

Supplementary Material for Neural Linguistic Steganography

A Human evaluation details

The human evaluation uses the same data as the KL evaluation, consisting of 3 sentence contexts and 1 sentence generations. The generations come from 11 sources: arithmetic coding with temperatures 0.4, 0.7, 1.0, 1.2, Huffman encoding with truncation lengths 2^1 , 2^3 , 2^5 , block encoding with block sizes 2^1 , 2^3 , 2^5 , and the original human-written next sentences. For the steganography systems the message is sampled uniformly at random. 80 generations from each source are gathered and randomly mixed into HITs with 5 generations per HIT.

Each HIT asks, “Given the start of a news article: <article> Is the following a likely next sentence: <generation> Yes/No. Please consider if it makes sense in the context of the article, if it contains factually correct information, and if it is grammatically correct.” The workers are additionally given further instructions defining what it means to make sense in context, contain factual information, and be grammatically correct. Human judgment is calculated from the mean response of the workers. We measure absolute human judgment instead of a head-to-head comparison because it is better aligned with the real world use: a viewer would not have access to two continuations of a paragraph, they would have to decide if the given text alone feels out of place.

In addition, each HIT includes one attention check question that can only be passed if the worker reads the entire article closely. HITs with failed attention checks, HITs from workers with frequent failed attention checks, and HITs completed too quickly relative to the other workers are not used for analysis.

B Additional Examples

Tables 1, 2 and 3 gives additional examples of the different steganography algorithms. For each, the context (human written) comes from the first three sentences of a randomly selected CNN/DM article. The message is a uniformly sampled bit string, and the generated cover text is cut off after one sentence. The steganography parameters used for the three tables are $\tau = 0.7$, $k = 300$ for arithmetic, truncation length $= 2^3$

for Huffman, and block size $= 2^3$ for block, which give similar compression efficiencies. The examples are the first four generated for each model and are not curated. For more samples and samples from models with other steganography parameters see <https://github.com/harvardnlp/NeuralSteganography>.

Arithmetic , $\tau = 0.7$, $k = 300$	
Context	kathmandu, nepal -lrb- cnn -rrb- rescue crews and residents in nepal early sunday began the desperate search for survivors after a magnitude-7 .8 quake near the capital of kathmandu a day earlier flattened homes, buildings and temples, causing widespread damage across the region and killing more than 1,800 people. follow the latest coverage of nepal earthquake.
Cover text	While rescue efforts had been concentrated in the capital, rescue operations continued across the entire country, with rescuers unable to find anyone alive in any of many districts.
Context	a man was caught allegedly trying to smuggle two pounds of cocaine worth \$30,000 in pairs of sneakers at jfk airport earlier this month. on april 7, thena adams, flying from guyana in south america was arrested after customs at jfk in new york searched the sneakers in his luggage. when customs opened the soles of the athletic shoes they found \$30,000 worth of cocaine, say airport officials.
Cover text	the shoes were later returned to the airport and it is unknown if the shoes were recovered from the plane or not.
Context	a talented body painter is travelling across america merging members of the public into beautiful back-grounds. natalie fletcher's' 100 bodies across america 'project sees painted individuals blended into the likes of tourist hotspots, forests and ruins. for each work natalie travels to a certain spot in the country before selecting volunteers - not models - who she then paints.
Cover text	to add to the realism of the process, the volunteers are drugged and disoriented after their arrival, and the final scenes are constructed from a series of real-life photographs taken by those who have tried to walk across America.
Context	-lrb- cnn -rrb- sarah brady, who with her husband, james brady, pushed for stricter gun control laws, including the brady handgun violence prevention act, died friday, her family said. brady, 73, died of pneumonia, the family said. "sarah courageously stepped up after jim was shot to prevent others from enduring what our family has gone through, and her work has saved countless lives," their statement said.
Cover text	The brady handgun violence prevention act, or HRP, bans the sale and possession of handguns with a magazine capacity greater than 10 rounds.

Table 1: Additional steganography examples using the arithmetic method. Messages are uniformly random bits, the context is the first three sentences from CNN/DM articles and the generated cover text is cut off after one sentence.

