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Failure to Replicate Ego Depletion in the Mechanism Underlying Teacher Aggression: A Conditional Process Analysis

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The ego depletion effect refers to the hypothesis that self-control is vulnerable to short-term deterioration after it is exerted, causing subsequent performance on other unrelated self-control tasks to diminish. A large number of published studies since 1998 have provided empirical support for the depletion effect. However, there is considerable debate in the literature about its actual cause. Furthermore, a recent series of meta-analyses indicate that the effect is substantially smaller than previously reported, and may even be zero. The present study investigated whether ego depletion influences the mechanism underlying teacher aggression, and specifically whether depleted teachers are more likely than nondepleted teachers to respond aggressively to students who misbehave. Participants included 110 Australian primary and secondary school teachers who completed five online procedures. Results revealed that ego depletion did not influence the mechanism underlying teacher aggression that was tested. Possible reasons for this null finding are discussed.

Keywords: Caregiving behavioural system, Ego depletion, Student misbehaviour, Teacher aggression, Conditional process analysis

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In a recent study investigating the mechanism underlying teacher aggression, Montuoro and Mainhard (in press) reported that the dysfunctional behaviour appears to follow the General Aggression Model (GAM). Using a series of multiple mediation analyses, the researchers found that lower caregiving responsiveness indirectly led to teacher aggression in response to student misbehaviour via higher misbehaviour provocation and lower trait self-control, in serial. The researchers concluded that teacher aggression, which refers to any form of direct or passive communication intended to psychologically control a student (Lewis & Riley, 2009; Montuoro & Lewis, 2014), appears to proceed from "the person in the situation" (Anderson & Bushman, 2002, p. 34). Montuoro and Mainhard explained that lower caregiving responsiveness appears to predispose teachers to negative affect, cognition, and arousal, which negatively influence how they perceive and interpret misbehaviour. These internal states, in turn, appear to negatively influence appraisal and decision processes, leading to immediate and impulsive actions.

The present study builds on Montuoro and Mainhard's (in press) research by using an experimental procedure to test whether ego depletion moderates a closely related model of the mechanism underlying teacher aggression. The present study is important for two reasons. First, ego depletion may be a common occurrence in teaching due to the stressors endemic to the profession, including demanding workloads, performance targets, and working conditions (for a review, see Kyriacou, 2011). Indeed, teaching is recognised as one of the "high stress" occupations (Dollard, Winefield, & Winefield, 2003, p. 226). Second, the present study aims to measure the influence of ego depletion on the overall mechanism underlying an everyday, real-world behaviour. This is a novel approach in ego depletion research, which has traditionally measured the *isolated* influence of ego depletion on a subsequent self-control task (for reviews, see Carter, Kofler, Foster, & McCullough, 2015; Carter & McCullough, 2014).

Ego Depletion

In the 1990s, Roy Baumeister and his colleagues hypothesised that the exertion of self-control depends on a limited energy resource (Baumeister, Heatherton, & Tice, 1994). The researchers proposed that this resource is vulnerable to short-term deterioration after it is exerted, causing subsequent performance on other unrelated self-control tasks to diminish, comparable to a weakened muscle. This hypothesis was later named the *ego depletion model* (Baumeister, Bratslavsky, Muraven, & Tice, 1998), and there is now a large body of published research supporting it (for a meta-analysis, see Hagger, Wood, Stiff, & Chatzisarantis, 2010). However, the cause of ego depletion remains unknown and continues to be debated in the literature (see Baumeister & Vohs, in press; Beedie & Lane, 2011; Inzlicht, Berkman, & Elkins-Brown, 2016; Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrae, 2014; Kurzban, 2010). Furthermore, through a series of meta-analyses, Carter and his colleagues have demonstrated that the depletion effect may be overestimated, and may even be zero (Carter et al., 2015; Carter & McCullough, 2013, 2014).

Empirical research testing the depletion effect normally adopts an experimental procedure using two unrelated tasks, known as the dual-task paradigm (Baumeister et al., 1998). Participants in the experimental condition are required to engage in two consecutive self-control tasks. Participants in the control condition are also required to engage in two consecutive tasks, but only the second task is a self-control task. According to the

ego depletion hypothesis, participants in the experimental condition should demonstrate impaired performance on the second self-control task compared to participants in the control condition. This is because participants in the experimental condition temporarily diminish their self-control resources during the initial self-control task.

For example, in one early ego depletion study participants who resisted the temptation to eat chocolate and forced themselves to eat radishes instead subsequently gave up much faster on a difficult and frustrating puzzle task compared to participants who were allowed to eat chocolate and participants who were not tempted at all during the initial self-control task (Baumeister et al., 1998). There is also evidence demonstrating that ego depletion impairs performance on real-world behaviours. For example, ego depletion has been shown to lead to a higher use of stereotypes (Gordijn, Hindriks, Koomen, Dijksterhuis, & Van Knippenberg, 2004), an increased incidence of inappropriate sexual thoughts and infidelity (Gailliot & Baumeister, 2007b), a decreased willingness to help strangers in need (DeWall, Baumeister, Gailliot, & Maner, 2008), and an increased likelihood of responding aggressively to an experimenter who provides insulting feedback on a writing task (DeWall, Baumeister, Stillman, & Gailliot, 2007; Stucke & Baumeister, 2006).

