

# Neural Natural Language Generation for Writing Style Transfer

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## Abstract

We propose to explore the space of neural natural language generation (NNLG) by transferring writing style. Most of the previous work in this field focuses on controlling content instead of attempting to learn stylistic features. We aim to bridge this gap with an approach based on neural image style transfer networks, where the strategy often includes a set of layers designated to learn content (i.e. objects in the images and larger structure trends) and another set of layers designated to learn style (i.e. the RGB values for individual pixels). This work is also inspired from related problems such as author disambiguation and neural machine translation. We can use these fields to explore a variety of problem formulations and approaches in NNLG to lead to a more general way of style transfer that diverges from recent work that focuses on manually extracted stylistic features. Our main challenge will be separating stylistic from content-based features. In the following section we will describe certain problem formulations and approaches that we think are promising.

## 1 Datasets and Possible Approaches

NNLG is an open problem in a relatively uncrowded research space and can hence be formulated in multiple ways. In literature, we have seen people referring to style transfer in the context of NLP both in terms of different authors but also in terms of different genres.

### 1.1 Ficler and Goldberg Review Dataset

Recently, we have also seen papers that use review datasets in order to learn different styles because of the breadth of style formality on the same subject that these datasets provide. An example of two movie reviews with large style variation is as follows, referenced from the Ficler and Goldberg paper.

(1) *“A genuinely unique, full-on sensory experience that treads its own path between narrative clarity and pure visual expression.”*

(2) *“OMG... This movie actually made me cry a little bit because I laughed so hard at some parts lol.”*

These datasets show examples of one author’s interpretation of difference in style can be conveyed succinctly on the same subject.

### 1.2 Viability of Research Study

We think this proposal is viable due to the large collection of datasets that are applicable to the problem. For example, if we choose to interpret to interpret style as that exhibited by different literary authors, then we have access to a large database of literary works that can be extracted from open source collections of text like Project Gutenberg. In the particular case of novels, we can benefit from literature work on author disambiguation. We believe that we can leverage research in this field as a starting point to understand what features the neural network learns when it attributes a particular work of text to an author.

### 1.3 Challenges in NNLG Approaches

The biggest challenge in the space at the moment is the one of separating stylistic and content-related features. Based on our survey of the existing work, researchers have explored isolated style characteristics like length, verbosity, tone, etc. instead of attempting a fully holistic approach. We hope that our approach will provide a more generalized way of learning stylistic characteristics without the need to hard-code these stylistic features.

### 1.4 Related Approaches

We think that this research has also a lot to benefit from the field of Neural Machine Translation. In particular, new exciting advancements like context vectors, the attention mechanism and others could be used to shed light on what makes the writing style of a particular person distinctive. The main challenge with the formulation of style transfer in natural language as a NMT task is that there is no parallel data that we can train on.

Our original interpretation for this work was derived from the field of neural artistic style transfer, where an image is reconstructed in the style of another artist. This field has been practically mastered, with efficient industry applications apparent through Google’s Deep Dream Generator and Microsoft’s StyleBank. The most influential papers in this field suggest the idea of separating content embeddings from style embeddings, which we seek to emulate.

### 1.5 Next Steps

We aim to start with understanding the field of author disambiguation, and then develop iterations upon the neural network architecture for the larger task of>NNLG.

## 2 Team Responsibilities

Proposal: Both Members

Idea Generation: Both Members

Literature Review: Both Members

Theoretical Understanding Focus: Vasilis

Practical Implementation Focus: Vinitra

Project Work: Weekly meetings, both team members

Paper Writing: Both Members – Theory/mathematical focus from Vasilis and Implementation Details from Vinitra

## 3 Background Work

### 3.1 NLP Word Style Transfer

- Controlling Linguistic Style Aspects in Neural Natural Language Generation: <https://arxiv.org/pdf/1707.02633.pdf>
- Texture Synthesis Using Convolutional Neural Networks: <https://arxiv.org/pdf/1505.07376.pdf>
- Stylistic Transfer in Natural Language Generation Systems Using Recurrent Neural Networks: <https://aclweb.org/anthology/W/W16/W16-6010.pdf>
- Some interesting comments on a forum for exploring style transfer for text: <http://forums.fast.ai/t/exploring-style-transfer-for-text/2055/3>

### 3.2 Neural Artistic Style Transfer

- A Neural Algorithm of Artistic Style: <https://arxiv.org/pdf/1508.06576.pdf>
- Image Style Transfer Using Convolutional Neural Networks: <http://ieeexplore.ieee.org/document/7780634/>

### 3.3 Author Disambiguation

- Deep Learning based Authorship Identification: <https://web.stanford.edu/class/cs224n/reports/2760185.pdf>
- KDD competition on Author Disambiguation: <https://www.kaggle.com/c/kdd-cup-2013-author-disambiguation/data>