Motivated Manipulators?
A NLP Analysis of Psychopathic Speech

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Abstract

Psychopaths have long been associated with a unique ability to manipulate others (Hare, 1999). According to the "bottleneck" hypothesis of psychopathy (Newman & Baskin-Sommers, 2012), psychopaths' cognitive abilities are directly related to goal-directed behavior. To shed more light on language production in psychopathy, two language production studies were completed contrasting content and fluency under different motivational and difficulty conditions. Individuals high in psychopathy (HP) were less fluent but maintained a more complex lexicon than their low psychopathy (LP) counterparts when under high cognitive load and low motivation. Yet when HP individuals were under low cognitive load and high motivation, they were more fluent, but used a less complex lexicon. Furthermore, the HP group produced more emotional language in both conditions. The results suggest that HP individuals' language production is inherently related to motivation and they attempt to balance fluency and complexity when cognitive load is increased.

Keywords: psycholinguistics, psychopathy, speech production, NLP

Introduction

Psychopathy is a personality trait characterized by emotional callousness, manipulative behaviours, parasitic lifestyle, and antisocial behaviours. Psychopathic individuals are also argued to be charming and manipulative (Hare, 1999), allowing them to perpetuate their lifestyle. Among other factors, the form, such as fluency, and content, such as emotionality, of speech is a crucial component of persuasion and manipulation.

Dual-process models of speech production suggest that the creation of the abstract message to be conveyed, the encoding of the message, and subsequent production, are all discrete processes (Levelt, 2001). Due to its resource intensive nature, the conceptual message formation stage is affected to a greater extent by cognitive load than language encoding. When message formation rate decreases due to higher cognitive load, the production system begins to compensate by producing disfluencies (silent and filled), using simpler, easy to retrieve, words, and reducing the complexity of the message by, for example, using shorter sentences to convey each thought. Even though speech production is a mature area of psycholinguistics, it has not been studied in the context of psychopathy. This knowledge gap hinders our understanding of what aspects of a psychopaths' speech is "charming and manipulative" and, by extension, how their use of language differs from individuals with few psychopathic characteristics.

In previous research on the semantic content of speech produced by psychopaths, Hancock, Woodworth, and Porter (2013) transcribed interviews with individuals incarcerated for murder in which they described the murder they committed. They found that psychopaths used a greater number of cause-and-effect descriptors, had a greater focus on physical needs (food, drink, sex, etc.), used distancing language, and had a greater number of disfluencies. Furthermore, Hancock et al. concluded that psychopaths' speech was less emotional and less pleasant than their non-psychopathic peers. Recently, similar findings were obtained through the analysis of PCL-R interviews (Le, Woodworth, Gillman, Hutton, & Hare, 2017).

However, two studies by Gawda examining individuals diagnosed with antisocial personality disorder (ASPD) found a different pattern of results. ASPD is a disorder that overlaps with the anti-social component of psychopathy. Participants, were asked to write stories based on pictures that displayed emotional scenes (Gawda, 2010). Contrary to Hancock et al. (2013), Gawda found that the ASPD individuals used more repetitions, pauses, and negations. In a follow-up study, Gawda (2013) showed that individuals with ASPD used a greater number of emotional words, and words of a greater emotional intensity, than a control group. Intriguingly, she also found that the antisocial individuals used emotional words of an inappropriate valence for the situation they were describing. Gawda argues that these linguistic techniques are tools for persuading the listener. According to Gawda, the use of repetitions, pauses, negations, and intense emotional lexicon is a way emphasizing certain statements, similar to an experienced orator using these tactics for impact.

Several explanations are possible for why one group of researchers found results that would seemingly contradict the view that psychopaths are charming and manipulative, while others found evidence that confirms the charming view (albeit sampled from a population that did not have identical characteristics; i.e., psychopathy versus ASPD). One starting point for reconciling this discrepancy is to consider how psychopathy is conceptualized in terms of cognitive functioning. According to the bottleneck hypothesis of psychopathy (Newman & Baskin-Sommers, 2012), the behaviours that are commonly associated with psychopathy (e.g., impulsiveness, risk-taking, emotional callousness, etc.) are predominantly the result of goal-oriented behaviour supressing bottom-up processing. The result of this response modulation error is that if a cognitive

process is not directly related to the ongoing attainment of a rewarding goal, it is inhibited.

