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Abstract

Deception is a foundational part of everyday interactions, and everyone will be deceived and will be a deceiver at some point in their life. When examining the brain while telling a lie, neuroimaging studies have shown an increased activity in the prefrontal cortex. While some evidence does not find a correlation between deception and prefrontal activity, different types of deception activating different brain regions could explain this. The prefrontal cortex is responsible for planning and executive control, which appears to be the main cognitive process associated with deception. This is evidenced by the ability to lie increasing as executive function develops in young children, and that lying becomes more difficult when executive function is strained. Lie detection in forensic settings is the most applicable use of the cognition of deception, and interviewers that use cognitive methods to detect deception do so at a significantly higher rate than chance (50%). Despite this finding, law enforcement and other investigative careers have not fully implemented cognitive deception detection into practice.

Deception is a part of everyday life, and something that all humans will encounter at some point in their respective lives. While deception and dishonesty have been debated about and studied since the beginning of time, a newfound movement has begun to study deception through cognition and cognitive processes (Zuckerman, Depaulo, & Rosenthal, 1981). While the act of deceiving had been studied empirically before, Zuckerman et al. (1981) provided the foundation for the cognitive study of deception and the practical study of cognitive lie detection that most recent research is built upon. This foundation included the basis for theoretical and methodological testing in future deception studies. Deception literature has primarily focused on three main areas: neurological correlates of deception (Abe et al., 2008), cognitive processes that factor into telling lies (Gombos, 2006), and practical applications of cognitive lie detection (Virj, Fisher, & Blank, 2015). The purpose of the present writing is to provide a cohesive understanding of the existing literature, and to suggest why this may be so important in the current political and social landscape.

Neurological Underpinnings of Deception

While Zuckerman et al. (1981) provided a theoretical basis for the study of deception; one area that was not as heavily understood was the neurological basis for deception and lie telling. To study properly study lying and lie detection, one must be able to understand how deception works in the mind, and which areas are associated with deceit. Due to newfound technological advances, such as the fMRI; researchers have been able to better identify which regions of the brain factor into deceptive processes (Abe et al., 2008). This research identified different regions of the brain that were active when participants were asked to either identify: words they had actually saw (true memory), semantically related words (false memory), and when asked to falsely identify new words (deception). Deception was mainly characterized by prefrontal activity, specifically activation within the dorsolateral prefrontal cortex. This differed between retrieving an actual memory, as actual memories showed increased activation within the anterior hippocampus and areas related to language processing. What truly set the deception activation apart from the actual memories was the inclusion of a false memory condition. False memories showed hippocampal activity, however they provided no activation in areas associated with language processing, thus the study provided correlational evidence that participants were not incorrectly remembering information and were truly trying to deceive investigators. Follow-up analysis (Abe et al., 2014) also supported the notion that the dorsolateral prefrontal cortex plays a significant role in the process of deception.

Further study has been done investigating the role of the prefrontal cortex during deception (Karim et al., 2009). This research reinforced the notion that the prefrontal cortexes play a significant role in deception, however this finding expanded the regions associated. This study provided evidence that the anterior prefrontal cortex (aPFC) played a significant role when trying to deceive an investigator. Using a process known as transcranial direct current (TCDC) stimulation, investigators were able to inhibit the excitability of this region of the brain while participants were being asked about a deceptive behavior that they had just completed. When this region was inhibited, participants were able to lie at a much higher rate as exhibited by: faster response times, less guilt while lying, and a higher overall lying quotient, a statistical measurement that rates liars deceptive abilities. With this region inhibited, liars were able to ignore the cognitive measures that make lying more difficult than truth telling as described by Zuckerman et al. (1998). While some evidence has been provided that the aPFC does not have significantly higher importance during deception (Panasiti et al., 2014), the lack of a true moral cognitively demanding task or the lack of a high-stake situation (Caso, Gnisci, Vrij, & Mann, 2005) can usually explain the finding.

