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ABSTRACT OF DISSERTATION

Aaron John Godlaski

The Graduate School
University of Kentucky

2011

IDENTIFYING COMPONENT-PROCESSES OF EXECUTIVE FUNCTIONING THAT SERVE AS RISK
FACTORS FOR ALCOHOL-RELATED AGGRESSION

ABSTRACT OF DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Arts and Sciences
at the University of Kentucky

By
Aaron John Godlaski

Lexington, Kentucky

Director: Dr. Peter R. Giancola, Professor of Psychology

Lexington, Kentucky

2011

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ABSTRACT OF DISSERTATION

IDENTIFYING COMPONENT-PROCESSES OF EXECUTIVE FUNCTIONING THAT SERVE AS RISK FACTORS FOR ALCOHOL-RELATED AGGRESSION

The present investigation determined how different component-processes of executive functioning (EF) acted as risk factors for intoxicated aggression. Participants were 512 (246 men and 266 women) healthy social drinkers between 21 and 35 years of age. EF was measured using the *Behavior Rating Inventory of Executive Functioning – Adult Version (BRIEF-A)*; Roth, Isquith, & Gioia, 2005) that assesses nine EF components. Following the consumption of either an alcohol or a placebo beverage, participants were tested on a modified version of the *Taylor Aggression Paradigm* (Taylor, 1967) in which mild electric shocks were received from, and administered to, a fictitious opponent. Aggressive behavior was operationalized as the shock intensities and durations administered to the fictitious opponent.

KEYWORDS: Aggression, Executive Functioning, Alcohol, BRIEF-A, Intoxication

Aaron John Godlaski

Student's Signature

July 14, 2011

Date

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DISSERTATION

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Chapter One: Introduction

Background

Consider the following recent news story:

A University of Virginia lacrosse player from an affluent New England family was recently indicted for murder. He stands accused of smashing his former girlfriend's head through a wall during an argument while he was in a state of alcohol intoxication. Evidence points to the accused, having a history of "out of control" behavior associated with drinking, becoming easily emotionally enraged, and being prone to erratic and violent behavior (Black, 2010).

This unfortunate story illustrates the damaging effects that alcohol can have on behavior, particularly when coupled with an emotionally charged scenario. How is it that the brain, which helps one to become an accomplished student-athlete, is the same organ that allows that person to kill in a murderous rage? Sadly, this scenario is not uncommon and highlights the importance of understanding the interaction between alcohol intoxication, the brain's self-regulatory functions, and violence. The loss of cognitive, emotional, and behavioral control under the influence of alcohol clearly drives some individuals to commit thoughtless and damaging acts. Alcohol consumption has been implicated in 55% to 60% of violent crimes in the U.S. (U.S. Department of Justice, 2005). Alcohol intoxication is reported in the majority of perpetrators of sexual assaults and is involved in a higher percentage of aggravated versus simple assaults in the general population (Maston, 2010). Similar relations are also observed in the data on alcohol-related crime prevalence among college students (Baum & Klaus, 2005).

It is well accepted within the psychological literature that alcohol increases the propensity for aggression in some, but not all, individuals and that the process by which this occurs is driven largely by what individual difference factors place a person at heightened risk for such behavior (Collins, 1988; Fishbein, 2003). Findings from several meta-analytic studies show that alcohol has a "medium" effect size ($d = 0.49$ to 0.61) on aggression (Bushman & Cooper, 1990; Hull & Bond, 1986; Ito, Miller, & Pollock, 1996). However, it has been hypothesized that this effect size may actually be obfuscating alcohol's true effect on aggression because it fails to take into account moderating individual difference risk factors (Giancola, 2004).

Executive Functioning

While several variables have been found to moderate the alcohol-aggression relation (e.g., Berman, Bradley, Fanning, & McCloskey, 2009; Giancola, 2002; Parrott & Zeichner, 2002), executive function (EF) will be the focus of this article. EF is a complex cognitive construct involved in the self-regulation of goal-directed behavior (Goldberg, 2001; Mesulam, 2002). Abilities that fall under the rubric of EF include strategic planning, abstract reasoning, set-shifting (i.e., flexible thinking), organization and manipulation of information in working memory, decision-making, behavioral inhibition, emotional regulation, as well as self- and task-monitoring (Alexander & Stuss, 2006; Bechara & Van Der Linden, 2005; Fuster, 2002). These skills help a person to problem-solve and thus properly respond to changing situational demands (Zelazo, Carter, Reznick, & Frye, 1997). Given the highly multifaceted nature of EF (Jurado & Rosselli, 2007; Stuss & Alexander, 2000), there exists a long history of scientific inquiry and debate regarding its underlying structure (Grafman, 2002; Luria, 1973; Porecman, 1987; Stuss, 2006; Teuber, 1972).

The empirical structure of the skills that comprise EF, and how they relate to one another, varies depending on one's conceptualization of the construct, which then dictates how it will be measured. From a conceptual stance, EF can be appreciated as a relatively unified whole (Duncan et al., 2000; Zelazo et al., 1997) or as a set of distinct components (Baddeley & Logie, 1999). Accordingly, some empirical studies have found EF to be best understood as a unitary general construct (Giancola, 2004; Giancola, Mezzich, & Tarter, 1998) while others have found that it better conforms to a set of fractionated components that still share a significant underlying commonality (Gioia, Isquith, Retzlaff, & Espy, 2002; Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Given the highly complex interconnectedness of the brain, particularly regions of the prefrontal cortex which are the primary neural region that subserves EF, the fact that separable EF components do exist and yet are also functionally related to one another is not surprising but even expected. Consequently, to better understand how specific components of EF work to control behavior it has been argued that it is necessary to measure EF from a broad neuropsychological approach (Friedman, et al., 2008; Séguin, 2009). Unfortunately, misunderstandings in seemingly opposing EF models stem largely from the tests selected to measure EF and the factor analytic methods used to assess its structure.

Mixed findings for the structure of EF tests is not surprising for a number of conceptual and methodological reasons. First, the construct of EF is highly underspecified. Exemplifying this is the number of related yet non-specific definitions of EF that abound (reviewed in Giancola, 2000). A logical corollary of this conceptual confusion is that any attempt to operationalize this construct will be a very difficult and arduous process that will most likely never result in a universally accepted standardized EF test battery. The construct is simply too complex to fit such artificial boundaries (Perecman, 1987). Second, what comes out of a factor analysis is greatly influenced by what goes into one; moreover, factor analysis must also be guided by clear research questions and theory so that the results can be meaningfully interpreted (Bandalos & Boehm-Kaufman, 2008).

Giancola's as well as Miyake and Friedman's work reviewed above clearly adhered to such methodological principals. Giancola's work viewed EF as a very broad and highly inter-related construct; understanding that the highly interactive neural circuitry of the brain makes it so that many EF skills are, by definition, intricately tied to one another and to even non-EF skills (Miyake et al., 2001; Stuss & Alexander, 2000). This position is borne out by the significant interfactor correlations seen in Miyake and Friedman's research. Miyake and Friedman's research group was guided by the theoretical stance that EF can be fractionated into three components [(i.e., inhibition, set-shifting, and updating (or in other words, working memory))]. As such, they selected more specific tests that satisfied their conceptual perspective. Obviously, these two theoretical approaches lead to different operationalizations of the same construct, which inevitably lead to different factor structures.