Another possibility for the divergent results is variation in the amount of cognitive load individuals are subjected to in the experimental tasks. In Gawda's (2010, 2013) studies the use of written responses may have relieved much of the cognitive load associated with the task. In contrast, the requirement for a spoken response in the Hancock et al. (2013) and Le et al. (2017) studies arguably imposed a higher cognitive load.

Present Studies

For the present studies we introduced the variables of cognitive load and level of motivation. Our goal was to see if we could reproduce the previous findings of Hancock et al. (2013) and Gawda (2010, 2013).

In Study 1, a sample of undergraduate participants produced spoken stories under very low motivation conditions. We asked participants to a) provide a truthful recollection of their own choosing; and b) provide us with fictional stories based on each of Ekman (2003) basic emotions. Participants dictated their stories into a microphone with no observers present. In Study 1, the dependent variables of interest were emotional content and linguistic complexity. Following Gawda's (2013) findings, we hypothesized that the high psychopathy (HP) group would produce speech content with more emotion words than the low psychopathy group (LP), but that the valence would be inappropriate for the emotion they were supposed to portray. For switching from recall (low cognitive load) to fictional stories (high cognitive load) we expected the HP individuals would show a significant deterioration in the fluency of their speech. However, we did not have a specific hypothesis about the emotional content.

In Study 2, we analyzed recordings of PCL:YV (Forth, Kosson, & Hare, 2003) interviews with incarcerated male youths (Flight, 2004). We predicted that due to the higher incentive for impression management in a forensic setting, and reduced cognitive load due to the question-answer style of the interview, the HP individuals would produce more fluent language, that is not reduced in complexity, and that it would have more emotional content.

Study 1

Method

Participants

41 undergraduate students volunteered to participate in exchange for course credit. From this original group, 7 participants were removed due to not following instructions, leaving 34 participants (20 female) with a mean age of 20.9 (*SD*= 7.4) years. Of the remaining participants a large subset (*N*=30) had the stories they produced transcribed verbatim. Four participants were excluded based on the reduced quality of their recordings. All participants self-identified English as their primary language.

Measures

Among other measures as part of a larger study, participants completed the Self-Report Psychopathy Scale III (SRP-III) (Williams, Paulhus, & Hare, 2007) short version. A median split was used to divide participants into LP (mean SRP = 36.75, *SD* = 5.66) and HP (mean SRP = 64.70, *SD* = 15.57) groups.

Stimuli

Visual stimuli consisted of six public domain images depicting the emotional categories of anger, happiness, fear, disgust, surprise, and sadness.

Procedure

Participants were tested individually in a sound-attenuated booth. Instructions, stimuli, and questionnaires were presented on a PC using PsychoPy software (Peirce, 2007). Participants' speech was recorded using a headset microphone and Audacity software (Audacity-Team, 2016). Each recording session was preceded and succeeded by a one-second tone denoting the onset and completion of the recording session. The study required approximately 75 minutes to complete.

Analysis

Speech Data

Speech recordings were manually segmented using Audacity software to separate the recordings into different emotional categories. Audio segments were trimmed to two minutes in length to allow for inclusion of participants who produced stories that were less than 4 minutes in length, and to be able to compare the fictional stories with the recollected stories. A total of 476 minutes of audio recording was analyzed. The recordings were subjected to high-pass and low-pass band filters of 500 *Hz* and 1 *kHz*, respectively, to remove non-speech artifacts. Praat software (Boersma & Weenink, 2016) was used to analyze the speech for silent disfluencies. Silences were measured by a modified version of a Praat script, originally created by Lennes (2017), set to detect silences with duration greater than 200 *ms* and intensity lower than 45 db. The 200 *ms* criterion for silent disfluencies was based on work by Jameson et al. (2010). Speech samples with less than 60 seconds of speech or fewer than 50 pauses detected were manually reviewed. A decision was then made to accept the results, or to reconfigure the intensity threshold of silence. Typically, the results were accepted, but some soft-spoken participants' recordings were reanalyzed with a threshold of 30 db. Syllables were counted using the Syllable Nuclei Praat script (de Jong & Wempe, 2009).