The Resource Model of Ego Depletion

According to the *resource model of ego depletion*, self-control depends on a limited biological resource that is expended and therefore depleted by acts of self-control. Baumeister and his colleagues hypothesised that the limited resource in question here is blood glucose (Gailliot & Baumeister, 2007a; Gailliot, Baumeister, et al., 2007). This is because blood glucose ($C_6H_{12}O_6$) is the brain's main fuel for energy metabolism, with a relatively expensive metabolism rate of 110g per day on average (Sokoloff, 1973), or the equivalent of a leg muscle running a marathon (Hochachka, 1994). Gailliot and Baumeister (2007a) hypothesised that self-control is particularly metabolically expensive because it must override powerful conflicting processes, which leads to falls in blood glucose.

For example, Fairclough and Houston (2004) conducted a repeated measures experiment in which participants completed a congruent Stroop task (i.e., control condition where all colour words appeared in a congruent colour) and an incongruent Stroop task (i.e., experimental condition where all colour words appeared in an incongruent colour). Participants completed three successive 15-minute periods of Stroop testing within each condition, and blood samples measuring blood glucose were taken after each 15-minute period. The researchers reported that blood glucose levels were significantly lower after the incongruent condition, adding that blood glucose fell significantly between each successive 15-minute period of performance. Other studies have supported the resource model of ego depletion by demonstrating that increasing blood glucose levels after the initial self-control task (e.g., ingesting a carbohydrate-based drink) eliminates the depletion effect (Denson, von Hippel, Kemp, & Teo, 2010; Gailliot, Baumeister, et al., 2007; Gailliot, Plant, Butz, & Baumeister, 2007; Masicampo & Baumeister, 2008; McMahon & Scheel, 2010).

Contradictions to the Resource Model of Ego Depletion

Some researchers have demonstrated alternative ways to reverse ego depletion, challenging the hypothesis that the phenomenon is caused by a short-term fall in blood glucose. Short periods of rest and relaxation (Muraven & Baumeister, 2000; Tyler & Burns,

2008) and mindfulness meditation (Friese, Messner, & Schaffner, 2012) have been reported to reverse ego depletion. Furthermore, inducing positive mood (Tice, Baumeister, Shmueli, & Muraven, 2007) and thoughts of family (Stillman, Tice, Fincham, & Lambert, 2009) have also been reported to counteract ego depletion.

Additionally, regular training on tasks requiring self-control has been shown to reduce the depletion effect (i.e., performance on self-control tasks deteriorates at a slower rate) in the same manner that physical training reduces the propensity for muscles to become fatigued and weakened after exertion (Baumeister, Gailliot, DeWall, & Oaten, 2006; Denson, Capper, Oaten, Freise, & Schofield, 2011; Finkel, DeWall, Slotter, Oaten, & Foshee, 2009; Gailliot, Plant, et al., 2007; Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006a, 2006b, 2007). This *ego bolstering effect* is domain-general in nature, so that regular training in one area of self-control (e.g., using one's nondominant hand for everyday tasks) has a bolstering effect on unrelated conditions requiring self-control (e.g., suppressing aggressive impulses during interpersonal conflicts).

The Motivational Model of Ego Depletion

In recent years researchers have hypothesised that ego depletion may be a short-term motivational deficit, representing a psychological phenomenon. For example, Inzlicht and Schmeichel (2012) hypothesised that initial acts of self-control shift an individual's "motivational orientation away from suppressing and inhibiting desires and toward approaching and gratifying them" (p. 451). Exerting self-control is certainly an effortful process, requiring attention, deliberation, and self-observation (Muraven & Baumeister, 2000), so it is plausible that depleted individuals are less motivated to expend further effort on subsequent tasks (Inzlicht & Schmeichel, 2012). Therefore, the motivational model of ego depletion suggests that it is not that depleted individuals cannot regulate their behaviour, but rather that they choose not to regulate their behaviour.

A recent series of studies provided support for the motivational model of ego depletion. For example, using a highly precise blood glucose monitor, Molden et al. (2012) found that blood glucose does not fall during ego depletion. The researchers also reversed the depletion effect after depleted participants rinsed their mouths with, but did not ingest, and therefore did not metabolise, a carbohydrate-based drink. Other researchers have also found that self-control can be impaired by the mere perception of being ego depleted (Clarkson, Hirt, Jia, & Alexander, 2010), the thought that self-control is a finite resource (Job, Dweck, & Walton, 2010), and the thought that free will does not exist (Rigoni, Kühn, Gaudino, Sartori, & Brass, 2012).

In light of these studies, Beedie and Lane (2011) hypothesised that ego depletion is a matter of blood glucose *allocation*, not limited supply. The researchers claimed that, with the exception of conditions such as hypoglycemia, there is always enough glucose in the blood to supply the brain, and that glucose is supplied to the brain in accordance with the perceived importance of a task. However, this hypothesis is unlikely. Although the brain cannot synthesise glucose or store more than several minutes' supply of glycogen, the transport of glucose to the brain always exceeds the rate of brain glucose metabolism. In fact, as the plasma glucose concentration falls below the physiologic range, blood-to-brain transport is limited to brain glucose metabolism in the interests of survival (Cryer, 2004).

