Journal of Clinical and Experimental Neuropsychology

ISSN: 1380-3395 (Print) 1744-411X (Online) Journal homepage: http://www.tandfonline.com/loi/ncen20

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To cite this article: Megan Fresson, Benoit Dardenne, Marie Geurten & Thierry Meulemans (2017): Stereotype contrast effect on neuropsychological assessment of contact-sport players: The moderating role of locus of control, Journal of Clinical and Experimental Neuropsychology, DOI: 10.1080/13803395.2017.1280450

To link to this article: http://dx.doi.org/10.1080/13803395.2017.1280450

Published online: 25 Jan 2017.

http://dx.doi.org/10.1080/13803395.2017.1280450

Stereotype contrast effect on neuropsychological assessment of contact-sport players: The moderating role of locus of control

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ABSTRACT

Introduction: Diagnosis threat has been shown to produce detrimental effects on neuropsychological performance in individuals with mild traumatic brain injury (mTBI). Focusing on contact-sport players who are at great risk of mTBI, our study was designed to examine the moderating role of internal locus of control. Specifically, we predicted that following diagnosis threat (reminder of their risk of sustaining mTBI and of its consequences), low-internal contact-sport players would underperform (assimilation to the stereotype), while their high-internal counterparts would outperform (contrast effect). We predicted that effort and anxiety would mediate these effects.

Method: Contact-sport players and non-contact-sport players ("control" group) were randomly assigned to one condition (diagnosis threat or neutral) and then completed attention, executive, episodic memory, and working memory tasks. Regarding mediating and moderating variables, participants rated their effort and anxiety (self-report measures) and completed the Levenson (1974) locus of control scale. Regression-based path analyses were carried out to examine the direct and indirect effects.

Results: As expected, there was no effect of condition on the control group's performance. Contact-sport players with moderate and high levels of internal control outperformed (contrast effect) on executive and episodic memory tasks following diagnosis threat compared to the neutral condition. Additionally, the less anxiety moderate- and high-internal contact-sport participants felt, the better they performed on episodic memory and executive tasks. However, contact-sport players low in internal control did not underperform (assimilation effect) under diagnosis threat.

Conclusions: Our results suggest that diagnosis threat instructions may have challenged moderate- and high-internal contact-sport participants, leading them to outperform compared to the neutral condition. Individuals who have moderate and high levels of internal locus of control may have higher performance under diagnosis threat compared to the neutral condition because of their feeling of control over their cognitive performance.

ARTICLE HISTORY
Received 14 April 2016
Accepted 4 January 2017

KEYWORDS
Diagnosis threat; locus of control; neuropsychological assessment; sports-related concussion; stereotype threat

Generally, mild traumatic brain injuries (mTBI) do not lead to persistent cognitive deficits for more than two or three months after the accident. In a minority of cases, however, cognitive deficits—affecting mainly memory and attention—and somatic problems (e.g., dizziness, headache, etc.) persist for one year or longer (e.g., Rabinowitz et al., 2015; Williams, Potter, & Ryland, 2010). These symptoms are grouped under the designation of postconcussion syndrome (PCS). There is a vigorous debate in the literature regarding how to explain the persistence of these difficulties after the three-month period, and many authors consider that a biopsychological approach could be the most appropriate to account for PCS (Barr, 2014; Silver, 2012; Wäljas et al., 2014). The purpose of this article is not to discuss the possibility that, in some patients, neurological factors might determine the persistence of cognitive deficits in mTBI. Rather, its purpose is to explore one of the non-neurological factors that may play a role in these long-term deficits: the stereotype threat effect.

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Stereotype threat refers to a situation in which the performance of individuals of a stigmatized group in a particular domain is impacted because situational cues remind them of their group's alleged inferiority in that domain. In this situation, individuals worry about confirming the inferiority stereotype, and these concerns impact their performance (Steele & Aronson, 1995). Wheeler and Petty (2001) explained that stereotype activation is a biasing factor that leads participants to engage in bias-correction processes. These processes can be either successful (leading to better performance) or ineffective, or even counterproductive (leading to poorer performance; i.e., stereotype threat effect by choking under pressure). This phenomenon has been widely studied with the stereotypes of women's mathematical inferiority (Spencer, Steele, & Quinn, 1999), the intellectual inferiority of African-Americans (Steele & Aronson, 1995), and memory decline in the elderly (Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005).

In most situations, stereotype activation due to stereotype threat triggers a decline in performance, which has been explained with reference to different mechanisms. The most commonly studied mechanisms include the anxiety and intrusive thoughts generated by the fear of confirming the stereotype, which interfere with performance (Schmader, Johns, & Forbes, 2008). However, as Wheeler and Petty (2001) explain, following exposure to a stereotype, "people's behavior can become consistent with the primed stereotype (assimilation effect) or inconsistent with the primed stereotype (contrast effect)" (p. 797). So, although stereotype activation has generally been found to produce detrimental effects, it is also true that exposure to stereotype threat can lead to improved performance (see, for example, Nguyen & Ryan, 2008; Picho, Rodriguez, & Finnie, 2013; Wheeler & Petty, 2001). Indeed, following stereotype threat exposure, individuals may be motivated to disconfirm the stereotype (this is especially true if participants perceive the activated stereotype to be inaccurate) and therefore modify how they act, which could lead to behaviors that contradict the stereotype.

In the neuropsychological domain, Suhr and Gunstad (2002) showed that students with mTBI exhibited a decline in cognitive performance (stereotype assimilation effect) when reminded of their history of mTBI before they undertook the neuropsychological assessment. This phenomenon, called "diagnosis threat" (DT), which is a particular case of stereotype threat (i.e., stereotype threat with neurologically impaired individuals confronted with a neuropsychological assessment), has since been confirmed by the results of several studies (Kit, Mateer, Tuokko, & Spencer-Rodgers, 2014; Ozen & Fernandes, 2011; Pavawalla, Salazar, Cimino, Belanger, & Vanderploeg, 2013; Suhr & Gunstad, 2005; Trontel, Hall, Ashendorf, & O'Connor, 2013). DT may explain why some individuals who have sustained a concussion or mTBI report cognitive difficulties beyond the typical three-month recovery period.

However, as in the stereotype threat literature, some studies did not show a clear decline in cognitive performance on neuropsychological tasks following DT instructions (Blaine, Sullivan, & Edmed, 2013; Ozen & Fernandes, 2011; Trontel et al., 2013). Ozen and Fernandes (2011) observed no significant deleterious effect of DT on neuropsychological performances, even though the patterns suggested such an effect on two tasks. Trontel et al. (2013) showed a harmful effect of DT only on self-evaluation of cognitive ability, but none on memory, attention/working memory, psychomotor speed/executive function, and verbal/visuospatial ability. And Pavawalla et al. (2013) found no negative impact of DT when participants did not identify with their mTBI group.

In this paper, we argue that the inconsistent effect of DT observed in the literature might be due to the fact that, in these studies, some moderating variables (i.e., individual characteristics that predict individuals' sensitivity to stereotype effect) were disregarded. As well, examining the underlying mechanisms (i.e., mediating variables) that do or do not lead to poorer performance could result in a better understanding of the consequences of DT.