Semantic Content

Speech from 30 participants was transcribed verbatim, including the filled disfluencies "um", "uh" and "so". The number of words produced and the number of polysyllabic words produced were also counted. For each word a rating of emotionality, frequency and rank were assigned using

custom Visual Basic scripts. The emotional valence of words was obtained from the NRC Emotion Lexicon (National Research Council Canada, 2011). Frequency and rank values for all the words were assigned according to the Frequency Words list for the 2016 OpenSubtitles dataset (David, 2017). The truncated version containing the fifty thousand most frequent words was used in the present analysis. The OpenSubtitles dataset was chosen over more traditional frequency lists because it is based on television transcripts, which provide a much closer approximation to spoken language than frequency lists based solely on written texts. Furthermore, the words were not stemmed to allow for the inherent complexity contributed by affixes.

Results

Participants were divided into HP and LP groups using a median split based on SRP scores. A series of mixed 2 (LP vs HP; between) x 2 (truthful recall vs fiction; within) ANOVAs were performed to test the hypotheses that the HP group's fluency and/or linguistic complexity would be reduced when producing fictional stories relative to recalling an actual, true event, but a similar trend would not appear in the LP group. Specifically, we expected to observe in the HP group: a reduction in the number words produced, a reduction of polysyllabic words (3 or more syllables) produced as a function of all words, an increase in silent pauses, and an increase in verbalized disfluencies; we predicted that LP individuals' fluency and complexity would not significantly change from recall to fiction. As per Rubin (2017), who argues that family-wise error adjustments in exploratory research is only needed when multiple tests of the same hypothesis are performed, each specific hypothesis was treated as a separate test with follow-up pairwise comparisons' significance criteria Bonferroni adjusted to .0125 (.05/4). All reported alpha values are unadjusted.

Gender

Male participants, on average, had higher SRP scores (M = 56.1, SD = 15.7), compared to females (M = 47, SD = 19.4). However, this difference was not statistically significant ($F(1, 33) = 2.10$, $p = .16$, $d = 0.52$), suggesting that gender differences in psychopathy did not significantly affect this study.

Words Produced

No significant main effect was observed for the number of words produced across all story types ($F(1, 28) = 2.62$, $p = .12$, $\eta_p^2 = .09$), nor between HP and LP participants ($F(1, 28) = .36$, $p = .55$, $\eta_p^2 = .01$). However, a significant interaction between psychopathy level and story type was observed ($F(1, 28) = 4.97$, $p = .034$, $\eta_p^2 = .15$). Consistent with our hypothesis, pairwise comparisons showed that the HP group had a significant decrease in the number of words produced between true ($M = 311.7$, $SD = 76.9$) and fictional stories ($M = 274.5$, $SD = 75$); $F(1, 16) = 7.95$, $p = .007$, $d = .49$. No significant change was observed when the LP individuals were switching from truthful recall to fictional stories, nor were significant differences observed between the HP and LP individuals in the recall or the fictional story conditions.

Polysyllabic Words

No significant main effect was observed for the number of polysyllabic words produced as a function of all words within participants ($F(1, 28) = 0.15$, $p = .70$, $\eta_p^2 = .01$), nor between participants ($F(1, 28) = .50$, $p = .49$, $\eta_p^2 = .02$). However, a significant interaction between psychopathy level and the number of polysyllabic words produced as a function of all words was observed ($F(1, 28) = 4.57$, $p = .041$, $\eta_p^2 = .14$). Follow-up pairwise comparisons showed no significant within group differences when switching from truthful recall to fictional stories in the number of polysyllabic words produced for the LP individuals. Furthermore, no significant group differences were observed in the recall condition. However, as predicted, the HP group ($M = 0.066$, $SD = 0.009$) produced significantly fewer polysyllabic words as a function of all words produced in the fictional story condition compared to the LP group ($M = 0.077$, $SD = 0.0095$); $F(1, 28) = 10.99$, $p = .003$, $d = 1.21$.