The Shifting Priorities and Valuation Models of Ego Depletion

In recent years, Inzlicht and his colleagues further developed the motivational model of ego depletion, presenting two integrated theoretical models of the phenomenon, which they named the *shifting priorities model* and *the valuation model* (Inzlicht et al., 2016; Inzlicht et al., 2014). According to the shifting priorities model of ego depletion, individuals experience a decrease in cognitive control and an inclination toward rest and leisure after exerting self-control. This motivated switching is evolutionarily adaptive because it allows an organism to pursue two distinct pathways for attaining resources (Cohen, McClure, & Yu, 2007; Kool & Botvinick, 2014). Therefore, ego depletion may simply be motivated switching between priorities, and the fatigue, boredom, and negative emotions characteristic of ego depletion may be an adaptive function preventing fixation on current activities and redirecting attention toward activities with potentially higher utility.

Motivated switching occurs at all levels of behaviour and is not limited to humans. For example, motivated switching is seen when foraging animals must decide whether to continue harvesting an established source of food, or explore the terrain for new sources of food (Kurzban, Duckworth, Kable, & Myers, 2013). This example demonstrates that, from an evolutionary perspective, it makes more sense for self-control to be driven by motivational priorities instead of some depletable biological resource.

The valuation model of ego depletion indicates when motivated switching is likely to occur. According to this model, the subjective value of cognitive or behavioural options is the main determinant of any self-control decision. Subjective value refers to any source of value that may be derived from an effortful cognition or behaviour (i.e., monetary value, social value, or self-relevance), minus the costs. Therefore, Inzlicht et al. (2016) described the valuation model of ego depletion as an accumulation of value signals into a unitary value calculation.

Research has shown that self-control can be improved by increasing the value of the self-control action. For example, in the treatment of substance use disorders, monetary incentives have been found to have a larger impact on alcohol, tobacco, and illicit drug abstinence ($d = 0.42$) than cognitive behavioural therapy ($d = 0.25$) and outpatient treatment ($d = 0.37$) (for a meta-analysis, see Prendergast, Podus, Finney, Greenwell, & Roll, 2006). Monetary incentives (Muraven & Slessareva, 2003), and even the mere thought of monetary incentives (Boucher & Kofos, 2012), have also been shown to mitigate the depletion effect.

Furthermore, self-control decisions that are related to an individual's identity appear to have a higher value. For example, merely inducing thoughts of the self can eliminate ego depletion, including self-monitoring (Alberts, Martijn, & de Vries, 2011; Seeley & Gardner, 2003; Wan & Sternthal, 2008) and self-affirmation (Schmeichel & Vohs, 2009). Together, these studies suggest that ego depletion is driven by multiple motivational inputs, raising further doubts about the limited resource model. Indeed, "if self-control is based on a finite (but renewable) resource, it is difficult to understand how changing perceptions… can instantly replenish self-regulatory capacity" (Inzlicht et al., 2014, p. 128).

Is Ego Depletion an Adaptation Shock or Too Incredible?

A recent series of studies suggest that the depletion effect is a temporary phenomenon that disappears when there is sufficient opportunity to adapt. For example, studies involving two initial self-control tasks instead of one have found no depletion effect in the third self-control task (Converse & DeShon, 2009; Xiao, Dang, Mao, & Lilijedahl, 2014). These results indicate that completing two initial self-control tasks gives individuals an opportunity

to become accustomed to the required level of exertion, leading to adaptation effects (Converse & DeShon, 2009). Another recent study demonstrated that completing a lengthy initial self-control task (i.e., a five minute attention/concentration task) in the dual-task paradigm also eliminates the depletion effect (Dang, Dewitte, Mao, Xiao, & Shi, 2013). Taken together these studies indicate that ego depletion is an *adaptation shock*, which occurs temporarily when participants are beginning to exert self-control.

Most recently, three meta-analyses conducted by Carter and his colleagues reported that the depletion effect appears to be substantially smaller than previously reported, and may even be zero (Carter et al., 2015; Carter & McCullough, 2013, 2014). Carter and McCullough (2013) used Schimmack's (2012) incredibility index and two weighted least squares regression models (Egger, Davey Smith, Schneider, & Minder, 1997; Moreno et al., 2009) to analyse Hagger et al.'s (2010) meta-anaytic dataset of 83 published ego depletion studies. The incredibility index found that the proportion of significant effects reported in the dataset was highly improbable (i.e., 3.7 in one billion). This indicates that null findings exist in ego depletion research, but are not published (i.e., *publication bias*). Furthermore, the regression analyses found that many of the depletion effects reported in the dataset were probably substantially smaller than reported, and may have even been zero. This indicates that studies in the dataset were extremely underpowered. Carter and McCullough (2013) explained that ego depletion:

> …could be a non-existent effect for which belief has been kept alive through the neglect of null findings… The highest priority for research on the depletion effect should not be arriving at a better theoretical account, but rather, determining with greater certainty whether an effect to be explained exists at all (p. 684).