Moderating variables of stereotype threat: Who?

In their literature review, Kit, Tuokko, and Mateer (2008) suggested that an important variable that could moderate the impact of diagnosis threat is locus of control, which refers to the degree to which people attribute events to internal or external causes (Rotter, 1966). Relating to cognitive assessment, individuals with an internal locus of control attribute their performance to their own behaviors while individuals with an external locus of control tend to evoke external factors (e.g., chance) to explain it. According to Kit et al. (2008), DT instructions instigate a sort of learned helplessness or, more specifically, a feeling of lack of control over cognitive performance, and individuals with a low level of internality are particularly sensitive to the deleterious effect of DT.

To our knowledge, only one study has directly examined the moderating role of locus of control under stereotype threat. In two experiments, Cadinu, Maass, Lombardo, and Frigerio (2006) categorized their participants as "internal" or "external," on the basis of participants' dichotomous responses on a locus of control scale. When specifically examining the moderating role of locus of control, Cadinu et al. (2006) compared the performance of women (and men) participants assigned to either a threat condition or an allegedly "no-threat" condition. In the first experiment, however, the no-threat instructions conveyed a presumably positive stereotype regarding women or men (the test was said to evaluate either social or logical intelligence abilities, respectively, for women and men). Cadinu et al. reported a detrimental effect of the threat condition but only for their internal participants. However, closer inspection of the data suggests another interpretation: Internal and nonthreatened (positive) participants scored particularly high on the test whereas the internal versus external classification made no difference for threatened participants. In other words, Cadinu et al. claimed that they observed a stereotype assimilation effect for internal participants, but it might also be the case that they actually triggered improved performance by internal participants following allegedly nonthreatening and, in fact, positive stereotype instructions (but see Cadinu et al., 2006, Study 2).

More generally, research on locus of control has shown that internality is linked to better outcomes in a wide range of domains (see, for example, Lachman, Neupert, & Agrigoroaei, 2011; Ng, Sorensen, & Eby, 2006). For example, internality has been shown to predict better results and enhanced well-being in an academic/school context, and this relationship was found to be mediated by engagement and perceived control (Au, 2015; You, Hong, & Ho, 2011). Internality is also positively associated with metacognition (S. Arslan & Akin, 2014). In the field of aging, externality seems to impede cognitive improvement following training (Zahodne et al., 2015), and control beliefs appear to influence resource allocation in reading, with only high-internal individuals maintaining resource allocation in the face of difficulty (Soederberg Miller & Gagne, 2005).

Furthermore, research carried out on the link between locus of control and resistance to influence has shown that internal individuals tend to resist influence more than external individuals (including resistance to the experimenter's influence). Indeed, several studies showed that external individuals are more prone to conformity and compliance, while internal individuals sometimes act in the opposite way to what was expected of them (see Lefcourt, 2014). Moreover, internal individuals have been shown to cope better with stress and anxiety than external individuals (Lefcourt, 2014). For example, in a stress-inducing condition, a higher physiological stress response is predicted by a higher level of external control (Szabo, Chang, & Chancellor-Freeland, 2015). Compared to external individuals, internal ones present less trait anxiety and are more likely to use problem-focused coping strategies, which are thought to be among the most effective coping strategies (C. Arslan, Dilmac, & Hamarta, 2009).

Overall, the studies presented above indicated that individuals with a strongly internal locus of control succeed better in different domains, cope better with stress, and resist influence better. Conversely, low-internal individuals appear to perform worse in various areas and to be susceptible to stress and suggestion. Since diagnosis threat induces a pressure to do well, and relates to some form of influence, we therefore hypothesized that low-internal individuals would present an assimilation effect (underperformance; see Kit et al., 2008, for similar proposition). Conversely, high-internal individuals would present no effect or might even show a contrast effect (outperformance) on neuropsychological tasks, as had been found in the stereotype threat literature (Nguyen & Ryan, 2008; Picho et al., 2013; Wheeler & Petty, 2001; but see Cadinu et al., 2006).

Mediating variables: How?

Regarding the mechanisms underlying stereotype threat, Kit et al. (2014) showed that the relation between cognitive underperformance by neurological patients (mild and moderate TBI) and DT instructions is mediated by memory self-efficacy (i.e., belief in one's memory capacity). Another mediating variable that has received a lot of attention in the stereotype threat literature is anxiety. Schmader et al. (2008) proposed a model of stereotype threat in which anxiety-related mechanisms play a crucial role. This model explains the decline in performance by a reduction in the executive resources needed to complete cognitive tasks through three different mechanisms: a physiological stress response, an increase of performance monitoring processes, and a self-regulation activity that suppresses negative thoughts and emotions.

Concerning diagnosis threat, Kit et al. (2014) observed that their mTBI group reported more anxiety than the control group, but found no evidence of an effect of DT on anxiety. Suhr and Gunstad (2005) did not find any effect of DT on anxiety either. However, it is important to note that Suhr and Gunstad (2005) did not assess baseline anxiety (before stereotype activation), which could have concealed the mediating role of anxiety. Our hypothesis is that DT instructions could lead to underperformance, but only in low-internal individuals, and that this effect is mediated by an increase in anxiety compared to the baseline anxiety level.

Another potential mediating variable that has been mentioned is effort (R. P. Brown & Pinel, 2003; Keller & Dauenheimer, 2003). Individuals in a stereotype threat condition may exhibit a state of learned helplessness that affects how they perform a task (Smith, 2004). Consequently, they use self-handicapping strategies (Keller, 2002), take less risk (avoidance goals; Smith, 2004), and make less effort. Suhr and Gunstad (2002) showed that participants in their DT condition reported making significantly less effort while performing tasks than the neutral group. Furthermore, effort was correlated with three out of the five tasks for which they showed a decrease in performance, suggesting that effort could be a mediator of the DT effect on cognitive performance (but see Suhr & Gunstad, 2005, for contrasting results). Hence, effort could mediate the relationship between stereotype activation and neuropsychological performance, with a decrease in self-reported effort for low-internal individuals and an increase in self-reported effort for high-internal individuals (reflecting their effort to disconfirm the stereotype).

The present study

The aim of this study was to further investigate the moderating role of locus of control and the mediating role of anxiety and effort in the context of diagnosis threat by focusing on contact-sport players. Since the 1980s, the interest in boxing-related concussion has been extended to contact sports in general (Webbe & Zimmer, 2015), in which players are known to be at risk of sustaining a concussion or mTBI (Noble & Hesdorffer, 2013). For example, the European home and leisure surveillance system report of 1999 indicated that, in Belgium, sport is the first-ranked activity (cause) in which young people between 15 and 24 years old are likely to sustain a traumatic brain injury and the second one for people aged 25 to 44 years. Similarly, the health interview survey conducted in 2004 showed that, in Belgium, 19% of TBIs are sustained during sports activities and that sports-related TBI occurred mainly among young people under 35 years old.