However, while fully appreciating the aforementioned issues, Bates (2000) argued that viewing EF as a set of related component-processes might improve our understanding of the construct by allowing for the advancement of theoretically supported predictions regarding how particular EF components might differentially relate to, or predict, specific behavioral outcomes. Relatedly, Block (1995) pointed out that deficits in EF may manifest in a variety of ways across different individuals. Therefore, assessing the role of these different EF facets may aid in understanding EF's overarching role in the prediction of aggressive behavior. Utilizing this line of thought as a theoretical guide, a logical parsing of EF would involve component-processes that represent metacognitive problem-solving skills as well as behavioral and emotional regulation. Related to this line of thinking, a recent conceptualization of EF divided the construct

into two categories termed “cool” and “hot” (Séguin, Arseneault, & Tremblay, 2007; Zelazo & Müller, 2002).

Cool EF skills are considered to be more “cerebral” or metacognitive in nature. These EF skills are utilized in abstract decontextualized reasoning and have been argued to be governed, at least in part, by the dorsolateral prefrontal cortex (Metcalf & Mischel, 1999; Zelazo & Müller, 2002). These skills fall under the general rubric of problem-solving competency that requires the ability to correctly appraise a troublesome situation, maintain and organize that information in working memory, strategically plan and execute a response, evaluate the efficacy of that response, and make any necessary changes based on the outcome (Séguin et al., 2007; Zelazo et al., 1997). In contrast, hot EF skills that have been described as being primarily governed by the ventromedial prefrontal cortex, which is closely connected to the limbic system, are more strongly involved with the regulation of affective and motivational processes as well as behavioral inhibition (Zelazo & Müller, 2002). Deficits in behavioral and emotional regulation have been associated with an increased sensitivity to environmental cues of punishment as well as quick visceral responses pursuant to oncoming danger such as a hostile provocation (Séguin et al., 2007). Deficits in hot EF are also reported to be more closely related to impairments in social and emotional functioning than cool EF (Hongwanishkul, Happaney, Lee, & Zelazo, 2005). Accordingly, impairment in EF’s self-regulatory capacities may contribute to aggression by reducing one’s ability to monitor the self and the situation for what are considered to be acceptable social behaviors, control emotional responses, and inhibit impulsive reactions.

When viewing EF from a hierarchical perspective, a distinct, yet related, set of cognitive component-processes quickly become apparent and reveal an increasingly complex social information-processing network that relates behavioral responses to one another thus requiring progressively greater amounts of time to carry out effectively more elaborate decontextualized problem-solving (Zelazo & Cunningham, 2007). However, before these and other related cognitive components can begin to be enacted, the ability to control emotional reactions and inhibit basic behavioral impulses is first required (Barkley, 1997; Sonuga-Barke, Dalen, Daley, & Remington, 2002). On this basis, it could be theorized that an inability to inhibit and control immediate behavioral and emotional responses will result in diminished access to the metacognitive EF components of strategic planning, organization and manipulation of

information in working memory, self-initiated execution of thoughtful goal-directed action, and the development of alternative hypotheses if initial inhibitory actions are not successful. In such a theoretical framework, emotional and behavioral self-regulation are considered to be temporally antecedent to abstract problem-solving. Therefore, understanding the role of behavioral and emotional regulation in alcohol-related aggression is of particular importance for predicting who will become aggressive when intoxicated.

EF and Aggression

The relation between poor EF and increased aggression has been documented in a wealth of studies (reviewed in Giancola, 1995; Hawkins & Trobst, 2000; Moffitt, 1993; Moffitt & Henry, 1991; Morgan & Lilienfeld, 2000). While these studies focus on a range of EF abilities, depending on the theoretical perspective taken, a number of reports implicate deficits in skills related to emotional and behavioral regulation. Inappropriate social behavior such as aggression has been shown to be related to, or moderated by, behavioral and emotional dysregulation in children (Calkins & Dedmon, 2000; Ellis, Weiss, & Lochman, 2009; Raaijmakers et al., 2008), adolescents (Fairchild et al., 2009; Friedman et al., 2007; Séguin, Arseneault, Boulerice, Harden, & Tremblay, 2002; Whittle et al., 2008), healthy adults (Pietrini, Guazzelli, Basso, Jaffe, & Grafman, 2000; Pietrzak, Sprague, & Snyder, 2008), and violent offenders (Hoaken, Allaby, & Earle, 2007; Raine & Yang, 2006; Syngelaki, Moore, Savage, Fairchild, & Van Goozen, 2009).

In this sense, EF can be conceptualized as a “gate-keeper” that controls emotional and behavioral reactions and can thus be considered to be a moderator of, or a risk factor for, violent behavior. Thus, on the one hand, when exposed to hostile provocation, a person with intact EF will be able to fully appraise their situation, inhibit any immediate emotional response to retaliate, and then behave in a socially-adaptive manner through the use of higher-order metacognitive/problem-solving abilities (unless violence is necessary for valid reasons of defense). However, on the other hand, if such a person had poor EF, they would be less likely to control their negative emotional state and thus become more likely to react in a violent manner via their inability to utilize metacognitive EF skills that could further inhibit an interpersonal altercation through the use of higher-order problem-solving skills.

Measuring EF with the BRIEF-A

The *Behavior Rating Inventory of Executive Function – Adult Version (BRIEF-A)* (Roth, Isquith, & Gioia, 2005) is a self-report inventory that assesses a variety of EFs. In contrast to standard performance-based neuropsychological tests, the BRIEF-A was designed to tap into everyday, real-world manifestations of EF. This may be particularly valuable given that it is not uncommon for individuals to perform well on neuropsychological measures of EF in a laboratory or a clinical setting despite clear evidence of problems with EF in more natural settings (Cripe, 1999; Denckla, 2002; Silver, 2000). Indeed, many neuropsychological tests assess narrow/specific skills (e.g., construction abilities) in contrast to more general aspects pertinent to real world adaptive decision making (Goldberg & Podell, 2000). Thus, it is not surprising that the BRIEF-A, as well as a version of the BRIEF designed for use with children (Gioia, Isquith, Guy, & Kenworthy, 2000), show limited statistical associations with scores on performance-based neuropsychological tests of EF (Garlinghouse, Roth, Isquith, Flashman, & Saykin, 2010; Rabin, Roth, Isquith, Wishart, Nutter-Upham, & Pare, 2006; Toplak, Bucciarelli, Jain, & Tannock, 2009). Following our above reasoning, it has been argued that these low relations suggest that performance-based neuropsychological tests and self-report instruments such as the BRIEF capture different aspects of EF (Gioia, Kenworthy, & Isquith, 2010; McAuley, Chen, Goos, Schachar, & Crosbie, 2010). Nevertheless, it is important to highlight the results from recent investigations showing that lower scores on self-report inventories of EF, including the BRIEF, are significantly related to decreased frontal brain volume (Garlinghouse et al., 2010; Kawada, Yoshizumi, Hirao, Fujiwara, Miyata, & Shimizu, 2009; Mahone, Martin, Kates, Hay, & Horska, 2009) as well as several other problematic biological (Brown, Ris, Beebe, Ammerman, Oppenheimer, & Yeates, 2008), psychiatric (Gilotty, Kenworthy, Sirian, Black, & Wagner, 2002), behavioral (Reid-Arndt, Nehl, & Hinkebein, 2007), and academic (Waber, Gerber, Turcios, Wagner, & Forbes, 2006) outcomes. Thus, performance-based neuropsychological measures are indeed complemented by the addition of self-report instruments, such as the BRIEF-A, because they provide valuable and unique information in predicting real-life problems associated with executive dysfunction in a comparatively more significant time-efficient manner (Ready, Stierman, & Paulson, 2001).