Carter and McCullough (2014) conducted further analyses of Hagger et al.'s (2010) meta-analytic dataset using a series of advanced regression-based methods. In this study, Carter and McCullough used the binomial test described by Ionnidis and Trikalinos (2007) to identify signs of publication bias, as well as the trim and fill method (Duval & Tweedie, 2000) and an extension of Egger's regression test (Egger et al., 1997; Moreno et al., 2009; Stanley, 2008) to correct for the influence of publication bias. Once again, the researchers found that the depletion effect appears to be overestimated due to a conspicuous lack of non-significant findings in the published literature, and that this phenomenon appears to be caused by *small-study effects*, which refers to the tendency for smaller sample sizes to produce larger effect size estimates. Carter and McCullough concluding that, "counter to our own personal intuitions about how human psychology works… our results do not support the claim that the depletion effect is meaningfully different from zero" (2014, p. 8).

Most recently, Carter et al. (2015) conducted a series of meta-anlyses on a dataset of 118 ego depletion studies, which included 49 unpublished studies. Instead of performing a single meta-anlysis, the reserachers divided the dataset by outcome task in order to group methodolically homogenous studies (e.g., standardised tests, hand grip stamina task, etc.). The researchers then applied a series of analyses to each dataset, including random/mixed-effects meta-anlysis models (Cooper, Hedges, & Valentine, 2009), the test for excess significance (Ionnidis & Trikalinos, 2007), the trim and fill method (Duval & Tweedie, 2000), and three estimators based on weighted least squares regression (Stanley & Doucouliagos, 2014), including the funnel plot assymetry test, precision-effect test, and precision-effect

estimation with standard errors. In addition to these a priori analyses, Carter et al. (2015) conducted a post hoc analysis in which all of the abovementioned methods were applied to the whole dataset of 118 studies.

Carter et al. (2015) found that the depletion effect in every dataset except for the standardised tests dataset was not different from zero. Even so, without applying corrections for small-study effects, the estimate of the depletion effect derived from the standardised tests dataset was less than half the size of the estimate reported in the meta-analysis conducted by Hagger et al. (2010), and the lower limit of the estimate was in fact nearly zero ($g = 0.05$). Carter et al. (2015) also found support for the notion that self-control actually improves if more than one initial self-control task is completed, supporting the findings of two studies that included two initial self-control tasks (Converse & DeShon, 2009; Xiao et al., 2014). In the context of almost 20 years of published empirical research supporting the depletion effect, Carter et al. (2015) remarkably concluded that, "Self-control in general does not decrease as a function of previous use," and added, "We encourage scientists and nonscientists alike to seriously consider other theories of when and why self-control might fail" (p. 18).

The Present Study

As discussed in the introduction, Montuoro and Mainhard (in press) found that the mechanism underlying teacher aggression appears to follow the GAM, reporting that lower caregiving responsiveness indirectly led to teacher aggression via higher misbehaviour provocation and lower trait self-control, in serial. The present study builds on this research by investigating whether ego depletion moderates one or more of the pathways in a closely related model of the mechanism. Specifically, the present study uses conditioned process analysis to test whether ego depletion moderates the direct pathway from caregiving responsiveness to teacher aggression, or the indirect pathway which passes through misbehaviour provocation (see Figure 1). This is a novel approach to ego depletion research because it examines the depletion effect within a metatheoretical model that simulates the mechanism underlying an everyday, real-world behaviour. Here, as in reality, the depletion effect is not so much the "main event" as it is in the dual-task paradigm, but rather a peripheral event that moderates a more complicated mechanism.

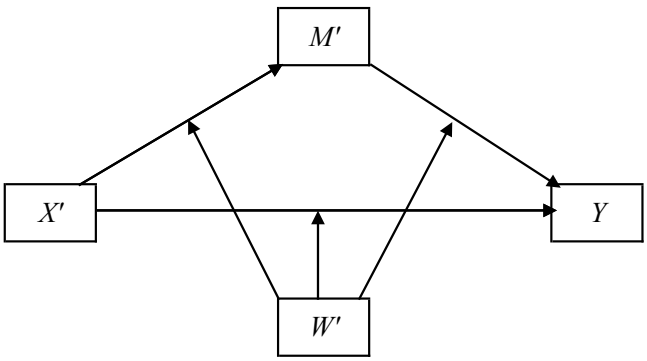

Figure 1. *The conditional process analysis depicted as a theoretical model*

Method

Procedure

A total of 110 teachers participated in this study. Participants were recruited from a national database of practicing primary and secondary school teachers. The database did not include school-related data. Participants included 23 primary school teachers (*Mdn* [age] = 35-39 years; *Mdn* [teaching experience] = 10-14 years), comprising of two males and 21 females, and 87 secondary school teachers (*Mdn* [age] = 35-39 years; *Mdn* [teaching experience] = 10-14 years), comprising of 22 males and 65 females. A total of 11 primary school teachers and 41 secondary school teachers were randomly assigned to the control condition, and a total of 12 primary school teachers and 46 secondary school teachers were randomly assigned to the experimental condition.

