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FACULTÉ DES SCIENCES SOCIALES ET POLITIQUES
INSTITUT DE PSYCHOLOGIE

ON THE RELATIONSHIP BETWEEN PERFORMANCE-APPROACH GOALS AND COGNITIVE PERFORMANCE:

When the desire to outperform others becomes interfering

THÈSE DE DOCTORAT

Présentée à la Faculté des Sciences Sociales et Politiques
de l'Université de Lausanne
pour l'obtention du grade de Docteur en Psychologie Sociale
par

Marie Crouzevialle

Directeur de Thèse
Professeur Fabrizio Butera

Membres du Jury
Professeure Veronika Brandstätter-Morawietz, Universität Zurich
Professeur Christian Staerklé, Université de Lausanne
Professeur Juan-Manuel Falomir-Pichastor, Université de Genève

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«On the relationship between performance-approach goals and cognitive performance : when the desire to outperform others becomes interfering.»

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On the relationship between performance-approach goals and cognitive performance: When the desire to outperform others becomes interfering

Marie Crouzevialle

Résumé

Cette thèse explore dans quelle mesure la poursuite d'un but de performance-approche (i.e., le désir de surpasser autrui et de démontrer ses compétences) favorise, ou au contraire endommage, la réussite et l'apprentissage—une question toujours largement débattue dans la littérature. Quatre études menées en laboratoire ont confirmé cette hypothèse et démontré que la poursuite du but de performance-approche amène les individus à diviser leur attention entre d'une part la réalisation de la tâche évaluée, et d'autre part la gestion de préoccupations liées à l'atteinte du but—ceci empêchant une concentration efficace sur les processus de résolution de la tâche. Dans une deuxième ligne de recherche, nous avons ensuite démontré que cette distraction est exacerbée chez les individus les plus performants et ayant le plus l'habitude de réussir, ceci dérivant d'une pression supplémentaire liée au souhait de maintenir le statut positif de « bon élève ». Enfin, notre troisième ligne de recherche a cherché à réconcilier ces résultats—pointant l'aspect distractif du but de performance-approche—avec le profil se dégageant des études longitudinales rapportées dans la littérature—associant ce but avec la réussite académique. Ainsi, nous avons mené une étude longitudinale testant si l'adoption du but de performance-approche en classe pourrait augmenter la mise en œuvre de stratégies d'étude tactiquement dirigées vers la performance—favorisant une réussite optimale aux tests. Nos résultats ont apporté des éléments en faveur de cette hypothèse, mais uniquement chez les élèves de bas niveau.

Ainsi, l'ensemble de nos résultats permet de mettre en lumière les processus cognitifs à l'œuvre lors de la poursuite du but de performance-approche, ainsi que d'alimenter le débat concernant leur aspect bénéfique ou nuisible en contexte éducatif.

Abstract

In this dissertation, we propose to investigate whether the pursuit of performance-approach goals (i.e., the desire to outperform others and appear talented) facilitates or rather endangers achievement and learning—an issue that is still widely discussed in the achievement goal literature. Four experiments carried out in a laboratory setting have provided evidence that performance-approach goals create a divided-attention situation that leads cognitive resources to be divided between task processing and the activation of goal-attainment concerns—which jeopardizes full cognitive immersion in the task. Then, in a second research line, we found evidence that high-achievers (i.e., those individuals who are the most used to succeed) experience, under evaluative contexts, heightened pressure to excel at the task, deriving from concerns associated with the preservation of their "high-achiever" status. Finally, a third research line was designed to try to reconcile results stemming from our laboratory studies with the overall profile emerging from longitudinal research—which have consistently found performance-approach goals to be a positive predictor of students' test scores. We thus set up a longitudinal study so as to test whether students' adoption of performance-approach goals in a long-term classroom setting enhances the implementation of strategic study behaviors tactically directed toward goal-attainment, hence favoring test performance. Our findings brought support for this hypothesis, but only for low-achieving students.

Taken together, our findings shed new light on the cognitive processes at play during the pursuit of performance-approach goals, and are likely to fuel the debate regarding whether performance-approach goals should be encouraged or not in educational settings.

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Au jour où j'écris cette page de remerciements, cela fait exactement 5 ans que cette aventure a commencé pour moi. Et ces cinq années de doctorat passées à Lausanne n'ont pas simplement donné jour au présent manuscrit: elles m'ont aussi et surtout amené à rencontrer des personnes remarquables, dont j'ai beaucoup appris, et qu'il me tient particulièrement à cœur de remercier ici.