The BRIEF-A provides a global score reflecting an individual's overall level of EF, termed the *Global Executive Composite (GEC)* as well as two factors reflecting higher-order cognitive

regulation (i.e., *Metacognition Index; MI*) and behavioral-emotional regulation (i.e., *Behavioral Regulation Index; BRI*). These two indices are moderately correlated with one another, they are better understood as two separate, yet related, components of EF (Gioia et al., 2002; Roth et al., 2005). Specifically, the MI assesses the ability to initiate tasks independently, organize and manipulate information in working memory, monitor task performance for accuracy, as well as engage in strategic planning and problem-solving (Roth et al., 2005). In contrast, the BRI represents the capacity to properly regulate behavioral and emotional impulses which includes the inhibiting inappropriate thoughts and actions, actively shifting/changing maladaptive problem-solving strategies (i.e., flexible thinking), and monitoring the effects of one's behaviors on others (Roth et al., 2005). According to theory (Zelazo & Cunningham, 2007), without the ability to regulate emotion and behavior, the enactment of skills such as strategic planning and abstract problem-solving become significantly less accessible. We believe the BRIEF-A represents a valuable tool for understanding the role of EF component-processes in the prediction of aggression because it differentially assesses the everyday manifestations of such EF difficulties that may heighten the risk for intoxicated aggression.

EF, Alcohol, and Aggression

EF is of particular importance as a risk factor for intoxicated aggression. EF governs the general cognitive, emotional, and behavioral regulatory capacities that alcohol is purported to disrupt (reviewed in Giancola, 2000). Hence, possessing limited EF coupled with alcohol's disinhibitory effects should engender greater aggression. Giancola (2004) supported this hypothesis by demonstrating that EF, as measured by a broad array of neuropsychological tests designed to assess a general EF construct, was a significant risk factor for intoxicated aggression. In other words, alcohol was significantly more likely to increase aggression in persons with lower, rather than higher, EF. However, the tests in Giancola's neuropsychological battery were selected to assess a general/broad EF factor, meaning that the battery was not designed to assess refined component processes.

The purpose of the present investigation is to extend prior work by examining whether more specific components of EF are associated with alcohol-related aggression. Here, the BRIEF-A was used as a measure of EF because it is capable of assessing a variety of EF components. As noted above, this will afford the advantage of testing the role of separate EF aspects in relation to intoxicated aggression in a way never conducted before. Consistent with

prior research (Giancola, 2004), it is hypothesized that a general EF score will moderate the alcohol-aggression relation (as noted above, the BRIEF-A provides an overall general EF score: the GEC index). Furthermore, to extend the potential explanatory power of our results the BRIEF-A's two major indices (the BRI and MI) were examined, allowing for a more precise evaluation of the role of components of behavioral/emotional regulation (i.e., BRI) and metacognition (i.e., MI) in the prediction of intoxicated aggression. Specifically, it is posited that the alcohol-aggression relation will be moderated by behavioral and emotional regulation, as reflected by the BRIEF-A BRI, but *not* by abstract problem-solving, as reflected by the BRIEF-A MI.

Chapter Two: Method

Participants

Participants were 512 (246 men and 266 women) healthy social drinkers between 21 and 35 years of age ($M = 23.08$; $SD = 2.93$). Social drinking was defined by consuming at least 3-4 drinks per occasion at least twice per month. Participants were recruited through advertisements placed in various newspapers and fliers posted around Lexington, Kentucky. Respondents were initially screened by telephone. Individuals reporting any past or present drug- or alcohol-related problems, serious head injuries, learning disabilities, or serious psychiatric symptomatology were excluded from participation. Individuals reporting abstinence from alcohol use or a condition in which alcohol consumption is medically contraindicated were also not allowed to participate in the study. Respondents were screened for alcohol use problems using the *Short Michigan Alcoholism Screening Test* (SMAST; Selzer, Vinokur, & van Rooijen, 1975). Any person scoring an "8" or more on the SMAST was excluded from participation. Anyone with a positive breath alcohol concentration (BrAC) reading or a positive urine pregnancy or drug test (i.e., cocaine, marijuana, morphine, amphetamines, benzodiazepines, and barbiturates) result was also excluded.

Participants identified themselves according to the following ethnic groups: $\approx 87\%$ Caucasian, $\approx 10\%$ African-American, $\approx 1.4\%$ Hispanic, $\approx .6\%$ Biracial, $\approx .4\%$ Indian, and $\approx .4\%$ Asian (essentially evenly split between men and women). Ninety-two percent of the participants were never married and the sample had an average of 16 years of education. The sample also had a mean yearly household income (including support from parents) of approximately \$61,000. This study was approved by the University of Kentucky's Institutional Review Board and complied with the *National Institute on Alcohol Abuse and Alcoholism's* guidelines for alcohol administration with human participants.

Pre-Laboratory Procedures

Following the telephone screening interview, individuals eligible for participation were scheduled for an appointment to come to the laboratory. They were told to refrain from drinking alcohol 24 hours prior to testing, to avoid drinking caffeinated beverages the day of the study, to refrain from using recreational drugs from the time of the telephone interview, and to refrain from eating one hour prior to testing (given that participants did not begin drinking until three hours into the experiment, the standard four hour fast used in most alcohol studies was

observed). Due to hormonal variations associated with menstruation which may affect aggressive responding (Volavka, 1995), women were not tested between one week before menstruation and the beginning of menstruation. Participants were told that they would receive \$75 at the completion of the study as compensation.