The study was administered by the Sydney-based market research firm, *Stable Research*, and took participants approximately 30 minutes to complete. *Stable Research* was commissioned to administer the study because of the firm's expertise in programming and administering technically complex online research. Once logged in, participants reported four covariates, including gender, age, years teaching, and teaching role (i.e., primary or secondary). These covariates were included because they have been found to influence teacher attachment styles (Riley, 2009), as well as the broader mechanism underlying teacher aggression (Montuoro & Mainhard, in press). After reporting the covariates, participants completed the five main procedures in the same order that they are presented below. Each participant was paid AU$30 for their time.

Measures and Procedures

Caregiving responsiveness. The Caregiving Questionnaire (CQ) is a four-factor instrument designed to measure individual differences in the adult caregiving system (Kunce & Shaver, 1994). Four eight-item scales assess four dimensions of caregiving, including proximity, sensitivity, cooperation, and compulsive caregiving. The instrument includes 32 items that participants respond to using a 6-point Likert scale ranging from 1 (*not at all descriptive of me*) to 6 (*very descriptive of me*). This study measured the composite mean of proximity, sensitivity, and cooperation to ascertain caregiving responsiveness (for an example of caregiving responsiveness, see Millings, Walsh, Hepper, & O'Brien, 2013). The instrument had good internal consistency estimates of reliability ($\alpha = .72$).

Ego depletion. The Attention Control Video (ACV) procedure was adapted from the cognitive load literature (Gilbert, Krull, & Pelham, 1988), and has recently been used by researchers to deplete self-control (see DeWall et al., 2007; Finkel et al., 2009; Gailliot, Baumeister, et al., 2007; Schmeichel, Vohs, & Baumeister, 2003). The procedure requires participants to watch a six-minute video (without audio), depicting a woman being interviewed by an interviewer who is located off camera. In addition to the woman, who appears in the upper left-hand portion of the screen, the video includes a series of one-syllable words, each of which appear for 10 seconds in the lower right-hand portion of the screen. Participants in the nondepletion control condition are asked to simply watch the video. Participants in the depletion experimental condition are asked to watch the video without looking at the one-syllable words. Because the present study was conducted online, there was a concern that participants in the experimental condition would not follow

the ACV procedure instructions. A simple measure was taken to address this concern. Participants in the experimental condition were told that the video would last between 10 seconds and 10 minutes, and were warned that if they did not press "next" within three seconds of the video ending, they would be "timed-out of the study without payment." None of the participants were timed-out of the study.

Student misbehaviour. The Simulated Student Misbehaviour (SSM) procedure was developed for the present study. The procedure is closely based on the Articulated Thoughts in Simulated Situations (ATSS) procedure (Davison, Feldman, & Osborn, 1984; Davison, Robins, & Johnson, 1983) and other similar procedures used in the ego depletion literature (see DeWall et al., 2008; Gailliot & Baumeister, 2007b). In the SSM procedure, participants are required to read a scenario describing a student displaying increasingly problematic misbehaviour. The text is lengthy and highly personally involving.

Misbehaviour provocation. The Student Misbehaviour Provocation in Simulated Situations Questionnaire (SMPSSQ) was adapted from the Student Misbehaviour Provocation Questionnaire (SMPQ) developed by Montuoro and Mainhard (in press). It is a six-item self-report instrument designed to measure teachers' tendency to feel frustrated and provoked by the student misbehaviour presented in the SSM procedure. Participants respond to each question using a 6-point Likert-scale ranging from 1 (*not at all descriptive of me*) to 6 (*very descriptive of me*). The instrument includes items such as, "At one or more points in the scenario, I would have felt frustrated" and, "I would not have felt helpless at any point in the scenario". The instrument had good internal consistency estimates of reliability (α = .87).

Teacher aggression. The Teacher Aggression in Simulated Situations Questionnaire (TASSQ) was adapted from the Teacher Aggression Questionnaire (TAQ) that was developed by Montuoro and Mainhard (in press). It is a 12-item self-report instrument designed to measure teachers' propensity to respond aggressively to the student misbehaviour presented in the SSM procedure. Participants respond to each item using a 6-point Likert-scale ranging from 1 (*not at all descriptive of me*) to 6 (*very descriptive of me*). The instrument includes items such as, "At one or more points in the scenario, I would have deliberately insulted Tyson, Michael, or the others boys who were misbehaving" and, "There was no point in the scenario where I would have been looked aggressively at Tyson, Michael, or the other boys who were misbehaving." The instrument had good internal consistency estimates of reliability (α = .86).

Results

The influence of ego depletion on the mechanism underlying teacher aggression was tested using conditional process analysis in Hayes's (2013) PROCESS macro for SPSS, Model #59. Briefly, conditional process analysis is used to understand and describe the moderating influence of one or more variables in a simple or multiple mediation model (for a review of the literature, see Hayes, 2013, pp. 325-333). The model used in the present study tested whether ego depletion moderates the direct or indirect pathways in a closely related model of the mechanism underlying teacher aggression identified by Montuoro and Mainhard (in press).