Relating to the pervasiveness of sports-related TBI, Mittenberg, DiGiulio, Perrin, and Bass (1992) showed that nonathletes had strong expectations concerning symptoms following a concussion or mTBI. Thus, when these nonathletes sustain a mTBI, their expectations lead them to selectively direct their attention to these expected symptoms, which could then contribute to the persistence of complaints related to PCS. In a vicious circle, the attention bias and the anxiety generated by the occurrence of the head injury increase the perceived symptoms. This “expectation as etiology” hypothesis has been proposed to account for the persistence of symptoms in some individuals beyond the usual three-month recovery period.

Similarly, some studies have shown that athletes themselves have clear negative expectations concerning the consequences of sports-related concussion or mTBI. For instance, Ferguson, Mittenberg, Barone, and Schneider (1999) showed that athletes without head injury expected significantly more symptoms following a head injury than were actually observed in a group of head-injured athletes. Results of Fedor and Gunstad (2015) recently indicated that expectations of symptoms following a concussion were stronger in student athletes than in control students, with this difference being particularly true of football (contact) players. However, Gunstad and Suhr (2001) showed that, whereas athletes have (negative) expectations regarding the consequences of mTBI, they also display generally positive expectations regarding recovery following mTBI or concussion (compared to nonathletes). Indeed, while they expected more symptoms than are actually experienced by head-injured athletes, healthy athletes expected fewer symptoms following a head injury than the healthy controls did. According to Gunstad and Suhr, these results may be explained by generally positive expectations of recovery, which could result from pressure or expectations by their sports team.

To date, no study has ever examined the impact of diagnosis threat on the cognitive performance of contact-sport players. On the one hand, the studies presented above suggest that noninjured athletes have expectations about the symptoms following sports-related concussion, and that these expectations could contribute to the postconcussion symptoms reported by head-injured athletes (Ferguson et al., 1999; Gunstad & Suhr, 2001). Consequently, DT might lead to a stereotype assimilation effect—namely, underperformance on neuropsychological tasks. On the other hand, the same studies (Ferguson et al., 1999; Gunstad & Suhr, 2001) also indicated that head-injured athletes did not report more symptoms than healthy control groups. Additionally, Gunstad and Suhr (2001) suggested that athletes hold generally positive expectations regarding recovery from mTBI. Considering these results, it cannot be ruled out that exposure to DT may lead to a stereotype contrast effect—that is, outperformance on neuropsychological tasks.

Regarding behavioral response to stereotype activation, the locus of control may predict which kind of effect (assimilation or contrast) contact-sport players will exhibit. Indeed, the results of the aforementioned studies suggested that higher internality is associated with better resistance to the deleterious effects of stereotype threat. Moreover, in athletes, internality is generally linked to reduced anxiety (Arnaud, Codou, & Palazzolo, 2012) and more competitive mental skills (Fallby, Hassmén, Kenttä, & Durand-Bush, 2006). Furthermore, Ntoumanis and Jones (1998) showed that, compared to external individuals, athletes with an internal locus of control were more likely to assess their cognitive and somatic anxiety symptoms as "facilitative" (vs. debilitative). Consequently, interpretation of anxiety symptoms by internal athletes was more positive. So, we hypothesized that contact-sport players with low internality would show poorer performance following exposure to DT, while their high-internal counterparts would show improved performance. Non-contact-sport players (the control group), for whom the threat is irrelevant, should not be concerned by the DT instructions and should therefore not be impacted by them.

Method

Participants

We recruited 100 participants who played either a contact sport (rugby or boxing), or a noncontact sport (running or tennis; control group) once a week or more, for at least one year. Participants were recruited if they were aged between 18 and 40 years; spoke French as their mother tongue; and did not report any diagnosis of psychiatric conditions (including alcoholism and substance abuse), learning disabilities, or neurological conditions other than mTBI. Because of a past history of moderate TBI, two of the 100 participants were excluded from the final analyses, leading to a sample of 98 individuals. Most participants were European and White (97%).

Material

Neuropsychological tasks

Since it has been proposed that stereotype threat mainly affects tasks requiring executive processes (Schmader et al., 2008), we selected tasks that are known to tap into these controlled cognitive processes: working memory, episodic memory, attention, and executive tasks. Furthermore, as a baseline measure, before the stereotype or neutral instructions, we administered a task that assesses verbal intellectual capacities. All neuropsychological tasks and questionnaires have been adapted and validated in the French-speaking population (see the French references for each task).

Verbal intellectual capacities

The French version of the National Adult Reading Test (FNART; Blair & Spreen, 1989; Mackinnon, Ritchie, & Mulligan, 1999). This task is indicative of individuals' intellectual capacities; it requires participants to read aloud words with irregular spelling.

Working memory tasks

Letter Number Sequencing (LNS). In this subtask of the Wechsler Adult Intelligence Scale–Fourth Edition (WAIS–IV; Wechsler, 2008, 2011), which assesses working memory capacities, the experimenter reads sequences of letters and numbers aloud. Participants have to repeat first the numbers in chronological order, and then the letters in alphabetical order.

Working Memory subtask of Version 2.3 of the Test of Attentional Performance (TAP; Zimmermann & Fimm, 2010). In this n-back working memory subtask, participants have to press the response button as quickly as possible when the digit presented on the screen is the same as the penultimate one.

Episodic memory task

California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987; Poitrenaud, Deweer, Kalafat, & Van der Linden, 2007). In this well-known episodic memory task, participants have to learn and recall (after a delay of 20 min) 16 words belonging to four different semantic categories.

Attention tasks

Divided Attention subtask of Version 2.3 of the TAP (Zimmermann & Fimm, 2010). In this attentional task, participants have to simultaneously process and respond to visual and auditory stimuli.

Incompatibility subtask of the TAP (Zimmermann & Fimm, 2010). This attentional task requires participants to press the response button (left or right) corresponding to the side indicated by arrows that appear on either the left or the right side of the screen.

Executive tasks

Brown–Peterson Task (J. Brown, 1958; Geurten, Vincent, Van der Linden, Coyette, & Meulemans, 2016; Peterson & Peterson, 1959). In this interference control task, participants have to memorize nonsignificant consonant trigrams (12 items) presented on the computer screen and recall them either immediately or after a 5- to 20-second delay during which they complete a reverse two-digit span task.

Flexibility subtask of the TAP (Zimmermann & Fimm, 2010). This task assesses attentional capacities by requiring participants to continuously alternate between two kinds of stimuli.

Stroop task (Godefroy, 2008; Stroop, 1935). This well-studied task assesses interference control capacities by requiring participants to refrain from automatically reading the names of colors, in order to name the color in which the word is printed.

Questionnaires

State–Trait Anxiety Inventory (STAI; Bruchon-Schweitzer & Paulhan, 1993; Spielberger, Gorsuch, & Lushene, 1983). This self-assessment scale assesses state anxiety (STAI–YA; Cronbach's alphas = .88 and .90 for baseline and posttest, respectively) and trait anxiety (STAI–YB; Cronbach's alpha = .87).

