes. The fake non-satirical images successfully captured the vast landscape or architectural background, crowds of people, and the center stage of the scene. For example, in Figure I (c), the background appears to be a large government building, and crowds of people surround what appears to be a guillotine at the center. The fake image was able to capture the three visual elements of a non-satirical scene: the background (in a city), the people (crowds), and the activity (the guillotine). It proves that the fake images were not just random combinations of visual elements from the real data, and the Generator learned how to logically morph the existing visual features into a scene that makes intuitive sense (instead of mistakenly putting the building in the foreground and the guillotine at the background). Additionally,

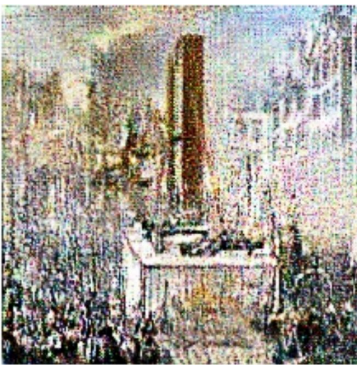
Generator discovered the most salient thematic motifs for non-satirical scenes--the guillotine, the executioner, and the crowd--symbolizing the Revolution, the Revolutionary leaders, and the people.



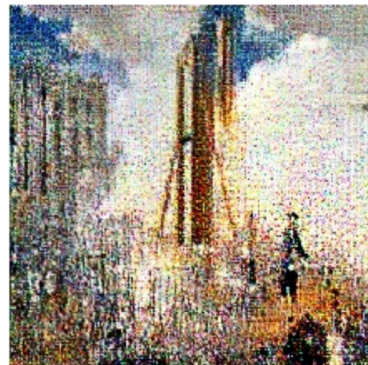
(a)



(b)



(c)



(d)



Figure 3. (a) and (b) are real images, and (c)-(f) are fake images. Note that these fake images contain salient visual features such as the guillotine, and crowd, and the background.

For satirical pictures, the visual elements were captured by the Generator with even more clarity. As the satirical scenes are much more simple, the Generator was able to output more defined lines and shapes (as opposed to the blurriness in generated non-satirical images). Additionally, the Generator also learned how to logically place the objects. As mentioned earlier, satirical pictures focus more on the relationship between characters through their postures and relative physical positions. For example, the Generator swaps the legs of the peasant with those of the prisoner in Figure II (c), whereas in Figure II (d), the prisoner on the bottom was completely swapped by a peasant. Moreover, in Figure III, logical rearrangements of the visual elements are seen, as the Generator not only swapped the characters, but also morphed upper and lower bodies, or added tails to the morphed character. This shows that the Generator captured the key satirical visual elements--colorful shapes and lines, simple scenes, exaggerated body parts, animal features superimposed on human figures, etc.