The simplified theoretical model in Figure 1 depicts the preliminary antecedent variable, caregiving responsiveness (*X'*), the mediator, misbehaviour provocation (*M'*), the moderator, ego depletion (*W'*), and the outcome variable, teacher aggression (*Y*). As can be

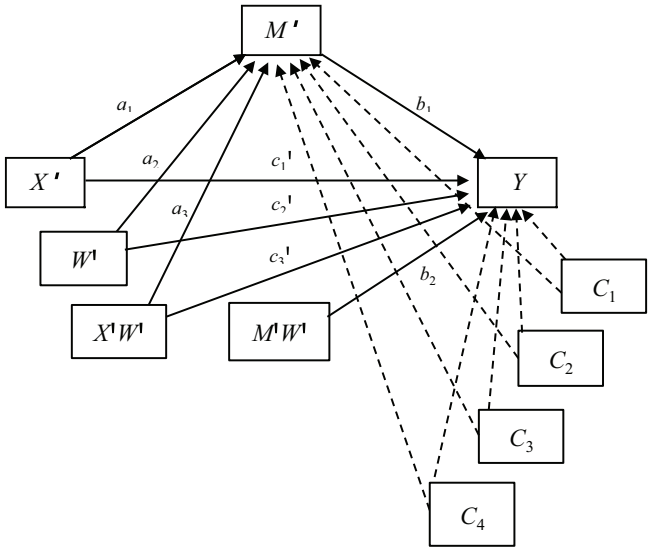

Figure 2. *The conditional process analysis depicted as a statistical model*

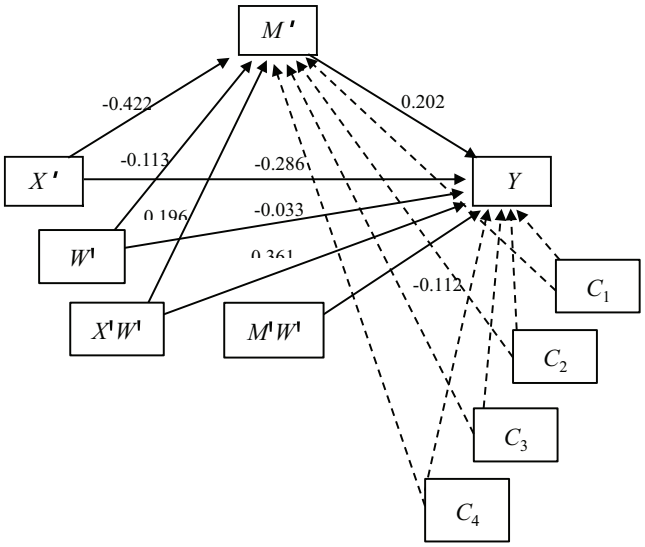

Figure 3. *The completed statistical model from the conditional process analysis*

seen, the moderating effect of ego depletion was tested through each pathway in the model. The statistical model in Figure 2 builds on the theoretical model, depicting each pathway and interaction. It also depicts the study covariates, gender (C_1), age (C_2), years teaching (C_3), and teaching role (C_4).

Assumption testing. The assumptions of OLS regression were tested. This included testing for independence of observations, outliers, normality, and homoscedasticity. Violations of normality were found. Errors in the estimation of the outcome variable, teacher aggression (Y), conditioned on $\hat{Y}$, were not normally distributed. Using the Shapiro-Wilk test, the teacher aggression scores in the control condition, $D(52) = 0.93$, $p = .006$, were significantly non-normal. Finally, using the Shapiro-Wilk test once again, the teacher aggression scores in the experimental condition, $D(58) = 0.92$, $p = .001$, were also significantly non-normal. In light of these severe violations, all of the linear regression coefficients were derived from 10,000 bias-corrected bootstrapped samples with replacement from the

original sample. This ensured the estimated standard errors were robust (Hayes, 2013).

Mean-centering predictor variables. The preliminary antecedent variable, caregiving responsiveness (*X*), the mediator, misbehaviour provocation (*M*), and the moderator, ego depletion (*W*), were all mean-centered prior to analysis. The type of conditional process analysis model used in this study includes the products, *XW* and *MW*, meaning that the effect of *W* on *M* (a_2) is conditioned on *X* equalling zero, and the effect of *W* on *Y* (c_2') is conditioned on *X* equalling zero, independent of *M*. However, the present dataset did not include instances in which the preliminary antecedent variable equalled zero. This meant that without mean-centering *X*, *M*, and *W*, the beta coefficients for a_2 and c_2' would have been meaningless.

Mean-centering the variables that constituted the products in the analysis meant that the effect of ego depletion (*W*) on misbehaviour provocation (*M*) was conditioned on participants who scored the mean for caregiving responsiveness (*X*), and the effect of ego depletion (*W*) on teacher aggression (*Y*) was conditioned on participants who scored the mean for caregiving responsiveness (*X*), independent of misbehaviour provocation (*M*). The models in both Figures 1 and 2 depict the mean-centered variables.

Mean-centering *X*, *M*, and *W* also changed the mediated regression coefficients, which included the effect of *X* on *M* (a_1), the effect of *M* on *Y* (b_1), and the direct effect of *X* on *Y* (c_1'). Because *W* was dichotomous, mean-centering this variable meant that the regression coefficients for a_1 and c_1' went from being conditioned on *W* equalling zero, to the weighted average effect of *X* on *M* and *Y* between the control and experimental group in *W*. Similarly, the regression coefficient for b_1 went from being conditioned on *W* equalling zero, to the weighted average effect of *M* on *Y* between the control and experimental group in *W*. Mean-centering the variables that constituted the products in the analysis did not influence the regression coefficients, inferential tests, or interpretation of the products, *XW* in the model of *M* (a_3), *XW* in the model of *Y* (c_3'), and *MW* in the model of *Y* (b_2).

