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# ***A Review of Cortisol Stress Reactivity to Public Speaking Stressors***

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## **Introduction**

Mark Twain once said, "There are two types of speakers: those that are nervous and those that are liars". Most people find themselves in the position of the former because public speaking is one of the most common fears, and it is by far the most prevalent social fear (Garcia-Leal et al., 2005). Intense feelings of nervousness or anxiety have significant impacts on public speaking performance (Gabrys et al., 2019; King & Finn, 2017; Merz et al., 2019). Further research is required to understand when and why these impacts occur because both positive and negative performance and health impacts have been observed. Researchers have measured stress responses to public speaking through physiological, psychological, and behavioral means (Bodie, 2010; Pull, 2012). One physiological measure, salivary cortisol analysis, has been used in multiple recent studies on stress reactivity to public speaking. Despite being a useful measure, researchers are still attempting to understand how cortisol levels change and react to public speaking stressors.

Salivary cortisol sampling offers many advantages over other measures of stress reactivity. Samples of salivary cortisol can be collected in less than a minute and are less invasive than other physiological measures (Kirschbaum et al., 1992; Labuschagne et al., 2019). Additionally, after a short demonstration by a research assistant, participants can take their own samples (Hostinar et al. 2014). However, some limitations still exist. Most studies require that participants do not eat, drink caffeinated beverages or alcohol, consume dairy, smoke tobacco, or engage in intense physical exercise an hour before experimental sessions (Westenberg et al. 2009; van den Bos 2017; Himmelstein 2018). Also, in past studies, participants have found that saliva samples are too invasive and disruptive. In a study by Merz and colleagues in 2019, students refused to provide salivary cortisol samples during their oral presentations. This appears to be a special

case in which participants were unwilling to provide a saliva sample as other studies had few or no issues with saliva sample collection. However, it is important to note that the oral presentations were graded assignments for a seminar course credit.

There are two commonly utilized methods of saliva collection in most experiments. In method one, participants are instructed to chew on a cotton ball which is then stored in a plastic tube (Priem & Solomon, 2009). Method two is called passive drooling, participants drool into plastic vials or collect the drool through a straw (Sumter et al., 2010). The Centre for Studies on Human Stress published a brochure which advocated for the passive drool method over absorbent methods of saliva collection. Their claim is that when collecting via absorbent methods, it is difficult to see how much saliva one has collected, the absorbent materials interfere with data collection, and certain testing approaches cannot be used. The brochure also states that the passive drool method is easier to demonstrate, collect samples with, and is compatible with most analyses.

## **1 Advantages and Disadvantages to sampling methods**

Some researchers find there are more advantages to absorbent methods of saliva collection. Labuschagne and colleagues claim that the absorbent methods are more reliable than the passive drool method (2019). They also reference other studies in which the participants and researchers found that the absorbent approach is easier to use. Regardless, Labuschagne and colleagues recognize that the passive drool method allows for a greater volume of saliva collection. Despite the differences between the two methods, both have been utilized widely in recent research projects. Labuschagne and colleagues suggest using the absorbent method for the Trier Social Stress Test (TSST), a test that reliably elicits physiological and psychological stress responses

involving mental arithmetic and public speaking. The reason for preferring the absorbent method is because the test requires multiple samples to be taken over time to yield accurate results. If a sample required a larger volume of saliva, then one might use the passive drool method. Ultimately, the choice of salivary cortisol collection method depends on the purposes of the study and the cost of sampling.

## **2 Cortisol fluctuations depending on the time of day**

An important consideration when collecting salivary cortisol samples is the time when the sample was taken. Cortisol levels spike in the hour upon waking up (Labuschagne et al., 2019). This rapid increase in cortisol is then followed by a gradual decrease in cortisol levels throughout the day (Labuschagne et al., 2019). Consequently, the time of day at which saliva samples are collected should remain consistent within groups of participants to minimize the chance of erroneous results. Many studies also identify novel environments as a potential limitation to obtaining accurate stress reactivity results (Kothgassner et al., 2016; Uhart et al., 2006; Westenberg et al., 2009). Salivary cortisol levels can increase in anticipation of a stressor when in an unfamiliar environment. Gabrys and colleagues included a habituation period of questionnaires that lasted around 30 minutes before participants were exposed to stressors to account for anticipation effects (2019).

## **3 Influences of gender on cortisol sampling**

Participants' gender also has a significant effect on salivary cortisol reactivity. Males consistently displayed significantly higher levels of cortisol than females (Kirschbaum et al., 1992; Labuschagne et al., 2019). Furthermore, the female menstruation cycle also has a significant effect on cortisol levels. In most studies, female salivary cortisol samples are taken within 14 to 28 days since their last menstruation because they show comparable levels of cortisol to males (Labuschagne et al., 2019; Kothgassner et al., 2016; Uhart et al., 2006). Sumter and colleagues' study on puberty differences in stress response to a public speaking stressor found no significant gender effect on stress reactivity (2009). These findings support Uhart and colleague's conclusion that sex differences may only affect the hypothalamic–pituitary–adrenal (HPA)

axis reactivity, the main neuroendocrine system responsible for balancing physiological responses to stress, rather than affecting how the stressor is perceived.