Laboratory Session

After establishing that the participants met all of the inclusion criteria, demographic data were collected. Participants then completed the *Behavior Rating Inventory of Executive Functioning – Adult Version (BRIEF-A; Roth, Isquith, & Gioia, 2005)* in addition to a number of other self-report inventories not pertinent to this experiment. The BRIEF-A is a 75-item questionnaire designed to gauge the integrity of EF component processes that are utilized in everyday life (Roth et al, 2005). As indicated above, the inventory yields an overall score (*Global Executive Composite, GEC*), that is a composite of two index scores (the *Behavioral Regulation Index, BRI* and the *Metacognition Index, MI*). The BRI is comprised of four scales (Inhibit, Shift, Emotional Control, and Self Monitor) and the MI is comprised of five scales (Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials) reflecting a variety of processes commonly considered to be key components of EF. Higher scores reflect greater difficulty with EF. Three validity scales are also included and referred to as Negativity, Infrequency and Inconsistency. No participants had to be excluded due to deviations on the validity scales. The BRIEF-A was standardized on 1050 adults sampled to approximate the 2002 U.S. Census proportions with respect to sociodemographic characteristics. The measure has excellent internal consistency (Cronbach α coefficients ranging from .93 to .96 for the three major indices) and 1-month test-retest reliabilities (ranging from $r = .93$ to .94 for the three major indices) (Roth et al., 2005). Support for the convergent and discriminant validity of the BRIEF-A has been reported (Roth et al., 2005) and its utility has been demonstrated in studies in several different clinical and non-clinical populations (Garlinghouse et al., 2010; Koven, 2010; Roth, et al., 2005).

The BRIEF-A was selected as our measure of EF based on a number of considerations: 1) the two indexes of the BRIEF-A, the BRI and MI, map relatively well onto the current theoretical conceptualization of hot and cool EFs (Metcalf & Mischel, 1999; Zelazo & Müller, 2002); 2) the measure reflects a wide variety of skills encompassed within the construct of EF that are consistent with the functional selection guidelines put forth by Diamond (1991); 3) it assesses

the subjective integrity of EF that has been argued to potentially offer greater ecological validity than, or at the least complement, traditional performance-based neuropsychological measures of EF (Gioia & Isquith, 2004); and 4) it also takes only 10-15 minutes to complete, thus being a time efficient manner in which to assess EF compared with many traditional neuropsychological tests.

Following the questionnaires, participants were given a 15-minute break and then received their beverages; after which they participated on the aggression task (see below).

Experimental Design

This investigation had three independent variables: Beverage, gender, and EF. Participants were assigned to one of the following groups: (a) men who received alcohol ($n = 115$), (b) men who received a placebo ($n = 131$), (c) women who received alcohol ($n = 129$), and (d) women who received a placebo ($n = 137$).

Beverage Administration

Men who received alcohol were administered a dose of 1g/kg of 95% alcohol USP mixed at a 1:5 ratio with Tropicana orange juice. Women were given a dose of 0.90g/kg of alcohol to control for gender differences in body fat composition and alcohol metabolism (Watson, Watson, & Batt, 1981). Beverages were poured into the requisite number of glasses in equal quantities. The dosing procedure was also calculated for the placebo group, however, they received an isovolemic beverage consisting of only orange juice (i.e., the missing alcohol portion was replaced with orange juice). Four mls of alcohol were added to each placebo beverage and four mls were layered onto the juice in each glass for a total of eight mls of alcohol in each glass. Immediately prior to serving the placebo beverages, the rims of the glasses were sprayed with alcohol. All participants were given 20 minutes to consume their beverages and were not given any information regarding what to expect from their beverages. However, during the informed consent process, they were told that they would consume the equivalent of about 3-4 mixed drinks. In order to ensure that participants would be accustomed to the dose of alcohol administered in our experiment, we excluded anyone that did not consume at least 3-4 drinks per occasion at least twice per month. No participant experienced any adverse effects due to alcohol consumption.

In addition to the two beverage groups used in this study (i.e., alcohol and placebo), a sober control group, in which participants receive a non-alcoholic beverage and are told that they consumed no alcohol, could have also been used. Overall, research has shown that the vast majority of investigations have indicated that whereas alcohol groups display significantly greater levels of aggression compared with sober control groups, placebo and sober controls do not tend to differ significantly (reviewed in Bushman & Cooper, 1990; Chermack & Giancola, 1997; Hull & Bond, 1986; Ito, Pollock, & Miller, 1996). In recognition of previous research demonstrating that sober and placebo groups do not differ significantly in aggression, and in order to provide an added control for the chance that the belief that one has consumed alcohol might influence aggression, an alcohol and a placebo group were employed.

Aggression Task

A modified version of the *Taylor Aggression Paradigm (TAP; Taylor, 1967)* was used to measure aggression. This task places participants in a situation where electric shocks are received from, and administered to, a fictitious opponent during a supposed competitive reaction-time task. Participants were seated at a table in a small room. On the table facing the participant was a computer screen and a keyboard. White adhesive labels marked “1” through “10” were attached to the number keys running across the top of the keyboard. The labels “low,” “medium,” and “high” were placed above keys “1,” “5,” and “10,” respectively, to indicate the subjective levels of shock corresponding to the number keys. The keyboard and monitor were connected to a computer located in an adjacent control room out of the participant’s view.

Participants were informed that shortly after the words “Get Ready” appeared on the computer screen, the words “Press the Spacebar” would appear at which time they had to press, and hold down, the spacebar. Following this, the words “Release the Spacebar” would appear at which time they had to lift their fingers off of the spacebar as quickly as possible. A “win” was signaled by the words “You Won. You Get to Give a Shock” and a “loss” was signaled by the words “You Lost. You Get a Shock.” Participants were told that they had a choice of 10 different shock intensities to administer at the end of each winning trial for a duration of their choosing. Following a losing trial, they received 1 of 10 shock intensities that lasted one second. Participants viewed the shocks they selected and received on a “volt meter” and by the illumination of one of 10 “shock lights” [(ranging from 1 (low) to 10 (high))] on the computer

screen. The entire TAP procedure consisted of 34 trials and shock intensities were administered to participants in a fixed random pattern with no more than three consecutive wins or losses. The trials were interspersed by five second intervals. The initiation of trials, administration of shocks to the participants, and the recording of their responses were controlled by a computer. The experimenters, other electronic equipment, and the computer that controlled the task were located in an adjacent control room out of the participants' view. To ensure safety and to protect the integrity of the study, the experimenter secretly viewed and heard the participant through a hidden video camera and microphone throughout the procedure.

Physical aggression was operationalized as the combined mean responses for shock intensity ("1" through "10") and shock duration (in milliseconds) across all trials of the TAP. The score was calculated by transforming each corresponding shock intensity and duration variables into z-scores and then summing them. This was done to increase the reliability of both indices as a meta-analytic investigation demonstrated that shock intensity and duration are significantly related to one another and are considered to be part of a more general construct of aggression (Carlson, Marcus-Newhall, & Miller, 1989). For this reason, more recent studies using the TAP, and its modified versions, have adopted, and successfully used, similar combinatory techniques involving shock intensity and duration (Bartholow, Anderson, Carnagey, & Benjamin, 2005; Carnagey & Anderson, 2005; Giancola & Corman, 2007; Parrott & Zeichner, 2001; Ward et al., 2008). The TAP has been repeatedly shown to be a safe and valid measure of aggressive behavior for men and women (Anderson & Bushman, 1997; Giancola & Chermack, 1998; Hoaken & Pihl, 2000).