Silent Disfluencies

A significant main effect was observed for the sum of silent intervals within participants ($F(1, 32) = 8.33$, $p = .007$, $d = 0.49$), with the recall condition containing significantly fewer silences ($M = 35.43$, $SD = 13.20$) than the fictional story condition ($M = 41.49$, $SD = 11.47$), but no between participants ($F(1, 32) = 1.20$, $p = .28$, $\eta_p^2 = .04$) main effect was observed. Furthermore, a significant interaction between psychopathy level and total silence was observed ($F(1, 32) = 4.48$, $p = .042$, $\eta_p^2 = .12$). Follow-up pairwise comparisons showed no significant group difference in the recall condition nor were significant differences observed within the LP group when switching from recall to fictional stories. A non-significant between-groups difference was observed in the fictional story condition with the HP ($M = 45.68$, $SD = 11.12$) individuals producing more silent pauses than the LP ($M = 37.29$, $SD = 10.50$); $p = .031$, $d = 0.78$. Finally, as predicted, it was observed that HP individuals had a significant increase in the total duration of silence when switching from recall ($M = 35.59$, $SD = 11.79$) to fictional stories ($M = 45.68$, $SD = 11.12$); $F(1, 16) = 18.04$, $p = .001$, $d = 0.48$.

Verbalized Disfluencies

For verbalized disfluencies, contrary to our hypothesis, the omnibus test did not reveal any significant differences as a function of psychopathy [$F(1, 28) = 0.12$, $p = 0.79$, $\eta_p^2 = .04$] or story type [$F(1, 28) = 1.10$, $p = 0.30$, $\eta_p^2 = .04$], nor was there a significant interaction [$F(1, 28) = 1.04$, $p = 0.32$, $\eta_p^2 = .04$].

Zipf's Law

To further explore the finding that the HP group's fluency suffered due to the added cognitive load of creating

a fictional story, we modeled the rank and frequency of all the words produced by the HP and the LP groups in both conditions (Zipf, 1950). For this analysis, articles and disfluencies were removed from the corpus. The recall condition showed virtually no distinction between the regression slopes of the HP (β = -1.008) and the LP (β = -0.995) groups. However, contrary to our prediction, a model of the fictional stories showed that the HP group had a smaller deviation (β = -1.208) from the ideal of -1 than the LP group (β = -1.243), suggesting that the set of words they produced are a more optimal conveyer of information (Zipf, 1950).

Emotional Lexicon

Based on the work of Gawda (2010, 2013), we hypothesized that the HP group would produce stories of a greater emotional intensity, but the emotional valence would be less appropriate for the stimuli (e.g., being happy at a funeral).

Congruent with our hypothesis, HP individuals produced a significantly greater number (M = 32.5, SD = 5.7) of emotional tokens in the truthful recollection condition compared to the LP group (M = 24.2, SD = 4.9); $t(28) = 1.86$, $p = 0.037$, $d = 1.57$ (See Figure 1).

A one-way ANOVA was used to determine if the HP group produced more inappropriate emotions than the LP group. Emotional appropriateness was operationally defined as the ratio of target emotional tokens and the sum of the other five emotional tokens. However, contrary to our hypothesis, no significant group or individual differences were present in the intensity or the appropriateness of the emotions produced between the HP and the LP groups for any of the emotional categories.

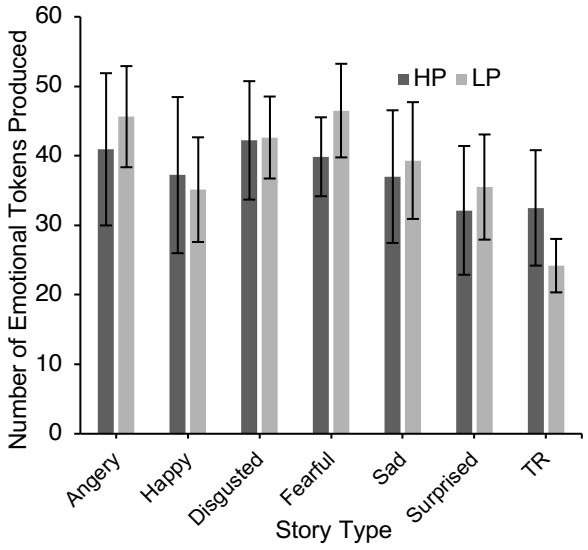

Figure 1. Total emotional tokens produced during each story condition. Error bars indicate 95% confidence intervals. TR = True Recall.