Beck Depression Inventory (BDI–II; Beck, Steer, & Brown, 1996, 1998). This self-assessment inventory assesses depression (Cronbach's alpha = .73).

Effort measure. Participants have to rate how much effort they made in the tests on two items (r = .36, p < .001) with a 7-point Likert scale ("How hard did you try on the tests?" and "How much mental effort did you invest in the tests?").

Levenson's Locus of Control Scale (IPC; Levenson, 1974; Rossier, Rigozzi, & Berthoud, 2002). This 24-item scale assesses three dimensions of locus of control. This scale comprises three 8-item subscales: Internality (Cronbach's alpha = .62), Powerful Others (Cronbach's alpha = .70), and Chance (Cronbach's alpha = .68). While the Powerful Others and Chance subscales were positively correlated, r = .52, p < .000, the Internality subscale was not correlated with the other two, ps > .187.

Manipulation check measure. This scale was administered to verify that participants understood the experimental instructions. This scale is composed of three statements, one extracted from the DT condition instructions, one from the neutral condition instructions, and one that is false in both cases (e.g., "It was explained that your performance will be compared to that of elderly individuals with hearing problems"). Participants have to respond on a 7-point Likert scale (ranging from "strongly disagree" to "strongly agree").

Dependent variables

In accordance with theoretical conceptualizations and on the basis of the observed correlations among task variables, we created composite scores by averaging *z*-scores, in order to reduce the number of dependent variables. We created a "working memory" score, composed of the number of omissions during the working memory subtask of the TAP (reversed) and the number of correct responses on the LNS subtask of the WAIS–IV (r = .31, p = .002). We calculated an "episodic memory" score with the total of correctly recalled words during the five trials of the encoding phase of the CVLT and the sum of the free and cued long-term recall conditions of the CVLT (r = .72, p < .001). We created an "executive" score composed of the reversed median reaction time (RT) on the Flexibility subtask of the TAP, the reversed time to complete the Stroop task (r = .58, p < .001, with Flexibility), and the total correctly recalled trigrams during the 5-, 10-, and 20-s trials of the Brown–Peterson (r = .20, p = .049, with flexibility; r = .27, p = .009, with Stroop). Finally, we created an "attention" score composed of the median RT in divided attention and incompatibility subtasks of the TAP (r = .25, p = .013).

Procedure

This study received research ethics approval from the University of Liège (Belgium). After signing their consent forms, participants were asked about sociodemographic variables, completed the French versions of the State–Trait Anxiety Inventory (STAI; Spielberger et al., 1983) and the Beck Depression Inventory (BDI–II; Beck et al., 1996) and were then given the French National Adult Reading Test (FNART; Blair & Spreen, 1989). Participants then received a letter containing different instructions depending on the condition they had been randomly assigned. The participants read the instructions silently, so that the experimenter was blinded to their condition.

Participants in the DT condition received a sheet of paper with the following introduction:

> *This study concerns the impact of contact sports on memory, attention, and reaction speed functions, because studies have shown that these sports have a negative impact on mental capacities. In this context, we are recruiting individuals who play one of the more violent contact sports, and individuals who don't play such a sport in order to compare their performance. That is why we recruited you.*

After this introduction, participants were asked to mark the corresponding checkbox according to their group (contact sport or noncontact sport) and read a letter informing them about the potential cognitive risks of playing contact sports.

Participants in the neutral condition read this introduction:

> *This study concerns memory, attention, and reaction speed, because these functions are composed of multiple mechanisms that researchers are still investigating. In this study, we would like to examine the different mechanisms, and in this way, better understand how memory, attention, and reaction speed work. That is why we recruited you.*

In this condition, participants selected one of two checkboxes to indicate their handedness and read a letter explaining the scientific advances made in neuropsychological research methods.

Half of the participants were then given the neuropsychological tasks in the following order (the other half completed the tasks in the opposite order): the LNS subtask of the WAIS–IV (Wechsler, 2008); the CVLT (Delis et al., 1987); the Divided Attention subtask of the TAP (Zimmermann & Fimm, 2010); the Incompatibility subtask of the TAP (Zimmermann & Fimm, 2010); the recall phase of the CVLT (Delis et al., 1987); the Brown–Peterson task (J. Brown, 1958; Peterson & Peterson, 1959); the Stroop task (Stroop, 1935); the Flexibility subtask of the TAP (Zimmermann & Fimm, 2010); and the Working Memory subtask of the TAP (Zimmermann & Fimm, 2010). Then, participants completed the STAI–State (Spielberger et al., 1983), the effort measure, and the Internality subscale of the Levenson Locus of Control scale (Levenson, 1974). Before receiving a written and oral debriefing, participants completed the manipulation check measure.

Results

Descriptive and preliminary analyses

Descriptive statistics are presented in Table 1. We conducted an analysis of variance (ANOVA) using group (contact sport vs. control) and condition (DT vs. neutral) as factors to examine the equivalence between groups for age, years of education, FNART, STAI–YA, STAI–YB, and BDI–II. Group had an effect on years of education, $F(1, 94) = 8.13$, $p = .005$, with the contact sport group having fewer years of education ($M = 13.18$, $SD = 2.00$) than the non-contact-sport group ($M = 14.39$, $SD = 2.09$); and on the FNART score, $F(1, 94) = 8.15$, $p = .005$, showing that the contact-sport group ($M = 19.86$,

Table 1. Descriptive statistics.

	Contact-sport group		Control group	
	DT	Neutral	DT	Neutral
Variables	(n = 26)	(n = 23)	(n = 24)	(n = 25)
Age (years)	23.27 (4.79)	24.48 (4.53)	24.46 (3.78)	24.00 (4.52)
Education (years)*	12.85 (2.13)	13.57 (1.80)	14.38 (2.18)	14.40 (2.04)
FNART*	20.15 (4.86)	19.52 (4.17)	21.92 (3.66)	22.44 (3.33)
STAI–YA pretest	28.50 (7.12)	26.43 (5.45)	28.54 (7.41)	29.28 (7.22)
STAI–YA posttest	37.92 (7.68)	35 (4.46)	37.25 (9.49)	34.72 (7.69)
BDI–II	7.81 (5.32)	6.09 (3.60)	6.17 (4.74)	4.92 (3.58)
Male (%)	69.23	69.57	79.17	64.00
mTBI history (%)*	46.15	43.48	20.83	16.00

Note. DT = diagnosis threat condition; neutral = neutral condition; education = number of achieved education years; FNART = French version of the National Adult Reading Test; STAI–YA pretest = State form of the State–Trait Anxiety Inventory at baseline; STAI–YA posttest = posttest State form of the State–Trait Anxiety Inventory; BDI–II = Beck Depression Inventory–Second Edition; mTBI = mild traumatic brain injury; mTBI history = percentage of participants who reported having sustained a mTBI.
$^{*}p < .05$.