Procedure

Upon entering the laboratory, participants were explained the procedures of the study and were asked to sign an informed consent form. In order to disguise the fact that the TAP is a measure of aggression, participants were given a fictitious cover story. They were informed that the study was aimed at understanding the effects of alcohol and personality on reaction-time in a competitive situation. The experimenter then assessed their BrACs to ensure sobriety. If the BrAC test was negative, participants underwent a urine drug test and women also underwent a urine pregnancy test. Demographic data were then collected followed by the administration of the BRIEF-A and other personality tests.

Participants were told that they were about to compete against a person of the same gender in an adjacent room on a reaction-time task. Instructions for the TAP were given as participants began drinking their beverages. Prior to beginning the TAP, participants' pain thresholds and tolerances were assessed in order to determine the intensity parameters for the shocks they would receive. This was accomplished via the administration of short duration shocks (.5 seconds) that increased in intensity in a stepwise manner from the lowest available shock setting, which was imperceptible, until the shocks reached a subjectively-reported "painful" level. All shocks were administered through two finger electrodes attached to the index and middle fingers of the non-dominant hand using Velcro straps. Participants were instructed to inform the experimenter when the shocks were "first detectable" and then when they reached a "painful" level. Later, during the actual testing, participants received shocks that ranged from "1" to "10." These shocks were respectively set at 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, and 100% of the highest tolerated shock intensity. The threshold determination procedure was conducted while the participant was seated in the testing room and the experimenter was in the adjacent control room. They communicated through an intercom.

Given that the aggression-potentiating effects of alcohol are more likely to occur on the ascending limb of the BrAC curve (Giancola & Zeichner, 1997) and because a BrAC of at least 0.08% is effective in eliciting robust levels of aggression (Giancola & Zeichner, 1997; Pihl, Smith, & Farrell, 1984), the alcohol group began the TAP as close to a BrAC of 0.09% as possible. This methodology indicates that BAC be standardized rather than the time latency following beverage consumption. One could argue that the time duration between the end of beverage consumption and beginning the aggression task should have been standardized for both beverage groups. This was not done because it would have reduced the effectiveness of the placebo manipulation (see below) and would have produced undesirably large individual differences in BACs during the aggression task. Participants in the placebo group completed the TAP immediately following their pain threshold and tolerance assessment. In order to maximize the placebo manipulation, individuals in the placebo group had their pain thresholds tested two minutes after they finished their drinks. It has been shown that placebo manipulations are only effective shortly after beverage consumption (Bradlyn & Young, 1983; Martin, Earleywine, Finn, & Young, 1990; Martin & Sayette, 1993). As such, testing pain thresholds two minutes after beverage consumption ensured that aggression was assessed while the placebo manipulation was most effective (Martin et al., 1990; Martin & Sayette, 1993). Finally, immediately before

beginning the TAP, participants provided subjective ratings of their level of intoxication. This was done using a specially constructed scale ranging from 0 to 11 on which “0” was labeled “not drunk at all,” “8” was labeled “drunk as I have ever been,” and “11” was labeled “more drunk than I have ever been.” Regardless of beverage group assignment, all participants were informed that their opponent was intoxicated. This was done to ensure that the “drinking status” of the opponent would not confound any potential beverage group differences in aggression.

Immediately following the TAP, BrACs were measured and participants were again asked to rate their subjective state of intoxication. In addition to this, they were asked whether the alcohol they drank caused them any impairment on a scale ranging from 0 to 10 on which “0” was labeled “no impairment,” “5” was labeled “moderate impairment,” and “10” was labeled “strong impairment.” Participants were then asked a yes/no question regarding whether they believed that they had consumed alcohol. They were also asked a variety of questions to indirectly assess the credibility of the experimental manipulation (see below). Participants were then debriefed and compensated. All individuals who received alcohol were required to remain in the laboratory until their BAC dropped to 0.04%.

Deception Manipulation

To convince participants that they actually competed against another person, prior to beverage consumption, an experimenter informed them that we wished to give them and their opponent “a chance to get to know one another” before proceeding with the “reaction-time” task. To do so, participants were told that both they, and their opponent, were going to be video-recorded, in separate rooms, while answering three questions about their personality [i.e., 1) “What is your favorite TV show?”, 2) “Do you have a favorite hobby; something you like to do for fun?”, and 3) “What is your favorite food?"]. The experimenter ostensibly recorded the participant’s responses (on a “cam-corder”) to the questions while another experimenter supposedly recorded their opponent’s responses to the same questions. Following the mock video recordings, participants were escorted into another testing room where they were given their beverages. Just as they began consuming their beverages, participants viewed a pre-recorded, gender and race matched, video clip in which their fictitious opponent provided neutral answers to the three questions. Their opponent was ostensibly viewing the participants video clip at the same time in a separate room. It is important to note that the cam-corder was

“rigged” to simulate taping the participant; no recordings were actually made. Furthermore, immediately prior to testing their pain thresholds and tolerances, participants were informed that their opponent would undergo the same threshold/tolerance testing procedure first. To further enhance the believability of the TAP, participants were also informed that they would be able to hear their opponent’s responses over an intercom that ostensibly served the two testing rooms and the control room. In actuality, an audio recording was played that simulated the fictitious opponent’s answers to the experimenter’s questions regarding the testing of his/her pain threshold and tolerance.

Chapter Three: Results

Manipulation Checks

Aggression Task Checks. In order to verify the success of the aggression task deception, participants were administered a post-task interview in which they were asked a number of questions about their subjective perceptions of their opponent, such as whether s/he tried hard to win, whether they thought the task was a good measure of reaction-time, and how well they believed they performed on the task. The deception manipulation appeared successful. Many participants called their opponent vulgar and profane names, or gave their opponent the middle finger, during the task. Ultimately, participants were asked if they believed that they were competing against a real person. Based on anecdotal evidence from the experimenters collecting data for the study, less than 1% of participants expressed that they believe the experiment did not involve another participant or was measuring a factor other than reaction time. Participants who did not believe there was an opponent or that the test was measuring something other than reaction time were excluded from the analyses.

Placebo Checks. All participants in the placebo group indicated that they believed that they drank alcohol. With regard to the question regarding how drunk they felt, persons in the alcohol group reported mean pre- and post-task ratings of 4.7 and 5.1 (scale range: 0 to 11) and those in the placebo group reported mean pre- and post-task ratings of 1.8 and 1.9, respectively, [pre-task ratings: $t(508) = -20.5, p < .05$; post-task ratings: $t(510) = -19.9, p < .05$]. With regard to the question about whether the alcohol they drank caused any impairment, persons in the alcohol group reported an average rating of 5.6 and those in the placebo group reported an average rating of 2.1, $t(510) = -19.56, p < .05$, (scale range: 0 to 10) indicating that persons in the placebo group did in fact believe that they consumed alcohol.