For further analysis, we submitted the emotional lexicons to a log-linear model to test if the HP group used a cognitive trade-off between complexity and appropriateness of emotional words, similarly to the trade-off they made between fluency and complexity of words. Once again, contrary to our hypothesis, the HP group (β = -1.337) and the LP group (β = -1.350) had virtually no difference in the slope of their regression lines. This finding suggests that the emotional lexicon of the two groups does not differ in complexity.

Conclusion

Study 1 findings provide mixed evidence for our hypotheses. We found evidence that HP individuals are affected to a greater extent by increased cognitive demands in a low-motivation task relative to their LP peers. This hypothesis was supported by the observed reductions in the HP individuals' use of polysyllabic words, and an increase in silent disfluencies, as well as an overall reduction in the number of words produced. However, we also observed that, contrary to our hypothesis, HP individuals produce a more optimal set of words in their fictional stories than did LP individuals. Finally, we found that HP individuals produce more emotional words, but we did not find that the emotions they were expressing were "inappropriate".

Study 2

Participants

Transcripts used in this study were derived from interviews of individuals recruited in a previous study by Flight (2004). Flight's participants were sixty incarcerated adolescent males who ranged from 16 to 20 years old (M= 17, SD=0.9) when interviewed. These individuals were incarcerated in Ontario, Canada. From this original group of 60 participants, a subset of 31 was selected for inclusion in the present study based on the audio quality of the recordings.

Materials

The data in the present study were derived from 60-90 minute semi-structured interviews that were part of an evaluation for psychopathy using the Psychopathy Checklist: Youth Version (PCL:YV) (Forth, Kosson, & Hare, 2003; Neumann, Kosson, Forth, & Hare, 2006).

Analysis

Speech data from 31 participants were transcribed verbatim by a team of volunteers. For each interview the filled disfluencies "um" and "uh" were counted. Furthermore, the number of words produced, and the number of polysyllabic words (3 syllables or more) produced was also counted. For each word, a rating of emotionality, frequency and rank was assigned using custom Visual Basic scripts. The emotional valence of words was obtained from the NRC Emotion Lexicon (National Research Council Canada, 2011). Frequency and rank values for all the words were assigned according to the

Frequency Words list for 2016 OpenSubtitles dataset (David, 2017).

Results

Fluency

Because the data were not normally distributed, we used Spearman's rho.

Congruent with our hypothesis, a negative relationship was observed between psychopathy scores and the number of verbalized disfluencies produced (r_s = -.45, p = .019), with the strength of the relationship increasing when disfluencies were counted as a function of all words produced (r_s = -.52, p = .006). No significant relationship was observed between psychopathy and the number of words produced.

However, findings from analysis of the complexity of the words used by the HP and the LP groups were contrary to our hypothesis. First, it was observed that the polysyllabic words, as a function of all words produced, were negatively correlated with psychopathy scores (r_s = -.42, p = .029). Furthermore, when the rank and frequency of the words were subjected to a log-linear model, the LP group had a much smaller deviation of β = -1.338 from the ideal of -1, compared to the HP group, with a regression slope of β = -1.432, suggesting that the HP group's lexicon is less complex.

Emotional Lexicon

Congruent with our hypothesis, a significant positive correlation was observed between the total number of emotional tokens produced and psychopathy scores (r_s = .43, p = .026); this relationship was also observed when the emotional tokens were taken as a function of all words produced (r_s = .43, p = .026). Furthermore, a significant positive correlation was observed for the specific categories of anger (r_s = .49, p = .009), disgust (r_s = .38, p = .048), and fear (r_s = .42, p = .030). Overall, words with a negative emotional valence were positively correlated with psychopathy scores (r_s = .43, p = .027).