Huffman , truncation length = 2^3	
Context	frank ernest shepherd, iii of houston, texas, led police on a high-speed chase after being pulled over for a traffic stop that ended when he slammed into another vehicle. an unarmed man shot dead by police on live television on wednesday afternoon was a 41-year-old father of three who had another baby on the way. frank ernest shepherd, iii of houston, texas, led police on a high-speed chase after being pulled over for a traffic stop that ended when he slammed into another vehicle.
Cover text	a 41 of 33 (82%) voters in the state of america believe the police should always be on call and armed, while only 22% think they are under the same authority to make arrest and only 16% of americana believe the state should not use deadly force to defend itself.
Context	-lrb- cnn -rrb- ahmed farouq didn't have the prestige of fellow al qaeda figure osama bin laden, the influence of anwar al-awlaki, or the notoriety of adam gadahn. still, he was a big deal. that's the assessment of multiple sources on a man who may not have been well-known in the west, but nonetheless had a special role in the terrorist group.
Cover text	In addition, there was an al Qaeda operative named Abu al-Khalid al Qahtaniai, also called Abu Musab Abu al-Khatib, or Abu Muhaysin al Qahtan, born in Yemen.
Context	the state of oregon on friday released 94,000 emails involving the fiancée of former gov. john kitzhaber, who resigned amid scandal earlier this year over allegations that the former first lady used her relationship with him to land contracts for her business. the emails show the very active role that cylvia hayes, kitzhaber's longtime companion, played in his administration, as well as the tension that it sometimes raised with the governor's staff.
Cover text	hayes has also been linked to the former president, and was involved as the secretary of state's chief deputy, during her first term as secretary in 2006.
Context	masters wednesday began on a sombre note when australian marc leishman, who got so close to victory in 2013 before finishing tied fourth behind countryman adam scott, had to withdraw. his wife audrey spent part of last week in an induced coma owing to a serious infection. leishman left augusta taking with him the best wishes of his sport.
Cover text	he said he had been "very disappointed in myself and my team for the last few days", but added: "I'm happy with my team and I'm happy with the fact my race went well in a very difficult condition.

Table 2: Additional steganography examples using the Huffman method. Messages are uniformly random bits, the context is the first three sentences from CNN/DM articles and the generated cover text is cut off after one sentence.

Block , block size = 2^3	
Context	the ten houses in australia that won't sell, despite being heavily discounted, have been revealed. a recent report, released by sqm research, found the properties across the country which haven't been able to spark enough interest among home buyers even after being on the market for up to two years. among them includes a one-bedroom home in oberon, central west of nsw, which was listed 800 days ago for \$299,000 but the price has since been cut by 50 per cent, the property observer reports.
Cover text	this particular piece sits empty for now, with an estimate from SQMR at just shy, 1,500\$ the total value is \$716M.
Context	doctors have been accused of letting a woman die after wrongly concluding she had terminal cancer. medics told the family of margaret hesketh that there was little they could do for the 70-year-old because she was riddled with tumours, her children will claim at an inquest this week. the family claim she was then put on a discredited liverpool care pathway-style treatment for the dying – having fluid and nutrition drips removed six days before she passed away.
Cover text	her cancer returned when hospital tests revealed tumores but when hospital tests turned on the liquid to cause further harm when her body rejected it she went into a vegetas mode and began suffering seizures at least twice daily over weeks and then went back on this luke-full path to cancer again and began suffering another seizures a week in and weeks which continued for months and was then confirmed after she finally was put in charge of the intensive rehabilitation treatment she had begun and that doctors were now claiming the fluid to treat tumor cells, was 'an important diagnostic tool for people' when really it had caused a death – her family claims her own doctors admitted she might be terminomised but her family has now spoken about the false claims at what the hearing today was set at by Sir James Gaventa and Sir Peter Fahlesworth, the medical directors who are investigating and looking further for evidence of misconduct by they medis.
Context	children may be drawn to greasy fries and burgers, but fatty foods can reduce the speed at which their brains work, according to a new study. it found that children who ate a diet higher in saturated fats and cholesterol had slower reaction times and a poorer working memory. children who ate the fatty diet performed worse when they were given a task-switching game to complete, the researchers said.
Cover text	The results suggest the fats may interfere not only by blocking fat transport between various locations but actually slowing it along.
Context	bruce jenner could be sued by the stepchildren of the woman who died in the pacific coast highway car crash earlier this year - despite the fact they had 'virtually no relationship'. kim howe's two adult stepchildren are said to be considering suing the former olympic athlete turned reality television star following her death. mrs howe was driving a white lexus, which jenner's cadillac escalade rear-ended on a segment of the pacific coast highway in malibu, california, on february 7.
Cover text	the accident led the authorities within days after her fatal, on March 13.

Table 3: Additional steganography examples using the block method. Messages are uniformly random bits, the context is the first three sentences from CNN/DM articles and the generated cover text is cut off after one sentence.