BrAC Levels. All participants tested in this study had BrACs of 0% upon entering the laboratory. Individuals in the alcohol group had a mean BrAC of 0.095% ($SD = 0.011$) just before beginning the aggression task and a mean BrAC of 0.105% ($SD = 0.015$) immediately after the task. Persons given the placebo had a mean BrAC of 0.015% ($SD = 0.011$) just before the aggression task and a mean BrAC of 0.007% ($SD = 0.007$) immediately after the task. There were no gender differences in mean BrACs either before (men = .094%; women = .096%) or after (men = .103%; women = .106%) the task.

Gender Differences

There were no significant gender differences on the demographic variables of age, years of education, and yearly salary. Gender differences for the BRIEF-A are presented in Table 3.1. Gender was associated with the Emotional Control and Working Memory scales, but not with any other scale, index score, or the GEC. These findings are consistent with the original BRIEF-A standardization sample that showed minimal gender differences (Roth et al., 2005).

Regression Analyses

The principal aim of this investigation was to determine whether specific components of EF, as measured by the BRIEF-A, would moderate the alcohol-aggression relation. Given that the BRIEF-A scores were continuous in nature, regression analyses were indicated. Values from the EF variable were first converted into z-scores therefore centering them as recommended by Aiken & West (1991). Beverage and gender groups were dummy-coded following the procedures outlined in Cohen, Cohen, West, & Aiken (2003). Interaction terms were calculated by obtaining the cross-products of pertinent first-order variables. It is important to create interaction terms using z-scores rather than raw scores because standardizing cross-products after they have already been created does not yield the same regression coefficients as multiplying standardized values (Aiken & West, 1991; Friedrich, 1982). Standardizing the first-order variables also automatically centers the values (i.e., deviation scores with a mean of zero) which reduces multicollinearity between interaction terms and their constituent lower-order terms (Aiken & West, 1991). When using this procedure, it is important to interpret the unstandardized, and not the standardized, regression solution. Traditional standardized solutions should not be interpreted because they are not scale invariant for multiplicative terms and will thus yield incorrect regression coefficients for these effects. As such, readers should be aware that the parameter estimates for the regression equations are reported as unstandardized *bs*.

Variables were entered into the regression models in a hierarchical fashion. According to the procedures put forth in Aiken and West (1991), significant interaction terms were interpreted by plotting the effect and testing to determine whether the slopes of the simple regression lines (1 *SD* above and 1 *SD* below the overall mean) differed significantly from zero.

Aggression Analyses.

BRIEF-A GEC. As summarized in Table 3.2, the first step of the model containing only the main effects was significant, $F(3, 508) = 23.45, p < .001; R^2 = .12$. These analyses revealed that alcohol significantly increased aggression compared with placebo, that men were significantly more aggressive than women, and that the GEC variable was related to aggression. The second step of model was also significant, $F(6, 505) = 14.10, p < .001; R^2 = .14$. Here, the GEC X Beverage and Beverage X Gender interactions were the only two significant 2-way effects. When the GEC X Beverage interaction was probed, it revealed a positive relation between GEC and aggression in the alcohol group, (simple slope $b = .21, p = .06$) but no significant effect in the placebo group, (simple slope $b = .02, p = .68$).

BRIEF-A BRI and MI. Following analyzing the total BRIEF-A score (GEC) above, the theory upon which this article rests, by definition, *requires* that a theoretically-based component-process model be tested whereby the BRI and MI scores are examined in a 4-way model that includes gender and beverage. These results are presented in Table 3.3. The first step of the model containing only the main effects was significant, $F(4, 507) = 19.97, p < .001; R^2 = .14$. These analyses revealed that alcohol significantly increased aggression compared with placebo, men were significantly more aggressive than women, greater BRI scores were significantly related to increased aggression and, as expected, the MI scores were *not* significantly related to aggression (in fact, the relation was even in the wrong direction), ($b = -.11, p = .ns$). The second step of the model was also significant, $F(10,501) = 9.60, p < .001; R^2 = .16$. The increment in R^2 from Step 1 for the BRI X Beverage interaction was .01 (F for change = 5.24, $p < .05$). Here, the BRI X Beverage was the only significant 2-way effect. This indicates that the our hypotheses were confirmed such that when all component-processes are considered together, the BRI is the most predictive risk factor for intoxicated aggression across both men and women. When the BRI X Beverage interaction was probed, it revealed a clearly significant positive relation between BRI and aggression in the alcohol group, (simple slope $b = .31, p < .001$) but not in the placebo group, (simple slope $b =$

.04, $p = .52$) (see Figure 3.1). The 3- and 4-way interactions in the model were not significant and thus were not further probed (see Aiken & West, 1991; Friedrich, 1982).

Table 3.1. Gender Differences for the BRIEF-A Scales.

<i>Measure</i>	<i>Men</i>		<i>Women</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Inhibit	1.64	0.34	1.59	0.36
Shift	1.38	0.34	1.43	0.34
Emotional Control	1.35	0.38	1.47	0.40*
Self-Monitor	1.48	0.37	1.45	0.36
Initiate	1.52	0.35	1.49	0.34
Working Memory	1.43	0.36	1.51	0.37*
Plan/Organize	1.46	0.35	1.43	0.32
Task Monitor	1.54	0.36	1.54	0.36
Organization of Materials	1.57	0.46	1.63	0.52
Behavioral Regulation Index	1.46	0.29	1.49	0.26
Metacognition Index	1.51	0.31	1.52	0.31
Global Executive Component	1.49	0.28	1.51	0.26

Note: * = $p < .05$; *Behavioral Regulation Index* represents a combination of the following subscales: Inhibit, Shift, Emotional Control, and Self-Monitor; the *Metacognition Index* represents a combination of the following subscales: Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials; and the *Global Executive Component* represents a total combination of all subscales

Table 3.2. Regression Equations Relating Beverage, Gender, and BREIF-A GEC Variables with Aggressive Behavior on the TAP.

Step and Measure		R^2	ΔR^2	F for Δ in R^2	Final bs
Step 1:	Beverage	0.12	0.12	23.45***	-0.49***
	Gender				-0.73***
	GEC				0.11
Step 2:	Beverage	0.14	0.02	4.30**	-0.75***
	Gender				-1.00***
	GEC				0.39***
	Gen X Bev				0.47*
	Bev X GEC				-0.29*
	Gen X GEC				-0.20
Step 3:	No significant 3-way effect				

Note: BREIF-A = Behavior Rating Inventory of Executive Functioning – Adult Version. GEC = Global Executive Composite; Gen = Gender; Bev = Beverage. TAP = Taylor Aggression Paradigm.

ΔR^2 = change in R^2

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3.3. Regression Equations Relating Beverage, Gender, and BREIF-A MI and BRI Variables with Aggressive Behavior on the TAP.