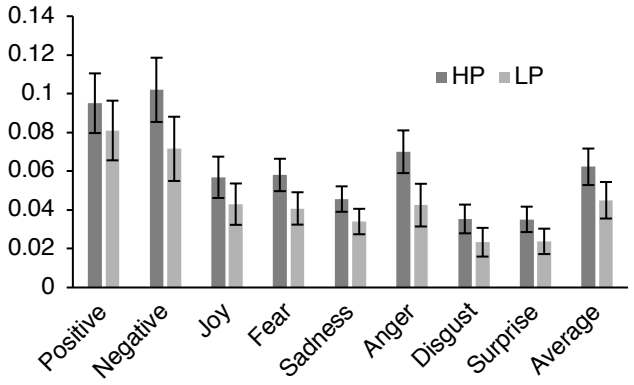

Figure 2. Proportion of emotional tokens produced as a function of all words produced during PCL-YV interviews. Error bars indicate 95% confidence intervals.

An incidental finding showed a significant positive correlation between emotional words produced as a function of all words produced, and psychopathy scores for Facet 1, interpersonal manipulation, (r_s = .46, p = .015) and Facet 4, antisocial behaviors, (r_s = .40, p = .040). When the emotional lexicons for the HP and the LP groups were subjected to the log-linear model, no difference was observed, with LP group's regression slope being β = -1.276 and the HP group's slope being β = -1.275

Conclusion

We found mixed evidence for the hypothesis that HP individuals, presumably under high impression management pressure, would not experience speech production deficits while producing more emotionally charged content. Supporting this hypothesis, we found that HP individuals produced fewer verbalized disfluencies. However, they were observed to produce less complex content than their peers. Finally, we observed that, congruent with our hypothesis, the HP individuals produced a greater number of emotional tokens.

Discussion

We conducted two studies to evaluate psychopathic language under different conditions of cognitive load and motivation. In Study 1, we sampled from an undergraduate population and manipulated their cognitive load during speech production under low motivation. In Study 2, we sampled from an incarcerated population under high impression management pressure. We hypothesized that under all conditions the high psychopathy (HP) individuals would produce more emotional content, but the fluency and complexity of their speech would fluctuate as a result of changing motivation and cognitive load.

In Study 1, we found evidence that the HP group's fluency deteriorates due to increased cognitive demands. However, we found mixed evidence with regard to complexity, with a significant reduction in polysyllabic words supporting our hypothesis, but the results of log-linear model contradict our hypothesis. Finally, we did find that the HP individuals produced significantly more emotional speech in the low cognitive load conditions, but this difference disappeared when cognitive load was increased. Study 2 replicated the finding that HP individuals produce more emotional words. Similar to other studies (Hancock et al., 2013; Le et al., 2017), we found that psychopathy is positively related to the production of angry, and generally negative emotional words. However, we also found that the HP individuals produce more words related to disgust and fear. Furthermore, we also replicated, contrary to our hypothesis, the finding that psychopathy is negatively related to linguistic complexity. Finally, we did find support for our hypothesis that motivation makes HP individuals' speech more fluent. We interpret this pattern of results as suggesting that individuals high in psychopathy traits, when motivated, produce more fluent and emotional language as a

manipulation technique, but are more vulnerable to cognitive load than their low psychopathy peers.

We believe that one reason for the divergence between our findings and those of Le and colleagues (2017), as well as Hancock and colleagues (2013), is the use of varying operational definitions. For example, Le and colleagues considered a disfluency filler statements (e.g., "you know", "like", etc.), whereas in our study we counted simple statements towards reduced linguistic complexity. Another possible source of divergence is the use of analytical tools. For example, in the current study we used an emotional dictionary that contained all 6 basic emotional categories, whereas the dictionaries used in other studies primarily focus on the distinction of positive and negative valence, as well as other categories such as "anxiety". Another source of variance is that the analysis, and emotional dictionary, used in our study did not stem words, so that "happy" and "unhappy" would be rated as polar opposites. Other studies did not include this information in their methods.

Limitations of this study include the absence of a high motivation condition with high cognitive load. In the absence of a manipulation of motivation in the HP group it is difficult to infer the exact effect that motivation plays in this group's speech production. In addition, the range of psychopathy in Study 1 was limited due to using a sample of university students. Finally, studies of language use as a function of personality characteristics are constrained by small sample sizes that may cause undue sampling error, which, in turn, may cause different studies to yield different patterns of results.