While Abe et al. (2008) did not find evidence of aPFC activity during deception, Karim et al. (2009) provides evidence that different brain regions may be active during different types of deception. Abe et al. (2008) strictly asked participants to lie about a word they saw, however in the Karim et al. (2009) study, participants had to make a moral judgment about deceiving an investigator, thus explaining the activity in the aPFC. Abe et al. (2014) specifically measured different types of dishonestly, as participants' brain activity was measured as they told altruistic lies, harmful lies, or a control judgment. They found a significant within-subjects difference that showed that different brain areas were activated when telling harmful lies that were not activated when telling altruistic lies. This collection of evidence (Abe et al., 2008; Karim et al., 2009; Abe et al., 2014) solidifies the idea that different brain regions are used when telling different types of lies, however the prefrontal activity remains a vital part of the lie telling process.

Cognitive Processes of Deception

With evidence (Abe et al., 2008; Karim et al., 2009; Abe et al., 2014) exemplifying the notion that the prefrontal cortex has a distinct impact on the lying process, the next stage in the research is to examine the cognitive process associated with those brain regions. The earliest cognitive examinations of lying did not specifically address the role of executive function (Zuckerman et al., 1981), however it was theorized that working memory might play a distinct role in the process. As empirical data was collected, it became more apparent that executive function was a major cognitive process that oversaw much of the lying process (Gombos, 2006). This research highlighted how the main executive functions: inhibition, task-switching, and working memory factor into telling an average lie. The deceiver must be able to remember the fabricated lie (working memory), be aware and incorporate of feedback from listener (task-switching), and not allow the truth to seep out verbal or nonverbally (inhibition). These functions, along with planning, metacognitive awareness, and problem-solving all highlight the important cognitive link between lying and the prefrontal cortex, especially the executive control functions.

To distinctively measure the role of executive function in regards to lie detection, one must be able to see how lying changes when executive function's role is reduced. Evans, Xu, and Lee (2001) used their understanding of child development to further the literature that relates executive function to the lying process. They measured children, age's three to five, and their ability to lie when they were caught red-handed lying to experimenters. They hypothesized that due to the lack of prefrontal development in the younger children, they would lie less overall and that the sophistication of their lies would be worse than their older peers. Their hypotheses were confirmed, and they also found a significant relationship between children's quantified executive function scores and the sophistication of their lies. Children with higher executive function scores were better able to fabricate lies to the experimenter, and experimenters linked this to enhanced inhibition skills shown by the children.

While Evans et al. (2001) was able to provide evidence of executive control correlating with children's lying ability, is this finding replicated in adults? While executive functioning cannot be completely turned off, Debey, Verschuere, and Crombez (2012) used a unique study design in which made executive functioning harder on the participant to test for links to deception. Participants were given a Stroop Test, a commonly used tool to measure executive function, but manipulated the time in which they had to wait before subsequent trials. In a normal Stroop Test, trials are provided instantly after the participant provides an answer, thus attention to the task is easier to maintain. In this experiment, the time between the participants' answer and the next trial was delayed which strained executive function by making it harder to maintain attention on the task. Different from most other Stroop Tests, participants were asked to lie and give incorrect answers. When attention and executive function were strained by the delay, participants had longer response times and made more errors than in the condition where trials were provided without a delay. These results are consistent with previous findings where participants are going through a more cognitively demanding task (Zuckerman et al., 1981), thus showing that executive function was indeed impaired by the time delay. In sum, proper executive functioning has shown an increase in lie telling abilities, as evidenced by decreased deceptive abilities due to underdevelopment (Evans et al., 2001) or impairment (Debay et al., 2012).

Are there other cognitive processes that underlie deception besides executive control? Vrij, Oliveira, Hammond, and Ehrilichman (2015) suggest that long-term memory (LTM) may also play a significant role in the deception process. They measured if participants showed more saccadic eye movement when asked to tell the truth, a planned lie, or a spontaneous lie. They found 68% more saccadic eye movement when participants were asked to lie, and this relates to the LTM retrieval process. Saccadic eye movement is exhibited when one is accessing LTM, and participants who were lying may have spent more time in LTM trying to retrieve information relevant to their lie than truth tellers. Participants who were not lying were able to retrieve the information out of long-term memory more quickly, thus leading to less saccadic eye movement.