Conditional Process Analysis

The indirect effects (a_1 and b_1). The moderated regression coefficient for *X'W'* in the model of *M'*, a_3, is not different from zero, meaning that the effect of *X'* on *M'* was not dependent on *W'*, $a_3 = 0.196$, $p = .567$. This means that there was no evidence that the relationship between caregiving responsiveness and misbehaviour provocation is conditioned on ego depletion, controlling for the covariates. Therefore, the effect of *X'* on *M'* given *W'* is actually a_1, with lower caregiving responsiveness leading to higher misbehaviour provocation, ($a_1 = -0.422$, $p = .019$).

The moderated regression coefficient for *M'W'*, b_2, is not different from zero, meaning that the effect of *M'* on *Y* was also not dependent on *W'*, $b_2 = -0.112$, $p = .364$. This means that there was no evidence that the relationship between misbehaviour provocation and teacher aggression is conditioned on ego depletion, independent of caregiving responsiveness and controlling for the covariates. Therefore, the effect of *M'* on *Y* given *W'* is actually b_1, with higher misbehaviour provocation leading to higher teacher aggression ($b_1 = 0.202$, $p = .001$).

The direct effect (c_1). The moderated regression coefficient for *X'W'* in the model of *Y*, c_3', is not different from zero, meaning that the direct effect of *X'* on *Y* was not dependent on *W'*, $c_3' = -0.361$, $p = .212$. This means that there was no evidence that the relationship between caregiving responsiveness and teacher aggression is conditioned

on ego depletion, controlling for the covariates. Therefore, the effect of X' on Y given W' is actually c_1, with lower caregiving responsiveness leading to higher teacher aggression (c_1 = -0.286, p = .496).

Discussion

Failure to Replicate Ego Depletion

The results of the present study revealed that ego depletion did not influence any of the pathways in the mechanism underlying teacher aggression. The results were, however, consistent with earlier research that investigated a closely related model of the mechanism underlying teacher aggression (Montuoro & Mainhard, in press), revealing that lower caregiving responsiveness indirectly led to higher teacher aggression through higher misbehaviour provocation, controlling for the covariates. The results of the present study also revealed that lower caregiving responsiveness directly led to higher teacher aggression, independent of misbehaviour provocation, and controlling for the covariates.

There are four possible reasons why ego depletion did not influence the mechanism underlying teacher aggression. The first is that self-control can indeed be strengthened through regular training, much like a muscle (Baumeister et al., 1998). It is possible that because teachers are commonly exposed to high levels of stress (Kyriacou, 2011), they are always "training" their self-control (e.g., managing demanding workloads, performance targets, and working conditions, as well as negotiating strained relationships with colleagues and students), and are therefore permanently ego bolstered. Ego bolstering has been repeatedly shown to mitigate the depletion effect (see Baumeister et al., 2006; Denson et al., 2011; Finkel et al., 2009; Gailliot, Plant, et al., 2007; Muraven et al., 1999; Oaten & Cheng, 2006a, 2006b, 2007).

The second possible reason why the depletion effect was not found in this study is that teachers are less likely to experience motivated switching because they perceive their role as having high subjective value. According to the motivational model of ego depletion, individuals experience a decrease in cognitive control and an inclination toward rest and leisure after exerting self-control (Inzlicht et al., 2016; Inzlicht et al., 2014). However, this inclination is probably dependent on the subjective value of cognitive and behavioural options. For example, it is possible that participants in the present study placed high subjective value on predicting how they would have responded to the scenario in the SSM procedure because it caused them to critically reflect on their professional identity. Inzlicht et al. (2016) explained:

> Decisions that are related to one's identity would be expected to have higher value – and therefore are more likely to promote self-control – than decisions that are not identity-relevant. Identity priming and other manipulations that make identity salient… can thus attenuate the ego depletion effect or eliminate it altogether (p. 24).

The third possible reason why the depletion effect was not found in the present study is that ego depletion is an adaptation shock. It can be said that the present study included three initial self-control tasks in addition to the ACV, including the CQ, SSM procedure, and SMPSSQ. Two of these procedures may have required participants to exert considerable

self-control. Most notably, the CQ is a relatively long 32-item questionnaire, which requires participants to answer sensitive and potentially upsetting questions about their romantic relationship. Additionally, the SSM procedure is a long and detailed narrative, describing potentially distressing student behaviours. If ego depletion is indeed an adaptation shock, it is possible that participants in the present study adapted to the self-control requirements of the study after completing the CQ, eliminating any depletion effect caused by the ACV. This kind of adaptation shock has been demonstrated in ego depletion studies with more than one initial self-control task (Converse & DeShon, 2009; Xiao et al., 2014), and one study with a particularly lengthy intial self-control task (Dang et al., 2013). In light of these studies, it is interesting to note that the multiple intital self-control tasks in the present study may have simulated the multiple stressors in the common classroom (see Kyriacou, 2011).