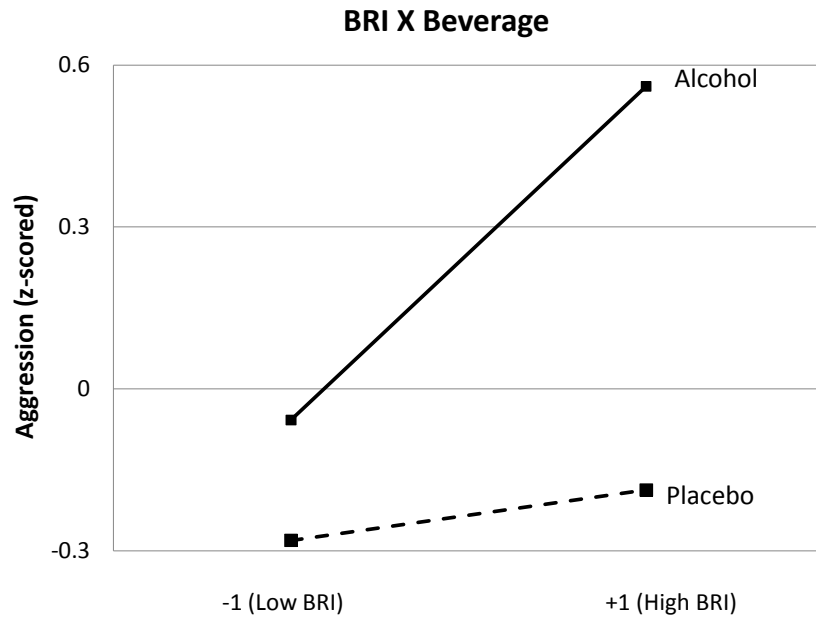
Step and Measure	R^2	ΔR^2	F for Δ in R^2	Final <i>bs</i>
Step 1: Beverage	0.136	0.136	19.97***	-0.50***
Gender				-0.74***
BRI				0.24**
MI				-0.11
Step 2: Beverage	0.144	0.024	2.43*	-0.71***
Gender				-0.98***
BRI				0.42**
MI				0.03
Gen X Bev				0.41
Bev X BRI				-0.28*
Bev X MI				-0.02
Gen X BRI				-0.06
Gen X MI				-0.15
BRI X MI				-0.06
Step 3: No Significant 3-way effects				
Step 4: No Significant 4-way effect				

Note: BREIF-A = Behavior Rating Inventory of Executive Functioning – Adult Version. GEC = Global Executive Composite; Gen = Gender; Bev = Beverage. TAP = Taylor Aggression Paradigm.

ΔR^2 = change in R^2

* $p < .05$; ** $p < .01$; *** $p < .001$

Figure 3.1. BRI X Beverage Interaction



Chapter Four: Discussion

The primary goal of this investigation was to explore the proposition put forth by Bates (2000) that identifying component-processes of EF may prove a fruitful avenue for advancing our understanding of the role of EF in the expression of alcohol-related aggression. To begin this process, the BRIEF-A, a multifaceted self-report measure was chosen to explore EF's component-processes. Viewing EF as a multifaceted cognitive construct consisting of a complex amalgam of functions governed by multiple brain regions is consistent with the view of several theoretical perspectives (Gioia & Isquith, 2004; Perecman, 1987; Stuss & Alexander, 2000; Tranel, Anderson, & Benton, 1994) and empirical data (Fassbender et al., 2004; Garavan, Ross, Murphy, Roche, & Stein, 2002; Roth, Randolph, Koven, & Isquith, 2006). By taking a "top-down" approach, specific EF components were found to be key moderators of the alcohol-aggression relation.

To begin at the "top," an overall measure of EF integrity, the GEC, was only marginally related to *intoxicated* aggression. Moreover, in keeping with this finding, the GEC was also only marginally related to aggression, *in toto*, when considered as a main effect. These findings indicate that EF, as a general construct, served only as a "mild" risk factor for overall aggression as well as alcohol-related aggression. Before proceeding, it is important to discuss these results in relation to the previously mentioned study conducted by Giancola (2004) who utilized a performance-based neuropsychological battery to assess EF to study the alcohol-aggression relation, rather than a self-report inventory. The present investigation was partially successful in replicating Giancola's finding that a general EF construct moderated the alcohol-aggression relation. The term "partially successful" is used because even though a significant GEC X Beverage interaction was found, the relations between the GEC and intoxicated aggression, as well as overall aggression, were only marginally significant. Nonetheless, although the GEC was found to be a relatively weak predictor of intoxicated aggression, these results significantly add to those of Giancola by clearly demonstrating that utilizing a component-process approach revealed more detailed and theoretically-important findings regarding the relations between specific EF elements and alcohol-related aggression.

When evaluating the MI and BRI of the BRIEF-A, the value of the component-process analysis in assessing EF's moderating qualities began to emerge. Specifically, the BRI was a significantly better risk factor for intoxicated aggression than the GEC, while the MI turned out

to not be a risk factor at all for either alcohol-related, or overall, aggression. This clearly indicates that the GEC's status as a "mild" risk factor for intoxicated aggression was actually driven by the BRI. The BRI is representative of an individual's capacity to regulate their behavioral and emotional responses including inhibiting inappropriate thoughts and actions, altering behaviors based on their success (shifting/flexible thinking), and monitoring the effects of their behaviors on others, while the MI involves components of working memory, strategic planning and organization, as well as monitoring performance accuracy when completing tasks (Roth et al., 2005). Following the line of reasoning in the Introduction, in a hostile situation, the role of the cognitive components assessed by the BRI is temporally antecedent to the role of the components assessed by the MI in the moderation of alcohol-related aggression. Specifically, the inhibition of basic emotional and behavioral reactions occurs prior to more elaborate and time-consuming abstract problem-solving cognitive functions described by the MI (Barkley, 1997; Sonuga-Barke et al, 2002).

One means of differentiating EF's component-processes is within the theoretical framework of hot and cool EFs described by Zelazo and Müller (2002) and Séguin et al. (2007). The hot-cool distinction provides a heuristic for understanding how specific EF's are related to behavioral outcomes depending, in part, on environmental contingencies, and are proposed to have at least a partially distinct neuroanatomical basis. Cool EF skills are considered to be more "cerebral" or metacognitive in nature, are more likely to be utilized in abstract decontextualized reasoning (Metcalf & Mischel, 1999; Zelazo & Müller, 2002). Cool EFs include problem-solving abilities that require the capacity to represent a dilemma, maintain and organize related information in working memory, strategically plan and execute a response, evaluate the efficacy of the solution, and make necessary changes based on the outcome (Séguin et al., 2007; Zelazo et al., 1997). In contrast, hot EF is associated with an increased sensitivity to environmental cues of punishment as well as quick visceral responses pursuant to oncoming danger such as a hostile provocation (Séguin et al., 2007). Deficits in hot EF are reported to be more closely related to impairments in social and emotional functioning than cool EF (Hongwanishkul, Happaney, Lee, & Zelazo, 2005). Impaired hot EF may contribute to aggression by reducing one's ability to monitor the self and the situation for what are considered to be acceptable social behaviors, regulate emotional responses, and inhibit impulsive reactions. The hot/cool distinction of EF provides a novel means of differentiating EF's component-processes based on the results shown in this study. However, it should be noted that while it can be argued that the BRI and MI scales

of the BRIEF-A map onto the theoretical conceptions of hot and cool EF, respectively, they do so imperfectly as the BRIEF-A was not specifically designed with the hot-cool distinction in mind. On balance, the hot-cool distinction was utilized because it provides a theoretically-intuitive means of understanding the BRI and the MI and how they may differentially predict, and provide the next “stepping stone” in understanding/explaining, the underlying etiology of the association between alcohol intoxication and aggression. Finally, in the context of this article, the BRI findings are also very important in that they are consistent with the “disinhibition model” of alcohol-related aggression (Collins, 1988) which states that alcohol is a general dysregulator of EF, and acts as a proxy for symptoms of organic EF deficits (Hoaken, Assaad, & Pihl, 1998; Lyvers & Maltzman, 1991; Peterson, Rothfleisch, Zelazo, & Pihl, 1990).