Practical Implications

With an understanding of the neurological basis and cognitive processes of deception, the next question asked is how to apply these findings practically, and the most notable way to apply these findings is through lie detection practices. However, are these practices needed or does the average person apply cognition to lie detection automatically? It seems that the average person only is able to detect deception at around chance (50%) levels (Ekman, O'Sullivan, & Frank, 1999). This finding also applies to the police, as they were not significantly better at detecting deception even though a main function of their job is to determine the validity of individuals' statements and stories. Most police forces do not have specific deception based training (Colwell, Miller, & Miller, 2006), and police officers continue to rely on stereotypes and false-beliefs to detect deception (i.e. "Liars always avoid eye contact"). However, there are specific cognitive tactics that can increase one's ability to detect deception (Vrij, Fisher et al., 2015), and when empirical training is implemented, investigators' ability to detect deception significantly increases (Ekman et al., 1999).

One of the main strategies suggested to better detect deception is increasing the amount of cognitive load on the interviewee (Zuckerman et al., 1981; Vrij, Fisher et al., 2015). This hypothesis suggests that an increase in cognitive load will cause the interviewee to produce more verbal and non-verbal leakage, and the observer will be able to more accurately make judgments of their truthfulness. The production of more leakage is produced because liars have to focus on several different tasks at once, rather than just recalling information (Vrij, Fisher, Mann, & Leal, 2008). These different tasks can be checking if the listener believes what they are saying, remembering the lie that they have told, and inhibiting the truth (Gombos, 2006). Walczyk et al. (2012) empirically supports the cognitive load hypothesis. Participants were asked to watch a mock crime, and then acted as witnesses and answered crime-related questions. Participants either told the truth, rehearsed lies, or spontaneous lies. When lying, participants showed greater inconsistencies than truth tellers and had significantly longer response times. The cues are consistent with cognitive difficulty (Zuckerman et al., 1981) and support the cognitive load hypothesis (Vrij et al., 2008).

To put the findings related to cognition and deception to practical use, there must be evidence that these interview methods get results and are effective in real world scenarios. One day training seminars have been comprised to teach investigators cognitive methods related to deception detection (Vrij, Leal, Mann, Vernham, & Brankaert, 2015). These seminars have proven to be effective, with accuracy rates rising significantly above chance levels (74%). However, problems with this type of training are that interviewers can suffer from overconfidence biases and may not implement the training in a proper manner. Overall, these methods the deception detection has shown to be effective and to raise accuracy levels significantly above chance. A large-scale meta-analysis (Vrij, Fisher et al., 2015) showed that overall accuracy rates rose to about 71% when these practices were properly implemented. Cognitive interrogation strategies that are taught during seminars include: asking interviewee to tell story in reverse to disrupt schema, having the interviewee maintain eye contact during the interview to increase distraction, asking spatial questions, and Devil's Advocate questions (Vrij, Granhag, Mann, & Leal, 2011). Implementing these strategies has shown to increase deception detection accuracy even to observers (not involved in the interview) who have not been trained in cognitive deception detection methods (Vrij, Fisher et al., 2015).

Despite the growing evidence that cognitive based deception detection leads to better accuracy rates overall (Vrij, Fisher et al., 2015), police departments have yet to implement cognitive deception detection training into their normal training routine (Colwell et al., 2006). One newfound limitation is that while officers are able to learn these new techniques, it can be difficult for them to incorporate them into their routines and investigation procedures (Vrij, Mann, Leal, Vernham, & Vaughan, 2016). Although there has been some evidence that in small groups, police can be effectively trained and can implement tactics to detect verbal cues for deception rather quickly (Dando & Bull, 2011). One other aspect that needs to be further investigated is the role of evidence in the interview process as well (Hartwig, Granhag, Stromwall, & Kronkvist, 2006). In real world scenarios, the police may have physical or circumstancial evidence to suggest a crime has been committed, and future research needs to account for this factor when investigating deception detection. While these strategies have shown to be effective, another limitation of this literature is that very few studies are focused towards law enforcement. While not all, a majority of research in this field use college students as participants, and this limits the generalization to police who need to implement these strategies towards criminals and witnesses. Future research should focus on the implementation of cognitive deception detection methods uses that are applicable for law enforcement.