Overall, we obtained results that are partially consistent with previous work and with the theoretical mechanisms proposed to account for the cognitive processes underlying psychopathy (i.e., Response Modulation Theory and capacity limitations in working memory). Clearly, additional studies are required to resolve differences in results across studies. Future work must focus on employing consistent methods (types of participants, stimuli, and tasks, as well as methods of speech content analysis) to clarify the relationship between psychopathy and language use.

References

David, H. (2017). Frequencywords. 2016, from https://github.com/hermitdave/FrequencyWords/

de Jong, N.H., & Wempe, T. (2009). Praat script to detect syllable nuclei and measure speech rate automatically. *Behavior Research Methods, 41*(2), 385-390. doi: 10.3758/brm.41.2.385

Ekman, P. (2003). *Emotions revealed* (2 ed.). New York: St. Martin's Press.

Flight, J.I. (2004). *The association between motivations for violence, the victim-offender relationship, and psychopathic traits in violent youth.* (Masters Thesis), Carleton University, Ottawa. Retrieved from http://catalogue.library.carleton.ca/record=b2064213

Forth, A.E., Kosson, D., & Hare, R. (2003). The Hare PCL: Youth Version. *Toronto, ON: Multi-Health Systems*.

Gawda, B. (2010). Syntax of emotional narratives of persons diagnosed with antisocial personality. *Journal of PsycholinguisticRresearch, 39*(4), 273-283. doi: 10.1007/s10936-009-9140-4

Gawda, B. (2013). The emotional lexicon of individuals diagnosed with antisocial personality disorder. *Journal of Psycholinguistic Research, 42*(6), 571-580. doi: 10.1007/s10936-012-9237-z

Hancock, J.T., Woodworth, M.T., & Porter, S. (2013). Hungry like the wolf: A word-pattern analysis of the language of psychopaths. *Legal And Criminological Psychology, 18*(1), 102-114. doi: 10.1111/j.2044-8333.2011.02025.x

Hare, R.D. (1999). *Without conscience: The disturbing world of the psychopaths among us*. New York: Guilford Press.

Jameson, A., Kiefer, J., Muller, C., Großmann-Hutter, B., Wittig, F., & Rummer, R. (2010). Assessment of a user's time pressure and cognitive load on the basis of features of speech. In H. C. Siekmann, Matthew W (Eds.), *Resource-adaptive cognitive processes* (pp. 171-204). Berlin; London: Springer.

Le, M.T., Woodworth, M., Gillman, L., Hutton, E., & Hare, R.D. (2017). The linguistic output of psychopathic offenders during a PCL-R interview. *Criminal Justice and Behavior, 44*(4), 551-565. doi: 10.1177/0093854816683423

Lennes, M. (2017). Spect - speech corpus toolkit for Praat (Version 1.0.0). Retrieved from https://github.com/lennes/spect/releases

Levelt, W.J.M. (2001). Spoken word production: A theory of lexical access. *Proceedings of the National Academy of Sciences of the United States of America, 98*(23), 13464-13471. doi: 10.1073/pnas.231459498

National Research Council Canada. (2011). *NRC emotion lexicon*.

Neumann, C.S., Kosson, D.S., Forth, A.E., & Hare, R.D. (2006). Factor structure of the hare psychopathy checklist: Youth version (PCL: YV) in incarcerated adolescents. *Psychological Assessment, 18*(2), 142-154. doi: 10.1037/1040-3590.18.2.142

Newman, J.P., & Baskin-Sommers, A.R. (2012). Early selective attention abnormalities in psychopathy. *Cognitive Neuroscience of Attention*, 421-440.

Rubin, M. (2017). Do p values lose their meaning in exploratory analyses? It depends how you define the familywise error rate. *Review Of General Psychology, 21*(3), 269-275. doi: 10.1037/gpr0000123

Zipf, G., K. (1950). *Human behavior and the principle of least effort.* Hoboken, NJ: John Wiley & Sons