The fourth possible reason why the depletion effect was not found in the present study is that the effect is substantially smaller than first thought, and may even be zero. Across three meta-analyses, Carter and his colleagues (Carter et al., 2015; Carter & McCullough, 2013, 2014) demonstrated that small study effects and publication bias may have led to the misrepresentation of the depletion effect in the published literature. It is interesting to note that the median sample size in Hagger et al.'s (2010) meta-analysis, which found support for the depletion effect, was $n = 27$ per condition. However, when Carter and McCullough (2014) conducted a meta-analysis on the same dataset, the researchers found that, assuming an overall effect of $d = 0.25$, 80% power could only have been reached with $n = 252$ per condition.

Limitations

There were four limitations in the present study. The first limitation was that there was no manipulation check for the ACV procedure. Seven past ego depletion tests that used this procedure did not use a manipulation check (see Finkel et al., 2009, Study 4; Gailliot, Baumeister, et al., 2007, Studies 1-6), while four past tests used a manipulation check (see DeWall et al., 2007, Study 2; Gailliot, Baumeister, et al., 2007, Study 7; Schmeichel et al., 2003, Studies 1 & 3). The studies that did use a manipulation check all found that the experimental condition required significantly more self-control resources than the control condition. Nevertheless, the validity of the present study could have been strengthened with the inclusion of a manipulation check.

The second limitation was that the sample was derived from a national database of existing research panel members who regularly participate in online research. Although this data collection method enabled access to a geographically diverse population, the participants' motivations and familiarity with online research may have led them to respond in different ways to a random sample of teachers. Furthermore, because the study was conducted online, the participants were not supervised. This limitation may have led some participants to adopt a relaxed attitude toward the research; on the other hand, it may have reduced the effects of social desirability as well.

The third limitation was that the study was based on self-report measures. Self-report measures are problematic because they rely on participants providing honest and unbiased answers. Research on response sets has shown that participants may not always provide answers that accurately describe themselves (Carducci, 2009). This limitation is worsened by questionnaires that focus on potentially sensitive matters such as personal relationships, student misbehaviour provocation, and teacher aggression. For example, in

the educational literature at least, significant discrepancies have been found between teacher and student perceptions of classroom management practices (for a review, see Montuoro & Lewis, 2014).

The fourth limitation was that the SSM procedure was a mere simulation of reality. Similar simulations have been used in the ego depletion literature (see DeWall et al., 2008; Gailliot & Baumeister, 2007b), but it is nevertheless possible that the procedure used in the present study did not elicit realistic affective responses. If so, the predictions reported in the SMPSSQ and TASSQ may not have been accurate. Future studies should focus on improving the degree to which the SSM procedure elicits realistic affective responses in readers.

Conclusion

The present study suggests that the depletion effect does not influence the mechanism underlying teacher aggression. This null finding may simply be evidence that ego bolstering occurs "naturally" in the teaching profession, or that teachers are less likely to experience motivated switching because they place high value on their role. Alternatively, however, this null finding may be evidence that the depletion effect is merely an adaptation shock and, perhaps, that it is not a real phenomenon at all. Whatever the reason for this null finding, the present study adds to growing uncertainty about the true nature of ego depletion, contributing to recently published studies (Converse & DeShon, 2009; Dang et al., 2013; Xiao et al., 2014) and meta-analyses (Carter et al., 2015; Carter & McCullough, 2013, 2014), as well as the substantial "file drawer" literature reporting null findings (for a review, see Carter et al., 2015). The present study therefore adds further weight to Carter et al.'s (2015) recommendation that, before engaging in further ego depletion research, researchers should seriously reconsider when and why self-control fails. At this early stage of self-control research in education, it appears that self-control failures leading to teacher aggression are partially caused by low trait self-control (Montuoro & Mainhard, in press), but not ego depletion.

Table 1. *Regression coefficients, standard errors, and summary information for conditional process analysis.*

		Consequent						
		Misbehaviour provocation (*M*)				Aggression (*Y*)		
		β^*	*SE*	*p*		β^*	*SE*	*p*
Caregiving responsiveness (*X'*)	a_1	0.422	0.178	.019	c_1'	-0.286	0.144	.050
Misbehaviour provocation (*M'*)		-	-	-	b_1	0.202	0.061	.001
Ego depletion (*W'*)	a_2	-0.113	0.229	.622	c_2'	-0.033	0.134	.805
X'W'	a_3	0.196	0.340	.567	c_3'	-0.361	0.287	.212
M'W'		-	-	-	b_2	-0.112	0.123	.364
Gender (C_1)	f_1	0.370	0.293	.209	g_1	-0.418	0.144	.005
Age (C_2)	f_2	-0.151	0.111	.176	g_2	0.026	0.081	.752
Years teaching (C_3)	f_3	0.158	0.120	.190	g_3	-0.176	0.091	.847
Role (C_4)	f_4	-0.586	0.294	.049	g_4	-0.010	0.202	.959
Intercept	i_1	0.850	0.635	.184	i_2	2.179	0.432	.000
		$R^2 = 0.157$				$R^2 = 0.297$		
		$F(7,102) = 2.818$, $p = .01$				$F(9,100) = 5.172$, $p < .00001$		

* Unstandardised beta coefficients.

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