Importance

Recently, there has been a resurface of issues related to trusting police, especially in minority communities both anecdotally (Carter, 2016) and empirically (Drake, 2015). There have been calls for police reform both nationally (Horwitz and Lowery, 2016) and abroad (Stano & Paduraru, 2016) suggesting there needs to be a restructuring of both police practices and training procedures. As found by Colwell et al. (2006), the practice of teaching empirically based deception detection skills is not found in the majority of police departments. While preliminary, there is evidence that different regions of the brain react differently when the self is the subject of deception verses watching another person be deceived in a hostile situation (Grezes, Berthoz, & Passingham, 2006). The unique region activated is the amygdala, which has been related to making quick judgements in a threatening social circumstance (Dolan, 2002; Adolphs, 2002; Schwarts et al., 2003). This appears to be similar to a situation a police officer must go through when he or she has to make a split second decision on whether a suspect, witness, or person of interest is being deceitful. With that being the case, it is important that police officers be informed of this neurological process and trained on how to understand and combat any biases.

One major issue facing the criminal justice system today is wrongful convictions. According to one of the main organizations combating this problem, The Innocence Project, the number of people wrongly incarcerated is "staggering," (Innocence Project, n.d.). They use DNA and other scientific means to exonerate those who have been wrongly convicted, but what if the number of those wrongly convicted could be lowered before incarceration? By implementing cognitive deception detections strategies laid out by Vrij, Leal, et al. (2015) and others, perhaps the number of wrongful convictions in could be lowered by a better understanding of deceptive behaviors. For example, a recent report done by The National Registry of Exonerations found that in 2015, that there were 149 exonerations of those wrongly convicted in the United States. Of these 149 exonerations, twenty-seven were due to false confessions being given in the initial investigation and sixty-five were based on false guilty pleas in the initial investigation. While these numbers may seem small initially, they most likely do not represent the actual number of those wrongly convicted as there could be as many as 4% of those on death row wrongly convicted (Gross, O'Brien, Hu, & Kennedy, 2014). This means that potentially thousands of people have been wronged by the criminal justice system, and an increase of accuracy, even a small one, could potentially save large numbers of people from injustice.

Conclusion

A better understanding of deception and deceptive behaviors would not only benefit the criminal justice system. A misunderstanding of lying can lead to problems in business (Logsdon & Patterson, 2010) relationships (Roggensack & Sillars, 2014), politics (Callander & Wilkie, 2007), and perhaps even journalism and reporting (Boudreau, McCubbins, & Coulson, 2009). This only increases the need for more awareness about lying practices and a better overall understanding of lying. While there will most likely never be a perfect way to detect deception, there is evidence that deception detection skills can be improved (Vrij, Fisher, et al., 2015; Vrij, Leal, et al., 2015). One could believe that it would be personally beneficial to be better at detecting deception, and that this skill could cause them to make better decisions in most aspects of their lives.

In conclusion, there is evidence of neurological and cognitive foundations in lying behaviors. There is evidence that the prefrontal cortex plays a significant role is lie-telling (Abe et al., 2008; Abe et al., 2014) and that executive control is the cognitive foundation of lying (Evans et al., 2001; Debay et al., 2012). Practically, it is apparent that these findings can be put to use by law enforcement (Vrij, Leal, et al., 2015), but there are still some issues with implementation and training (Vrij, et al., 2016). By implementing these newfound training techniques and providing these skills to law enforcement in the United States, that they would be better equipped to do their jobs and perhaps some reduce some of the problems in our criminal justice system (Innocence Project, n.d.). As Martin Luther King once said, "Injustice anywhere is a threat to justice everywhere."

One point that the author of this manuscript would like to make clear is that this is not a devaluation of law enforcement, as they are some of the hardest working, most respectable people in our society. It hopes to justify is why it is so important that they are provided with every tool possible to do their jobs to the best of their ability and to keep them safe.

