



## Sex differences in self-regulatory executive functions are amplified by trait anxiety: The case of students at risk for academic failure<sup>☆</sup>



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### ABSTRACT

Deficits in self-regulatory executive functions (SR-EF) are associated with emotional and behavioral problems. Men and women may differ along SR-EF dimensions and these differences may be influenced by trait anxiety. We used the Barkley Deficits in Executive Functioning Scale, which incorporates various self-regulatory processes as measure of executive functions, to examine sex differences in SR-EF and the moderating effect of trait anxiety. The sample consisted of 347 undergraduate students between 17 and 30 years ( $M = 20.62$ ;  $SD = 1.97$ ), enrolled in support courses offered by the university's student learning services. Within dimensions of SR-EF, men demonstrated more problems in self-management to time, and self-motivation, while women demonstrated greater difficulties in the self-regulation of emotion. High trait anxiety was associated with reduced SR-EF in all participants. Sex and trait anxiety also had an interactive relationship with SR-EF: women with high trait anxiety had more difficulty in self-regulation of emotion compared to men with high trait anxiety. Women and men may have different SR-EF strategies which interact differently with high and low trait anxiety. Support programs can promote strategies to enhance self-regulation of emotion, especially female students or those who may be struggling academically and high, but sub-clinical levels of anxiety.

### 1. Introduction

Executive function (EF) is typically defined within a cognitive domain because of its influences on goal-setting and problem-solving abilities (Zelazo, Carter, Reznick, & Frye, 1997). However, recent definitions of EF have suggested a close association with self-regulatory processes (Barkley, 2001; Hofmann, Schmeichel, & Baddeley, 2012; Hosseini-Kamkar & Morton, 2014; Miller & Cohen, 2001). Though EF and self-regulation (SR) are usually studied as separate constructs, they may be quite similar and potentially interdependent (Baumeister & Vohs, 2012). Barkley (2001, 2011) has defined EF as a set of self-regulatory skills characterized by a diverse set of independent and interdependent bio-psychological processes used to achieve a subjective goal. SR may require a dynamic interaction between basic processes (bottom-up) and higher order cognitive control (top-down), which requires the involvement of EFs (e.g., monitoring, inhibiting, and responding appropriately to environmental demands). This interaction is supported by neuroscience research that has demonstrated structural and functional connectivity between the cortico-cortical and the cortico-subcortical networks that support various executive functions (Leh, Petrides, & Strafella, 2010) including the regulation of emotions

(Ochsner et al., 2004). Due to this functional dependency, executive and self-regulatory processes may both be affected by psychopathology. Indeed, the vulnerability of EF and SR processes has been well-documented on a wide spectrum of emotional and behavioral disorders such as ADHD, anxiety, depression (Barkley, 1997).

#### 1.1. Trait anxiety and associations with EF and SR

Trait anxiety is a personality disposition characterized by chronic elevated levels of anxiety (Eysenck, 1997; Eysenck, Payne, & Derakshan, 2005) and is a strong predictor of general anxiety disorders (Hirsch, Mathews, Lequertier, Perman, & Hayes, 2013). Trait anxiety is also associated with EF (Ursache & Raver, 2013) and SR since it interferes with working memory, task-shifting, inhibition (Basten, Stezel, & Fiebach, 2011), orienting, alerting, executive control (Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010), and introduces information processing biases (Mathews & MacLeod, 2002). People with high trait anxiety have lower levels of SR, which relate to difficulties in coping with stress (Clark & Steer, 1996). Moreover, Englert, Bertrams, and Dickhauser (2011) identified a mediating role of trait anxiety in relationship between EF and SR; suggesting that high levels of trait

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anxiety may impair both EF and SR processes.

### 1.2. Sex differences in self-regulatory executive functions

Past research has also presented evidence of sex differences in both EF and SR. Specifically, women may have an advantage for SR (Hosseini-Kamkar & Morton, 2014) as they outperform men in delayed-gratification (Mischel & Underwood, 1974; Silverman, 2003), self-control (Duckworth & Seligman, 2006), behavioral self-regulation (Weis, Heikamp, & Trommsdorff, 2013), and social inhibition tasks (Hosseini-Kamkar & Morton, 2014). The largest sex discrepancies in EF and SR are seen in the self-regulation of emotion. Women tend to have higher levels of self-regulation of emotion (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Nolen-Hoeksema, 2012; Tamres, Janicki, & Helgeson, 2002) presumably due to a greater use of emotion regulation strategies (e.g., Tamres et al., 2002). Such strategies involve executive skills associated with the ability to control emotional reactions (Barkley, 2001; Eisenberg, Hofer, & Vaughan, 2007), cognitive reappraisal, emotional-coping (Nolen-Hoeksema, 2012), and rumination. Conversely, men tend to avoid or suppress emotional experiences (Barrett & Bliss-Moreau, 2009) and may use relatively more problem-focused coping, such as efforts to mitigate or eliminate stressful situations, to alleviate aversive and stressful states (Matud, 2004).