Caveats, Limitations, and Issues for Further Consideration

The cultural idea that aggression is a “hot” behavior, because of its relation to being “red with anger” or “hot-headed” rather than “calm, cool, and collected,” and therefore more closely tied to hot EF processes (i.e., emotional control, inhibition), makes sense semantically. However, the extent to which this metaphor is used/accepted should be tempered. As described by Zelazo and colleagues (Zelazo & Müller, 2002; Zelazo & Cunningham, 2007), specific EFs do not necessarily fall into mutually exclusive hot or cool categories; but rather, the extent to which they are hot or cool depends, in part, on situational circumstances and demands. For example, inhibitory control may be considered hot when engaged in more emotionally-laden contexts such as those involving the potential for reward or punishment but would be seen as cool in situations that require problem solving with little or no emotionally-laden content (see Huijbregts, Warren, de Sonneville, & Swaab-Barneveld, 2008). The point being is that the hot-cool distinction is merely a theoretical heuristic to aid researchers in better understanding the complex construct of EF; in other words, it does not represent the entire sum of the parts that comprise the multifaceted and complex construct (Jurado & Rosselli, 2007; Perecman, 1987; Stuss & Alexander, 2000). More specifically, describing EF’s components as hot or cool simply allows scientists a means of theoretical classification to determine which components are the most salient risk factors for alcohol-related aggression, as well as other destructive behaviors in related areas such as substance abuse (Tarter et al., 2003), risky sex (MacDonald, Fong, Zanna, & Martineau, 2000), drinking and driving (MacDonald, Zanna, & Fong, 1995), suicide (Hufford, 2001), disinhibited eating (Mann & Ward, 2004), smoking (Kassel &

Unrod, 2000), poor self-control (Mann & Ward, 2007), etc (see Giancola, Josephs, Parrott, & Duke, 2010). Finally, readers must always be aware of the perils and pitfalls of reification. Simply because appealing labels such as “hot” and “cool” are applied to cognitive functions *does not make them real*.

Findings from the current study are consistent with prior work demonstrating that EF, assessed with performance-based neuropsychological tests moderates the alcohol-aggression relation (Giancola, 2004). While interpretation of our present findings must take into account the subjective nature of the BRIEF-A, prior work using this measure has indicated good ecological validity as reflected by its association with a variety of outcome measures (Gilotty, et al., 2002; Weber, et al., 2006), as well as correlations with neuroimaging measures of frontal lobe integrity (Garlinghouse et al., 2010; Kawada et al., 2009; Mahone, et al., 2009). Furthermore, performance-based EF measures have been reported to be limited in their sensitivity to real-world functional problems (Cripe, 1999; Denckla, 2002). Neuropsychological measures alone may overlook important information about how EF deficits can negatively affect daily life (Damasio & Anderson, 1993; Lezak, 1995). This assertion is supported by data showing that, compared with neuropsychological measures alone, self-report tools appear to be better at predicting real-life problems associated with executive dysfunction such as previously noted risky behaviors and aggression (Ready, et al., 2001). Thus, self-report measures of EF can provide a valuable and time-efficient means by which to gauge the integrity of EF and its component processes. Nevertheless, despite extending the results of Giancola’s previous experiment that used a broad neuropsychological battery to measure EF, the present investigation did not employ any performance-based tests and therefore cannot compare the relative power of subjective versus objective measures of EF in relation to alcohol-related aggression. Future studies would benefit by directly contrasting how a full performance-based neuropsychological battery assessing EF relates to a self-report tool such as the BRIEF-A, and how they both moderate the alcohol-aggression relation from a component-processes perspective.

While research into the role of EF integrity and alcohol-related aggression will benefit from coupling self-report and neuropsychological assessment, the BRIEF-A may also prove useful in traumatic brain injury (TBI) assessment and treatment planning particularly in relation to risk for aggressive behavior. Frontal damage is very common in TBI patients (Anderson &

Silver, 1998) and studies show 25% of individuals with TBI show propensities for aggression at some point following their injuries (Bagulay, Cooper, & Felmingham, 2006). Based on imaging data, impulsive and aggressive behaviors are most commonly associated with injuries to the orbitofrontal and ventromedial PFC, resulting in behavioral and emotional disinhibition (Anderson & Silver, 1998; Cato, Delis, Abildskov, & Bigler, 2003). While the presence of a prior traumatic brain injury was not assessed in our sample, the disinhibitory affects of alcohol can be considered similar to those cognitive dysfunctions sometimes associated with TBI. Intoxication and TBI can also have a compounding effect. Among patients with TBI alcohol use rates are roughly equivalent to the general population, however increased alcohol consumption has also been associated with less severe TBI dysfunction (Kreutzer, Witol, Sander, Cifn, Martvitz, & Delmonico, 1996). With this information in mind, as well as the results of the present investigation, using the BRIEF-A coupled with data regarding patient alcohol use may provide a rapid assessment for alcohol-related aggression risk assessment in TBI, and other populations where the risk of alcohol-related aggression is of concern.

The ecology of alcohol-related violence is such that a person is placed in an often emotionally-charged situation where the modulation of behavior requires an immediate response to either engage in retaliatory violent behavior or to inhibit that response. When a sober individual possesses intact EF s/he is capable of cognitively regulating emotion and inhibiting a violent reaction and subsequently utilizing metacognitive skills such as strategic planning, organizing and manipulating key information in working memory, initiating behavioral solutions and monitoring their progress, and then generating new hypotheses that will aid in either diffusing or avoiding a potentially violent reaction (Giancola, 2000). However, when EF does not function normally, either due to a cognitive deficit or when coupled with the disinhibitory effects of alcohol intoxication, the propensity for violence is heightened. Our findings indicate that from a component-process perspective, this breakdown occurs within EF's capacity for emotional regulation and behavioral inhibition, that is, what may be considered hot EF. Hot EF is closely related to increased sensitivity to environmental cues of punishment and quick emotional responses to an oncoming danger such as a hostile provocation (Séguin et al., 2007). When behavioral inhibition and emotional regulation collapse, the ability to engage metacognitive skills to diffuse a hostile situation is significantly mitigated. Thus, EF's capacity to control alcohol-related aggression through the use of abstract problem-solving skills and other metacognitive skills is likely due, in part, to an individual's ability to *first* regulate immediate

behavioral and emotional responses to provocation.

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