References

Abe, N., Fujii, T., Ito, A., Ueno, A., Koseki, Y., Hashimoto, R., & ... Mori, E. (2014). The neural basis of dishonest decisions that serve to harm or help the target. *Brain And Cognition*, *90*41-49. doi:10.1016/j.bandc.2014.06.005

Abe, N., Okuda, J., Suzuki, M., Sasaki, H., Matsuda, T., Mori, E., & ... Fujii, T. (2008). Neural correlates of true memory, false memory, and deception. *Cerebral Cortex*, *18*(12), 2811-2819. doi:10.1093/cercor/bhn037

Adolphs, R. (2003). Is the human amygdala specialized for processing social information?. *Annals of the New York Academy of Sciences*, *985*(1), 326-340.

Boudreau, C., McCubbins, M. D., & Coulson, S. (2009). Knowing when to trust others: An ERP study of decision making after receiving information from unknown people. *Social Cognitive And Affective Neuroscience*, *4*(1), 23-34. doi:10.1093/scan/nsn034

Callander, S., & Wilkie, S. (2007). Lies, damned lies, and political campaigns. *Games And Economic Behavior*, *60*(2), 262-286. doi:10.1016/j.geb.2006.12.003

Carter, S. (2016). The outrage to black America of police shootings: Bloomberg View. Retrieved October 06, 2016, from http://www.oregonlive.com/opinion/index.ssf/2016/07/the_outrage_to_black_america_o.html

Caso, L., Gnisci, A., Vrij, A., & Mann, S. (2005). Processes underlying deception: An empirical analysis of truth and lies when manipulating the stakes. *Journal Of Investigative Psychology And Offender Profiling*, *2*(3), 195-202. doi:10.1002/jip.32

Colwell, L. H., Miller, H. A., Miller, R. S., & Lyons, P. J. (2006). US police officers' knowledge regarding behaviors indicative of deception: Implications for eradicating erroneous beliefs through training. *Psychology, Crime & Law*, *12*(5), 489-503. doi:10.1080/10683160500254839

Dando, C. J., & Bull, R. (2011). Maximising Opportunities to Detect Verbal Deception: Training Police Officers to Interview Tactically. *Journal Of Investigative Psychology & Offender Profiling*, *8*(2), 189-202. doi:10.1002/jip.145

Debey, E., Verschuere, B., & Crombez, G. (2012). Lying and executive control: An experimental investigation using ego depletion and goal neglect. *Acta Psychologica*, *140*(2), 133-141. doi:10.1016/j.actpsy.2012.03.004

Doherty, C., Tyson, A., & Weisel, R. (2014). Few Say Police Forces Nationally Do Well in Treating Races Equally. Retrieved October 6, 2016, from http://www.people-press.org/files/2014/08/8-25-14-Police-and-Race-Release.pdf

Dolan, R. J. (2002). Emotion, cognition, and behavior. *science*, *298*(5596), 1191-1194.

Ekman, P., O'Sullivan, M., & Frank, M. G. (1999). A few can catch a liar. *Psychological Science*, *10*(3), 263-266. doi:10.1111/1467-9280.00147

Evans, A. D., Xu, F., & Lee, K. (2011). When all signs point to you: Lies told in the face of evidence. *Developmental Psychology*, *47*(1), 39-49. doi:10.1037/a0020787

Exonerations in 2015. (2015). Retrieved October 6, 2016, from https://www.law.umich.edu/special/exoneration/Documents/Exonerations_in_2015.pdf

Gombos, V. A. (2006). The cognition of deception: The role of executive processes in producing lies. *Genetic, Social, And General Psychology Monographs*, *132*(3), 197-214. doi:10.3200/MONO.132.3.197-214

Grezes, J., Berthoz, S., & Passingham, R. E. (2006). Amygdala activation when one is the target of deceit: Did he lie to you or to someone else?. *NeuroImage*, *30*(2), 601-608.