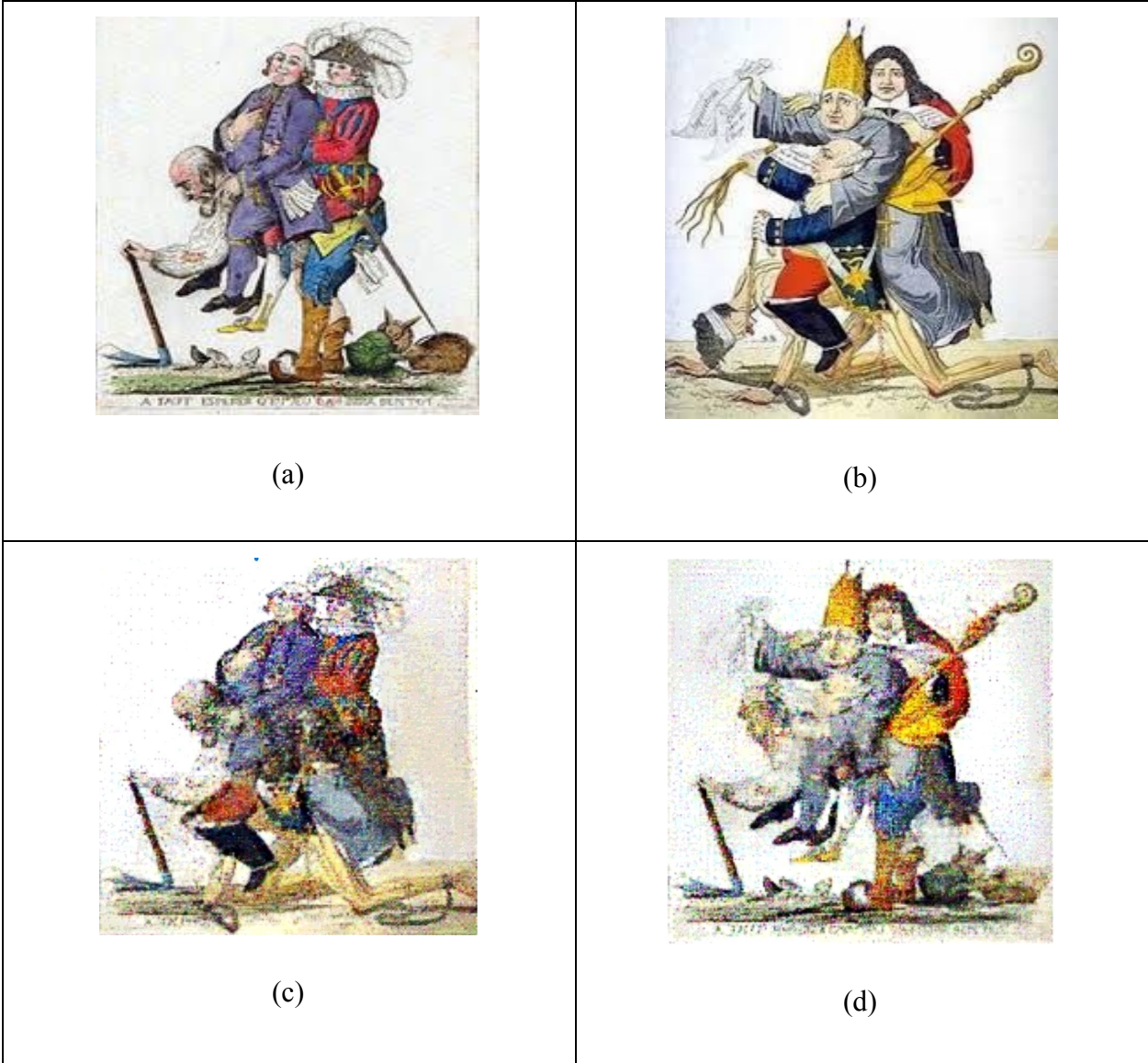


Figure 4. (a) and (b) are real pictures depicting how the Third Estate man (peasant or prisoner) is oppressed by the nobleman and the clergyman. Note that in (c), the legs of the peasants and the prisoner are swapped, and in (d), the prisoner is completely swapped by the peasant.



Figure 5. The top three pictures are real. The bottom three pictures are fake images combining elements of the real pictures. Logical arrangements of body parts and items are observed, such as the correct positioning of the cane, the tail, and the legs.

Overall, the fake images successfully extracted salient features from both satirical and non-satirical pictures, and the results are congruent with my claim that Revolution-era satirical cartoons or pictures use simpler scenes, more vibrant colors, and exaggerated characters to deliver stronger stimuli to its audience, provoking their reactions to the national scale political debates. Meanwhile non-satirical engravings contain much larger scenes, which typically consist of three visual layers: the background landscape or architecture (location), large crowds (participant), and the center stage activity (purpose). Non-satirical engravings delivered strong Revolutionary messages through the recurring motifs such as the guillotine, the executioner, and the crowd, which represent the Revolution, its leaders, and its participants.

4 Conclusion and future research

This study showcases the powerful potential of using deep learning techniques to study historical media. The GAN framework was proven powerful for extracting significant visual features from a large number of images and reconstructing fake but logically congruent images using these salient features. In the era of big data, analyzing history through machine learning and modern computing technologies paves the way to discovering and understanding historical, social and economical patterns, and incorporating these patterns for the betterment of modern policy-making. For future research directions, a larger and more accessible French Revolution digital image dataset needs to be developed, with more sophisticated machine learning frameworks applied to surface hidden semantic relationships among Revolution-era images and text.

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