Sex differences in self-regulation of emotion may interact with anxiety at various levels. For example, Kogler, Gur, and Derntl (2014) found that attempts to regulate emotions in stressful situations increased anxiety in women but not in men. This may be related to greater use of the rumination strategy by women, which has been closely related to anxiety (Aldao, Nolen-Hoeksema, & Schweizer, 2010). However, although men seem to struggle less with emotional coping than women, they still present other areas of difficulty in coping with anxiety and related EFs, such as decision-making (De Visser et al., 2010).

### 1.3. Current study

Barkley argues that executive functions are closely related to one's ability to self-direct towards everyday life tasks, and therefore the assessment of EF should include ecologically valid measurements besides neurocognitive tests and laboratory tasks (Barkley, 2001, 2011). To extend current work suggesting an interdependent relationship between EF and SR, we adopted Barkley's definition of EF as a "self-regulation across time for the attainment of one's goals (self-interests)" (Barkley, 2011, p.13). We examined the relationship between sex and self-regulatory executive processes and the effect of trait anxiety on this relationship. We predicted that a) women and men will differ in subscales of SR-EF b) high levels of trait anxiety would be associated with reduced SR-EF and that c) trait anxiety would moderate the relationship between sex and SR-EF. We expected that differences in SR-EF between men and women would vary according to trait anxiety, with higher trait anxiety being associated with greater differences. We examined the effects of sex in SR-EF and the moderating effect of trait anxiety in this relationship while also controlling for state anxiety (contextual anxiety; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) across analyses.

## 2. Method

### 2.1. Participants

Participants included 347 adults aged 17 to 30 years ( $M = 20.62$ ;  $SD = 1.97$ ) consisting of 166 men (48%), 177 women (51%), and 4 cases (0.01%) who indicated "no response" for sex. Majority of the participants reported their race to be White ( $n = 176$ , 50.7%) with a minority of Asian ( $n = 74$ , 21.3%), Black/African-American ( $n = 38$ , 11%), other ( $n = 14$ , 4.1%), don't know ( $n = 7$ , 2%), and  $n = 34$ , 9.8% did not respond. Approximately 11.5% of the participants were English

Language Learners (ELL) and 86.7% identified English as their native language. Participants were volunteer undergraduate students from a university in Southern Ontario who were enrolled in one of two programs designed to assist students with relatively lower achievement, or who were at risk of academic failure, in comparison the larger university population.

### 2.2. Measures

#### 2.2.1. Demographics

A series of questions on a demographics questionnaire was used to gather information about a participant's age, sex, race, and language status.

#### 2.2.2. Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF)

The BDEFS-SF (Barkley, 2011) is a self-report measure that presents a series of behavior-related statements paired with a 4-point Likert rating scale (1 = *never or rarely* to 4 = *very often*). During this task participants are asked to reflect on their behaviors within the past six months. The BDEFS-SF categorizes executive functions into five dimensions. The first, self-management to time, involves sense of time, time management, planning, and other goal-directed behaviors (sample-derived reliability,  $\alpha = 0.77$ ). Second, self-organization is comprised of organizing one's thoughts and actions, thinking quickly when faced with uncertain events, and developing solutions to problems that are intercepting when pursuing goals (sample-derived reliability,  $\alpha = 0.79$ ). Third, self-restraint is comprised of impulsive decisions, disregarding consequences when decision-making, poor self-awareness, and disregarding other people's perspectives (sample-derived reliability,  $\alpha = 0.72$ ). Fourth, self-motivation is comprised of taking short-cuts in tasks, doing minimal work, and requiring more supervision on tasks (sample-derived reliability,  $\alpha = 0.83$ ). Fifth, self-regulation of emotion is controlling one's emotions (sample-derived reliability,  $\alpha = 0.92$ ). Across all subscales, higher scores represent a greater deficit on that dimension of executive function.

#### 2.2.3. The Spielberger State-Trait Anxiety Inventory (STAI)

The STAI (Spielberger et al., 1983) is a self-report measure that presents a series of items related to personal feelings (e.g., happy, rested, nervous, secure) and asks participants to indicate the appropriateness of each statement (1 = *almost never* to 4 = *almost always*). This inventory is comprised of two forms. The first form is State Anxiety and presents 20 statements (e.g., "I feel secure", "I feel nervous") and asks participants to rate the appropriateness of each statement based on how they feel at the present moment (sample-derived reliability,  $\alpha = 0.88$ ). The second form is Trait Anxiety presents an additional 20 statements (e.g., "I am a steady person", "I make decisions easily") and asks participants to rate the appropriateness of each statement based on how they generally feel (sample-derived reliability,  $\alpha = 0.82$ ). The STAI assesses state and trait anxiety, which are dimensions of personality and situational anxiety, respectively.

#### 2.2.4. Procedure

Upon receiving clearance from the University Research Ethics Board, participants were recruited in partnership with the university's student learning services. Participants were informed of the study prior to a visit from the research team and later invited to participate during one of their supplemental learning and study-skills classes. Participation was voluntary and separate from program requirements. Thus, their decisions to participate were not related to their course or program status. Recruitment and data collection occurred in the first half of either the fall or winter academic terms beginning in the fall of 2013 through spring of 2015. The abovementioned measures were group-administered to those who provided consent and took approximately 1 h of their scheduled class time. Those who did not wish to

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