Horwitz, S., & Lowery, W. (2016). Obama's crusade against a criminal justice system devoid of 'second chances' Retrieved October 06, 2016, from https://www.washingtonpost.com/graphics/national/obama-legacy/racial-profiling-criminal-justice-reform.html

Innocence Project - Help us put an end to wrongful convictions! (n.d.). Retrieved October 05, 2016, from http://www.innocenceproject.org/about

Logsdon, J. M., & Patterson, K. W. (2010). Deception in business networks: Is it easier to lie online?. *Journal Of Business Ethics*, *90*(Suppl 4), 537-549. doi:10.1007/s10551-010-0605-z

Karim, A. A., Schneider, M., Lotze, M., Veit, R., Sauseng, P., Braun, C., & Birbaumer, N. (2010). The truth about lying: Inhibition of the anterior prefrontal cortex improves deceptive behavior. *Cerebral Cortex*, *20*(1), 205-213. doi:10.1093/cercor/bhp090

Panasiti, M. S., Pavone, E. F., Mancini, A., Merla, A., Grisoni, L., & Aglioti, S. M. (2014). The motor cost of telling lies: Electrocortical signatures and personality foundations of spontaneous deception. *Social Neuroscience*, *9*(6), 573-589.

Roggensack, K. E., & Sillars, A. (2014). Agreement and understanding about honesty and deception rules in romantic relationships. *Journal Of Social And Personal Relationships*, *31*(2), 178-199. doi:10.1177/0265407513489914

Schwartz, C. E., Wright, C. I., Shin, L. M., Kagan, J., Whalen, P. J., McMullin, K. G., & Rauch, S. L. (2003). Differential amygdalar response to novel versus newly familiar neutral faces: a functional MRI probe developed for studying inhibited temperament. *Biological psychiatry*, *53*(10), 854-862.

Stano, P., & Paduraru, A. (2016). European Commission - PRESS RELEASES - Press release - EU increases its support to the Criminal Justice Reform process in Georgia. Retrieved October 06, 2016, from http://europa.eu/rapid/press-release_IP-12-198_en.htm?locale=en

Vrij, A., Fisher, R. P., & Blank, H. (2015). A cognitive approach to lie detection: A meta-analysis. *Legal And Criminological Psychology*, Advance online publication. doi:10.1111/lcrp.12088

Vrij, A., Fisher, R., Mann, S., & Leal, S. (2006). Detecting deception by manipulating cognitive load. *Trends In Cognitive Sciences*, *10*(4), 141-142. doi:10.1016/j.tics.2006.02.003

Vrij, A., Granhag, P. A., Mann, S., & Leal, S. (2011). Outsmarting the liars: Toward a cognitive lie detection approach. *Current Directions In Psychological Science*, *20*(1), 28-32. doi:10.1177/0963721410391245

Vrij, A., Leal, S., Mann, S., Vernham, Z., & Brankaert, F. (2015). Translating theory into practice: Evaluating a cognitive lie detection training workshop. *Journal Of Applied Research In Memory And Cognition*, *4*(2), 110-120. doi:10.1016/j.jarmac.2015.02.002

Vrij, A., Mann, S., Leal, S., Vernham, Z., & Vaughan, M. (2016). Train the Trainers: A First Step towards a Science-Based Cognitive Lie Detection Training Workshop Delivered by a Practitioner. *Journal Of*

Investigative Psychology & Offender Profiling, *13*(2), 110-130. doi:10.1002/jip.1443

Vrij, A., Oliveira, J., Hammond, A., & Ehrlichman, H. (2015). Saccadic eye movement rate as a cue to deceit. *Journal Of Applied Research In Memory And Cognition*, *4*(1), 15-19. doi:10.1016/j.jarmac.2014.07.005

Walczyk, J. J., Griffith, D. A., Yates, R., Visconte, S. R., Simoneaux, B., & Harris, L. L. (2012). Lie detection by inducing cognitive load: Eye movements and other cues to the false answers of 'witnesses' to crimes. *Criminal Justice And Behavior*, *39*(7), 887-909. doi:10.1177/0093854812437014

Zuckerman, M., DePaulo, B. M., & Rosenthal, R. (1981). Verbal and nonverbal communication of deception. *Advances in experimental social psychology*, *14*(1), 59.