SD = 4.51) performed worse than the control group (M = 22.18, SD = 3.47). Since we ceased to observe a significant FNART difference between groups after we controlled for years of education, $F(1, 93) = 2.40$, $p = .125$, we only controlled for years of education in the subsequent analyses. Finally, we conducted Pearson chi-square tests for gender, $\chi^2(3) = 1.40$, $p = .705$, and mTBI history, $\chi^2(3) = 8.15$, $p = .043$. The significance of the chi-square test was due to the small number of cases of mTBI in the control group for the neutral condition (statistical value = 2.83 > critical value = 2.49).

As expected, analyses of the manipulation check results showed an effect of condition, with individuals in the DT condition showing greater agreement with the idea that the study concerned cognitive problems in contact-sport players, $ps < .001$, and individuals in the neutral condition showing stronger agreement with the statement from the neutral instructions, $p < .001$. There was no significant difference between conditions for the nonspecific question, $p = .336$. Finally, administration order had no effect on the dependent variables, $ps > .232$.

Main analyses

Using PROCESS as a computational tool (Hayes, 2013), our general analytical strategy was to carry out regression-based path analyses to test the predicted model, with one analysis for each dependent variable. In each model, the independent, moderating, and mediating variables were either contrast coded or mean centered. This enabled us to examine conditional (when all the other predictors are equal to their average, and the scores are the same on any covariates) direct and indirect effects simultaneously in moderated mediation models. Since we observed a significant difference in years of education between groups, we controlled for this variable across all analyses. We also included anxiety at baseline (“preanxiety”; first administration of STAI–YA) as a covariate to control for baseline level in state anxiety. The effect of the covariates was controlled for on the mediators and on the dependent variables as well.

Table 2 presents Pearson correlational analyses between the variables of interest and reveals a positive correlation between education and two dependent variables (episodic memory and executive scores). As well, the baseline anxiety level was negatively correlated with internal locus of control[1] and

Table 2. Pearson correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education	__							
Preanxiety	−.01	__						
ILOC	.06	−.23*	__					
Effort	.04	−.03	−.10	__				
Anxiety	−.00	.64**	−.05	.04	__			
WM	.12	.08	.02	.17	−.07	__		
Episodic M	.22*	.11	−.02	.00	−.09	.30**	__	
Executive	.28**	−.06	−.05	−.07	−.22*	.43**	.42**	__
Attention	.17	.10	.03	−.03	.10	.27**	.10	.23*

Note. Education = years of education; preanxiety = State form of the State–Trait Anxiety Inventory (STAI–YA) at baseline; ILOC = internal locus of control; effort = effort measure; anxiety = STAI–YA at posttest; WM = working memory score; episodic M = episodic memory score; executive = executive score; attention = Attention score.
$^{*}p < .05$. $^{**}p < .01$.

[1]In all the analyses, we used the internality score as raw data. The pattern of results remained exactly the same when the residuals of internality, not explained by “Powerful Others” and “Chance” (the other dimensions of Levenson’s Locus of Control scale), were used instead of the raw internality score.

positively correlated with the posttest level of anxiety. Finally, we observed that the executive score was negatively correlated with anxiety (posttest).

Is the effect of condition moderated by group and internal locus of control?

We conducted a first set of regressions in which we expected to find that diagnosis threat had a differential impact on cognitive performance only for contact-sport players and depending on their level of internal control. More precisely, we expected that diagnosis threat impaired performances of contact-sport players who were low in internal locus of control (ILOC) and improved performances for these players who were high in ILOC. For each cognitive score, we tested whether effort and anxiety mediated the impact of DT on performance, while these indirect effects (as well as the direct effect) were conditional on group and ILOC. We performed regressions with the neutral condition contrast coded −1, and the DT condition contrast coded +1. The control group was contrast coded −1, and the contact-sport group was contrast-coded +1. Continuous variables were mean centered.

For the episodic memory score, there was a statistical interaction between condition and group, $b = 0.24$, $SE = 0.10$, $t = 2.32$, $p = .023$. We probed this interaction, and conditional coefficients revealed a statistically significant effect of condition only for the contact-sport group, $b = 0.31$, $SE = 0.15$, $t = 2.09$, $p = .040$, showing that performance in the DT condition is higher than that in the neutral condition, $p = .250$, for the control group. Although there was no statistically significant interaction between condition, group, and ILOC, $b = 0.15$, $SE = 0.17$, $t = 0.92$, $p = .360$, due to our strong hypothesis regarding the moderating role of ILOC, we probed the interaction using a pick-a-point approach that created three ILOC values: low ILOC (1 *SD* below the mean), moderate ILOC (mean), and high ILOC (1 *SD* above the mean). Conditional effects showed that performance is higher in the DT condition than in the neutral one, only for moderate-, $b = 0.31$, $SE = 0.15$, $t = 2.09$, $p = .040$, and high-, $b = 0.56$, $SE = 0.27$, $t = 2.11$, $p = .038$, ILOC contact-sport players. We did not observe any significant effect of condition for the other contrasts, $ps > .250$.

For the executive score, we observed a statistically significant interaction between condition and group, $b = 0.15$, $SE = 0.07$, $t = 2.02$, $p = .047$. We probed this interaction and observed a significant conditional effect of condition only for the contact-sport group, $b = 0.28$, $SE = 0.10$, $t = 2.71$, $p = .008$, with higher performance in the DT condition than in the neutral condition, $p = .917$, for the non-contact-sport group. Considering our specific hypothesis, although there was no significant interaction between condition, group, and ILOC, $b = 0.12$, $SE = 0.12$, $t = 1.02$, $p = .310$, we examined specific contrasts. The results showed that performance is higher in the DT condition than in the neutral one, only for moderate-, $b = 0.28$, $SE = 0.10$, $t = 2.71$, $p = .008$, and high-, $b = 0.58$, $SE = 0.19$, $t = 3.05$, $p = .003$, ILOC contact-sport players. We did not find a significant effect of condition for the other contrasts, $ps > .341$.

Regarding both the attention and working memory scores, the interactions between condition and group were not significant, $ps > .647$. For both attention and working memory scores, neither the triple interaction, $ps > .478$, nor the specific contrasts, $ps > .236$, suggested an effect of condition on the dependent variables.

In conclusion, our first analyses showed that there was no statistically significant effect of condition in the control group. There was an effect of condition only for the contact-sport group and only on the executive and episodic memory scores. In subsequent analyses, we therefore specifically examined direct and indirect paths in the contact-sport group and for the episodic memory and executive scores only.

Is the effect of condition on the cognitive performance of contact-sport players moderated by internal locus of control and mediated by effort and anxiety?

We specifically examined direct and indirect paths in the contact-sport group only. As in the analyses above, the neutral condition was contrast coded −1, and the DT condition was contrast coded +1. We first analyzed regression models that predicted both mediators by condition, ILOC, and their interactions (Models 1 and 2 in Table 3). Then, we conducted models to test the two dependent variables by condition, effort, anxiety, and ILOC, and their interactions (Models 3a and 3b in Table 3).

As Table 3 shows, when predicting mediators, there was no effect of condition or ILOC or

Table 3. Ordinary least squares regression model coefficients in contact-sport group.