## **4 Effects of race on cortisol sampling**

Past research has also identified race as a potentially significant variable for salivary cortisol reactivity. Chong and colleagues studied differences in stress responses to the TSST between white and black participants (2008). The study found that white participants had a 36 percent larger relative mean cortisol level than black participants did. Additionally, whites and blacks did not significantly differ in subjective anxiety levels. Hostinar and colleagues discovered similar results when investigating stress responses to the Trier Social Stress Test for Groups (TSST-G), a group version of the TSST (2014). Non-Hispanic white participants had significantly greater salivary cortisol responses as opposed to black and "other" participants to the TSST-G. In Chong and colleagues' study, subjective levels of anxiety were relatively comparable between blacks and whites, they concluded that physiological responses differed due to a difference in HPA-axis reactivity (2008).

## **5 Stressor factors and self-reported anxiety**

Public speaking involves emotional investment and social evaluative threats, which can induce debilitating levels of stress (Absi et al., 1997). High levels of stress related to public speaking can negatively affect speech performance and the quality of speech preparation (Bodie, 2010). One study on the negative effects of public speaking stress found that participants memory retrieval was worse after giving an oral presentation (Merz et al., 2019). However, negative effects of stress related to public speaking may depend on the presenter's perception of the public speaking situation. Gabrys and colleagues measured participants' subjective stress experiences and salivary cortisol when exposed to the TSST (2019). Participants who perceived the public speaking stressor as out of their control made more perseverative errors on a cognitive flexibility task. Essentially, participants who feel hopeless during public speaking are not able to change cognitive or behavioral strategies as easily as those who feel they have more control.

In a recent study on the concordance of salivary cortisol and self-reported stress reactivity,

subjective anxiety, participants with social anxiety disorder (SAD) and without SAD engaged in a public speaking task (Grace et al., 2022). They found no significant group differences on self-reported reactivity and salivary cortisol. However, participants with SAD showed significantly higher negative affect and diminished happiness. Grace and colleagues also examined within person concordance of self-reported anxiety and salivary cortisol levels and found a moderate positive association between them. These findings suggest that public speaking stressors may make people with SAD feel worse than participants without SAD, but cortisol levels between the two will be comparable. Additionally, spikes in subjective anxiety preceded spikes in salivary cortisol levels. This finding supports the notion that psychological responses are quicker than the slower acting physiological response systems.

Evidence has been found that the physiological measures of stress reactivity may not parallel subjective feelings of anxiety. Garcia-Leal and colleagues discovered similar findings in their study on panic patients and public speaking stress reactivity (2005). In their study, participants engaged in simulated public speaking (SPS), performing a prepared speech on tape. They found that cortisol levels spiked at the beginning of the SPS test then gradually declined. Despite the decline in cortisol, subjective anxiety levels remained constant throughout the SPS test. Public speaking may elicit different subjective experiences of anxiety between groups of people, and salivary cortisol levels may not be enough on their own to distinguish those experiences.

## **6 Impact of personality traits and coping strategies on cortisol levels**

Some studies have been focused on identifying differences between certain groups of people based on psychological trait differences. In 2004, Pérez and colleagues conducted a study on personality traits and stress responses to giving an oral presentation. They recorded participants' responses to two different personality inventories and found significant negative correlations between cortisol increases and the personality traits of extraversion and neuroticism. Both traits were also significant predictors of increased cortisol for participants whose cortisol levels increased after the oral presentation. Introverted students displayed

significantly increased cortisol levels on the day of the oral presentation. Unexpectedly, higher scores of emotional stability compared to neuroticism were significant predictors of greater cortisol response levels. Unfortunately, the role of subjective anxiety was not considered as it was not an included measure in the study.

Studies have also investigated the effects that one's coping behaviors have on stress reactivity to public speaking. Oskis and colleagues have studied how repressors, people with low trait anxiety and high defensiveness scores react to public speaking stressors (2018). In their study, repressors displayed significantly lower levels of subjective anxiety and salivary cortisol reactivity to the TSST-G than non-repressors. Another study investigated how active coping strategies reduced stress reactivity to public speaking (Perez et al., 2021). In the study, seventh grade students were assessed for active coping strategies using the Children's Coping Strategies Checklist and were subject to an adolescent version of the TSST-G. Students that exhibited active coping strategies were able to recover to baseline levels of cortisol after the TSST-G significantly quicker than students who did not exhibit active coping strategies. Positive strategies for managing reactions to stressors appear to mitigate prolonged cortisol reactions.

## **7 Application and future experimentation**

Further research needs to be done on how the subjective anxiety of public speakers interacts with physiological stress measures and how it might influence public speaking performance. Physiological measures alone cannot provide an accurate perspective on one's public speaking experience. The studies mentioned above have shown that one's subjective public speaking experience can affect performance. However, there are few studies that investigate treatment methods to manage stress responses to public speaking. This issue is highly relevant to Hampden Sydney College as the school regularly promotes its ability to produce better writers and speakers through the Rhetoric Program. With the resources available to the college at the Rhetoric Center, a study investigating this line of research is highly feasible and beneficial to the college and its mission.

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