	Model 1		Model 2		Model 3a		Model 3b	
	Effort		Anxiety		Episodic memory		Executive	
Outcomes→predictors	Coefficient	p	Coefficient	p	Coefficient	p	Coefficient	p
Intercept	−0.435 (1.03)	.673	−1.303 (0.33)	<.001	−3.143 (1.01)	.004	−1.641 (0.86)	.065
Cond.	−0.014 (0.130)	.916	0.015 (0.04)	.723	0.280 (0.11)	.012	0.172 (0.091)	.066
ILOC	0.003 (0.20)	.990	0.105 (0.06)	.109	−0.179 (0.19)	.363	−0.352 (0.17)	.041
Effort					0.060 (0.13)	.653	0.102 (0.11)	.370
Anx.					−0.371 (0.46)	.424	−0.798 (0.39)	.049
Effort × ILOC					−0.050 (0.16)	.755	−0.197 (0.14)	.154
Anx. × ILOC					−1.070 (0.59)	.070	−0.863 (0.51)	.097
Cond. × ILOC	−0.109 (0.20)	.610	0.112 (0.06)	.089	0.449 (0.20)	.028	0.357 (0.17)	.040
Education	0.028 (0.07)	.700	0.014 (0.02)	.567	0.222 (0.06)	.001	0.088 (0.05)	.093
Preanxiety	0.051 (0.41)	.903	0.811 (0.13)	<.001	0.093 (0.51)	.858	0.273 (0.44)	.538
Model R^2	.130	.979	.707	<.001	.616	.017	.621	.015

Note. Cond. = condition; ILOC = internal locus of control; effort = effort measure; anx. = State form of the State–Trait Anxiety Inventory (STAI–YA) at posttest; education = years of education; preanxiety = STAI–YA at baseline; episodic M = episodic memory score; executive = executive score. Standard errors in parentheses.

interactions (Models 1 and 2). On the episodic memory score (Model 3a), there was a significant effect of condition, with better performance in the DT condition than in the neutral one. More importantly, there was a significant interaction between condition and ILOC on episodic memory. Conditional effects showed that episodic memory performance was higher in the DT condition than in the neutral one, only for moderate- (b = 0.28, SE = 0.11, t = 2.64, p = .012) and high- (b = 0.59, SE = 0.18, t = 3.28, p = .002) ILOC individuals. The effect of condition was not significant for low-ILOC participants (b = −0.03, SE = 0.16, t = −0.17, p = .867). In a symmetric way, this interaction also revealed a significant effect of ILOC in the neutral condition only, b = −0.63, SE = 0.28, t = −2.28, p = .028 (b = 0.27, SE = 0.28, t = 0.97, p = .336, in the DT condition). Unexpectedly, in the neutral condition, results indicated that the higher the ILOC, the worse the episodic memory performance. When we examined bias-corrected confidence intervals (with 10,000 resamples), regardless of ILOC level, the indirect effects of condition through effort and anxiety on the episodic memory score were no different from zero (through effort: b = 0.01, SE = 0.06; b = −0.00, SE = 0.02; b = −0.00, SE = 0.06; 95% confidence intervals, CIs [−0.11, 0.14], [−0.06, 0.04], [−0.15, 0.10], for low-, moderate-, and high-ILOC participants, respectively; through anxiety: b = −0.02, SE = 0.11; b = −0.01, SE = 0.03; b = 0.10, SE = 0.12, 95% CIs [−0.45, 0.10], [−0.12, 0.02], [−0.43, 0.05], for low-, moderate-, and high-ILOC participants, respectively).

We also observed a nonsignificant trend toward an interaction between anxiety and ILOC on episodic memory. In probing this interaction, specific contrasts showed a significant effect of anxiety on episodic memory score only for high-ILOC individuals, b = −1.10, SE = 0.44, t = −2.52, p = .016, indicating that the less anxiety participants felt, the better they performed. The other specific contrasts were not significant, ps > .42.

For the executive score (Model 3b, Table 3), there was a trend toward an effect of condition, indicating better performance in the DT condition. More importantly, as predicted and as observed on the episodic memory score, there was a statistical interaction between condition and ILOC. We probed this interaction, and specific contrasts showed that performance is higher in the DT condition than in the neutral one (direct effect) only for high-, b = 0.416, SE = 0.15, t = 2.72, p = .001, and moderate-ILOC, b = 0.172, SE = 0.09, t = 1.89, p = .066, individuals, but there was no significant effect for low-ILOC individuals, b = −0.073, SE = 0.14, t = −0.52, p = .606. This interaction also revealed an effect of ILOC in the neutral condition only, b = −0.71, SE = 0.24, t = −3.01, p = .005 (b = 0.01, SE = 0.24, t = 0.02, p = .982, in the DT condition) indicating that the more participants were high in ILOC, the worse they performed on the executive score. This interaction explained the (negative) conditional effect of ILOC when all the other predictors are at their average. Examination of bias-corrected confidence intervals (with 10,000 resamples) revealed that, regardless of ILOC level, the indirect effects of condition through effort and anxiety on the executive score were no different from zero (through effort: b = 0.01, SE = 0.08; b = −0.00, SE = 0.02; b = 0.00, SE = 0.04, 95% CIs [−0.12, 0.19], [−0.06, 0.05], [−0.08, 0.10], for low-, moderate-, and high-ILOC participants, respectively; through anxiety: b = 0.01, SE = 0.07; b = −0.01, SE = 0.03; b = −0.13, SE = 0.13, 95% CIs [−0.06, 0.21], [−0.12, 0.03], [−0.47, 0.04], for low-, moderate-, and high-ILOC individuals, respectively).

There was a significant effect of anxiety on executive score, indicating that when anxiety level is low, performance is high. As for the episodic memory score, we probed the nonsignificant interaction between anxiety and ILOC on the executive score, p = .097. Conditional effects revealed a significant effect of anxiety on performance only for moderate-, b = −0.80, SE = 0.39, t = −2.04, p = .049, and high-, b = −1.39, SE = 0.38, t = −3.71, p = .001, ILOC individuals, revealing that the less anxiety these participants felt, the better they performed.

Discussion

As expected, the results of our study showed that diagnosis threat instructions had no effect on the control group. This was presumably due to the fact that these participants were not involved in the stereotype and therefore did not feel concerned. Concerning contact-sport players, while there was no assimilation effect for low-internal participants, we observed that, as predicted, moderate- and high-internal contact-sport participants performed better on episodic memory and executive scores in the DT condition than in the neutral one. We also observed, quite unexpectedly, that in the neutral condition, the more these participants were internal, the worse they performed. Finally, we observed a significant effect of anxiety on the executive score, with lower anxiety being associated with better performance, and marginal interactions between anxiety and internality on the episodic memory and executive scores, revealing that for moderate- and high-internal participants, lower anxiety was linked to better performance.

Following exposure to DT instructions, contact-sport participants who are moderate or high in ILOC performed better than the contact-sport participants who are moderate and high (respectively) in ILOC in the neutral condition. According to Wheeler and Petty (2001), following exposure to stereotype threat, individuals can act in opposition to the activated stereotype, showing a contrast effect (see, for example, Hall & Crisp, 2008; Keller & Molix, 2008; Schubert & Häfner, 2003). While stereotype threat generally triggers an assimilation effect, this kind of contrast effect has been highlighted in several reviews and meta-analyses (Nguyen & Ryan, 2008; Picho et al., 2013; Wheeler & Petty, 2001).

Unexpectedly, we did not observe an assimilation effect (underperformance in diagnosis threat condition compared to the neutral condition) in low-internal contact-sport participants. Several characteristics of our stereotype activation and participants could explain this pattern of results.

Stereotype contrast effect, but no assimilation: Why?

Our results showed that, when exposed to DT instructions, moderate- and high-ILOC contact-sport participants outperformed those in the neutral condition. We propose that this contrast effect could be due to the way in which we activated the stereotype—that is, quite explicitly and even blatantly. Indeed, some research suggests that the nature of stereotype activation (implicit or explicit) could determine the direction of the effect, with implicit activation preferentially triggering assimilation and explicit activation generally producing contrast effects (Nguyen & Ryan, 2008; Wheeler & Petty, 2001). In their meta-analysis, Nguyen and Ryan (2008) compared the impact of different kinds of stereotype activation (implicit, moderately explicit, and blatant) in producing declines in performance (assimilation effect). Their results indicated that effect size was greater for moderately explicit threat-activating cues than for blatant ones. In their view, this finding partially supports several stereotype contrast theories that postulate that when individuals perceive clear limitations on their ability to perform well (as is the case with blatant stereotype cues), they engage in behaviors that disconfirm the stereotype, leading to improved performance. For example, in the study by Kray, Thompson, and Galinsky (2001), compared to the implicit stereotype condition (in which the diagnostic nature of the upcoming task was emphasized), which produced the deleterious stereotype threat effect, the explicit stereotype condition (in which the gender difference was clearly stated) led women to perform better. Therefore, in our study, our stereotype activation could have favored a contrast effect because we induced blatant stereotype activation by explicitly stating that contact sports have been proven to induce cognitive deficits. The emergence of a "beneficial" effect following the blatant activation of negative stereotypes has been linked to other characteristics of the stereotype activation as well, notably the use of a comparison standard (Wheeler & Petty, 2001) and the challenging nature of the stereotype activation (see, for example, Alter, Aronson, Darley, Rodriguez, & Ruble, 2010); these could be additional, nonmutually exclusive reasons why our stereotype activation produced a contrast.

First, comparison of the self to standards is a core feature of both contrast and assimilation effects (Biernat, 2005). According to Wheeler and Petty (2001), stereotype activation that leads participants to use the information given during the stereotype activation as a comparison standard increases the likelihood of a contrast effect. For example, providing an explicit comparison between the stereotype content and the targeted individual facilitates contrast effects. In our DT instructions, we made a clear comparison between contact-sport players and non-contact-sport players, indicating that the latter have better cognitive capacities. Consequently, the way we activated the stereotype—a highly explicit, contrastive threat—could explain why our stereotype activation did not induce an assimilation effect but preferentially triggered a contrast effect for moderate- and high-ILOC contact-sport participants.

Secondly, several studies have shown that it is possible to counteract the harmful effects of stereotype threat by reframing the stereotype instructions (see, for example, Autin & Croizet, 2012; Turner, Jones, Sheffield, Barker, & Coffee, 2014). Alter et al. (2010) showed that, in the stereotype condition, African-American participants underperformed unless the task was framed as challenging (vs. threatening). Accordingly, along with the comparison component of the stereotype activation instructions, some elements of our stereotype activation instructions may have elicited challenge (rather than dejection, for example) for moderate- and high-ILOC contact-sport players and consequently led them to outperform compared to the neutral condition.

Stereotype contrast effect: Who?

In the preceding section, we suggested that our stereotype instructions could have favored a contrast effect, due to the explicit comparison with non-contact-sport players and/or some elements that may have elicited feelings of challenge. Some of the characteristics of our participants, including locus of control, could also explain why we mainly observed a contrast effect.

mTBI expectations of contact-sport players: An expectancy of recovery

In the introduction to this article, we suggested that, because contact-sport players have certain expectations regarding the consequences of mTBI (Fedor & Gunstad, 2015), they should be vulnerable to DT. However, the findings regarding the consequences of mTBI in athletes indicate that they do not actually report more symptoms than controls (Ferguson et al., 1999; Gunstad & Suhr, 2001). Regarding mTBI expectations, it appears that non-mTBI athletes expect fewer symptoms following a mTBI than other healthy nonathlete groups (Gunstad & Suhr, 2001). Gunstad and Suhr (2001) proposed that because of their experiences with head injury, athletes may develop a general positive expectation regarding recovery. Finally, according to cognitive dissonance theory (Festinger, 1962), individuals try to feel a sense of consistency, and avoid feeling dissonance between their standards (i.e., their ideal self-concept) and how they assess their own behaviors. So, playing a contact sport, and therefore engaging in risky behaviors, could create a kind of cognitive dissonance (between the will to maintain good cognitive status and the involvement in "cognitively risky behaviors"), possibly leading our participants to try to resolve this dissonance. Taken together, a contrast effect could have been triggered by a generally positive expectation of recovery, a tendency to dissimulate potential deficits, and cognitive dissonance created by risky behaviors.

Athletes: Used to performing under pressure

Individuals who play sports are used to feeling pressure to perform well and to coping with performance anxiety. McKelvie, Lemieux, and Stout (2003) showed that compared to nonathletes, athletes scored lower for neuroticism on the Eysenck personality inventory (Eysenck & Eysenck, 1968). Individuals who are low in neuroticism are generally described as less prone to psychological distress and therefore respond better to stressors (see also Bäckmand, Kaprio, Kujala, & Sarna, 2001). Perfectionism and striving for perfection constitute another important characteristic of individuals who play sports (Haase & Prapavessis, 2004; Stoeber, Otto, Pescheck, Becker, & Stoll, 2007). Therefore, since contact-sport players are used to performing under pressure and tend to strive for perfection, our DT instructions could have triggered a feeling of challenge in all these participants, leading them to outperform compared to the neutral condition, but only if they felt great responsibility for their own actions—that is, if they were moderate- and high-ILOC individuals.

Internal locus of control

Our results are globally consistent with studies showing that internality is associated with greater resistance to social influence and better management of stress and anxiety (C. Arslan et al., 2009; Lefcourt, 2014; Szabo et al., 2015). Since diagnosis threat is a kind of social influence, only moderate- and high-ILOC individuals presented a contrast effect, because such people tend to feel responsibility for their own actions and are known to better manage anxiety and social influence. Regarding the results of Cadinu et al. (2006), we mentioned in the introduction that they did not include a "pure" no-threat condition. For example, Steinberg, Okun, and Aiken (2012) showed that a condition in which participants are told that gender equivalence is a fallacy, as in Cadinu et al.'s (2006) second experiment, does not always elicit the same pattern of results as a pure neutral condition. If in fact Cadinu et al. observed an improvement in performance (i.e., stereotype boost effect) in response to their nonthreatening positive conditions for internal participants, their results, like our own, may indeed indicate that internal individuals can overcome threat when facing negative stereotypes, because they feel they are in control of their own performance.

We have hypothesized that contact-sport players low in internality would be prone to show the stereotype deleterious effects because low-internal people are known to perform worse in such conditions and to be more vulnerable to social influence and stress (C. Arslan et al., 2009; Lefcourt, 2014; Szabo et al., 2015). However, because of the small number of participants with a very low level of internality in our sample, we could not probe for this effect.

Surprisingly, our results showed an effect of the internal locus of control in the neutral condition only, with higher levels of internal locus of control being associated with poorer performance on both executive and episodic memory scores. More explicitly, when all the other variables in the model are at their average, ILOC has a negative effect on performance. These results were unexpected, but could be explained by participants- and instructions-related factors. It could be that for high internal athletes who used to be challenged and who think they control their actions, the neutral instructions (studying mechanisms of cognition) were not stimulating enough to induce engagement in the tasks, or were even annoying. In other words, to perform at their best level, internal athletes might need to be challenged. Relatedly, the neutral instructions stated that the goal was to study the "mechanisms" influencing cognitive functions (not how well people perform). This kind of instructions could have induced an external attributional style for performance (emphasis on mechanisms outside of people control), which could have impaired performance of people who feel and need control over their actions (Neumann, 2000). These explanations are speculative, and future studies should, of course, be conducted to clarify this relationship.

Stereotype contrast effect: How?

The contrast effect observed for contact-sport players was not mediated by effort and anxiety. There was, however, a significant effect of anxiety on episodic memory for high-ILOC individuals, and a significant global effect of anxiety on the executive score, with low levels of anxiety being associated with better performance for both scores. These results are in accordance with the literature on the impact of anxiety on cognitive performance (see, for example, Clarke & MacLeod, 2013). However, we did not observe an effect of stereotype instructions on anxiety. It could be that anxiety is an overly general construct to account for the contrast effect observed in contact-sport participants. Likewise, the effort measure could be too simplistic to capture the complex phenomenon of stereotype contrast effect. "Pressure to perform" or a feeling of "challenge" might have been better candidates for mediation.

A more general explanation of our contrast effect may be found in the regulatory fit account involving goal direction adoption (prevention or promotion focus; see, for example, Grimm, Markman, Maddox, & Baldwin, 2009; Seibt &

Forster, 2004). When adopting a prevention focus, people guide their decisions by focusing their attention on the presence (or absence) of losses, whereas a promotion focus directs their attention to the presence (or absence) of gains. The adoption of these goals elicits different cognitive processes when people execute tasks. According to this theory, poorer performance under stereotype threat is due to discordance (mismatch) between the focus of the task and the focus of the individual. Several studies have shown that stereotype threat triggers a prevention focus that pushes people to avoid doing badly, rather than try to do their best (Barber & Mather, 2013; Brodish & Devine, 2009; Stahl, Van Laar, & Ellemers, 2012). Since most task instructions used in neuropsychological assessment focus on gains/nongains (and not on losses/nonlosses), the prevention focus induced by stereotype threat instructions results in decreased performance.

In our study, the experimental manipulation could have elicited challenge (promotion) for higher ILOC individuals. It may have triggered a promotion focus only in our moderate- and high-ILOC participants because they are the ones who feel in control over their performance and who cope better with anxiety. Since our tasks highlight gains (because participants start from scratch and accumulate correct responses during task completion), our instructions could lead them to outperform because of the match between their motivational state and the tasks' reward structure. To take just one example, Keller (2007) showed that activating negative stereotypes about one's group can turn into challenge and therefore lead to outperformance if a promotion focus is experimentally induced (compared to a situation in which a prevention focus is induced).

Limitations

There are some limitations in our study. First, we selected a set of neuropsychological tasks that tap on some cognitive functions, but we did not assess other cognitive domains like language or reasoning abilities. Our results could therefore be specific to the domains we assessed. Another limitation relates to the absence of impact of condition on attention and working memory performance. In the stereotype threat literature, some tasks' characteristics have been found to determine stereotype effects. For example, easy tasks have been found to foster contrast effects (O'Brien & Crandall, 2003). It could be that moderate- and high-ILOC participants found the executive and episodic memory tasks easy. In turn, under diagnosis threat, they showed higher performance on these tasks than their counterparts in the neutral condition. On the other hand, it could be that participants found the attention and working memory tasks difficult, preventing them from improving their performance in the diagnosis threat condition compared to the neutral one. However, once again, this hypothesis is speculative and should be examined specifically.

Our study showed that diagnosis threat instructions do not systematically lead to underperformance compared to a neutral condition, providing a more nuanced view of the impact of diagnosis threat. However, it is important to note that the negative relationship between ILOC and performances observed under the neutral condition could have determined our effect of diagnosis threat for moderate- and high-internal participants. We have proposed some explanations for this unexpected result, notably the influence of the phrasing of instructions in the neutral condition. Further studies should be conducted to examine whether diagnosis threat would still improve performance of moderate- and high-internal participants in the absence of a detrimental impact of ILOC in the neutral condition (e.g., by emphasizing personal performance rather than the influence of cognitive mechanisms in the neutral condition).

Conclusion

While our results need to be replicated in order to better understand the moderating role of locus of control in the contrast effect (as well as the underlying mechanisms), our study showed that diagnosis threat instructions lead to cognitive outperformance in contact-sport players compared to a neutral condition. Furthermore, this effect was moderated by internal locus of control, with only moderate- and high-ILOC individuals showing this contrast effect. This contrast effect could be due to the way we activated the stereotype and characteristics of athletes; and while we found no evidence of mediation by anxiety and effort, we propose that a feeling of challenge and regulatory focus could mediate this effect.

Finally, our data could have practical implications for the rehabilitation of concussed athletes with PCS.

Indeed, given the challenging nature of our stereotype activation and its "standards" comparison component, turning rehabilitation into a challenge, particularly by establishing standards, could be beneficial for athletes with an internal locus of control. Our results could suggest that athletes with moderate and high level of internal locus of control need to be challenged to perform at their best level. In this regard, the effect of goal (standard) setting, especially a high goal, had already been shown to improve arithmetic performance by brain-damaged patients (see, for example, Gauggel & Billino, 2002; Gauggel, Hoop, & Werner, 2002). As well, providing brain-damaged patients with negative feedback about their performance has been shown to improve it (Gauggel, Wietasch, Bayer, & Rolko, 2000). There are reasons to believe that our recommendations (turning rehabilitation into a challenge) will not be effective for all individuals; still, for high-internal individuals, our results suggest that framing the rehabilitation program in challenging terms and making a comparison between difficult goals and actual performance would elicit better patient involvement in the rehabilitation process, and possibly lead to better cognitive outcomes.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Fonds De La Recherche Scientifique (Belgian Fund for Scientific Research, F.R.S.-FNRS).

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