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"It is truly amazing how, in the Olympics, for example, commentators speak about the performance of someone who ends up taking the silver medal in, say, men's figure skating as if he were a disappointing failure. The second-best skater in the world, and he's treated like a loser. That's what happens when we turn everything into a contest in which there is only one winner, in which winning matters more than playing well or being a good sport."

E. L. Deci, 1995, p. 69.

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THEORETICAL PART

“I mean look, grades are the focus. I tell you, people don’t go to school to learn. They go to get good grades, which bring them to college, which brings them to the high-paying jobs, which brings them to happiness, so they think” (Pope, 2001, p. 11). Beyond suggesting that grades, more than learning, can become students’ core concerns, these words—coming from a high-achieving student enrolled in an American high school—nicely illustrate how striving for academic success, through being embedded with higher-order and future-oriented goal strivings, can become synonymous with feelings of tremendous pressure: pressure to perform, pressure to rise above others, pressure to demonstrate one’s full potential to teachers so as to get access to the highest diploma and most prestigious positions in society… all purposes which have recently been exacerbated by the world economic crisis, leading to an increase in students’ drive to achieve at their best and distinguish themselves from their peers in order to approach job prospects in optimum conditions when they graduate (Lewin, 2011). It is, therefore, of practical significance to determine the consequences such a performance-focused motivation might carry for academic outcomes—and in particular regarding learning and achievement outcomes. In other words, is the pursuit of normative performance (that is, the aim to outperform others) in academic settings a potentially beneficial or rather damaging form of achievement motivation?

This question refers to an important ongoing debate in motivation and achievement research, and thus also has theoretical significance. Indeed, the study of consequences stemming from the pursuit of goals that are focused on the desire to outperform others as well as to appear talented—namely, performance-approach goals, Elliot and Harackiewicz (1996)—has inspired a conspicuous amount of research, which today is confronted to a paradox: while some research shows that performance-approach goals essentially subordinate learning and knowledge acquisition to obtaining favorable grades and ranks, other research has consistently demonstrated that the endorsement of performance-approach goals is a positive predictor of academic achievement, measured as students’ exam scores (see Harackiewicz, Barron, Pintrich, Elliot, & Trash, 2002, for a review). This contradiction has led researchers to intensely discuss the question of whether performance-approach goals should be regarded as an efficient drive to achievement and therefore encouraged in the realm of education, or whether its prevalence in the classroom, partly favored by the competitive and grade-focused structure of most educational environments, should rather be considered as contrary to learning processes, and thus be challenged and discouraged in educational structures (Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, et al., 2002; Midgley, Kaplan, & Middleton, 2001).

In this dissertation, we aim to shed new light on this debate, in particular by investigating how the pursuit of performance-approach goals might focus a significant part of individuals’ attention and cognitive resources on outcome- and goal-attainment concerns, to the detriment of task focus and full cognitive immersion in task processing. More specifically, we claim that the salience of performance-approach goal concerns in mind may have different consequences on performance depending on the achievement context: they would be irrelevant and thus interfering when facing a novel and complex task solving requiring full cognitive concentration, while proving more adaptive in long-term settings requiring planning and the implementation of strategic behaviors tactically directed toward goal-attainment. We believe that this approach, by shedding light on the cognitive processes at play during the pursuit of performance-approach goals, could bring new and fruitful arguments to fuel the debate on whether and for which reasons normative strivings favor or inhibit academic achievement.

1. Definition, antecedents, and consequences of performance-approach goals

1.1. The achievement goal approach: definitions and conceptualization

The desire to understand the motivational components underlying students' adaptive and maladaptive behaviors and cognitions in the face of challenging tasks gave rise in the 80' to the development of the achievement goal construct (Dweck, 1986; Nicholls, 1984). The first conceptualization of achievement goals basically distinguished between two different goal orientations that children could endorse in achievement situations, namely *learning* goals—emphasizing a focus on task mastery and knowledge acquisition—and *performance* goals—rather focused on demonstration of competence and normative strivings (Dweck, 1986; Dweck & Elliott, 1983). Although being labeled differently, Nicholls' (1984) achievement goal construct referred to a similar distinction between on the one hand *task involvement*, representing the desire to gain learning and task mastery, and on the other hand *ego involvement*, implying seeking to "demonstrate ability in the differentiated sense" (p. 329), that is, through outperforming peers. Thus, taking the example of academic settings, this conceptualization distinguishes between students mainly motivated by the prospect to gain knowledge and learn from challenging and stimulating material, and students whose main concerns are rather directed toward the obtaining of high grades as well as the desire to demonstrate their self-worth to others (e.g., teachers, peers).

One major difference stemming from these two motives is that they are associated with divergent representations of competence, since competence is defined "by the standard or referent that is used in evaluating it" (Elliot, 2005); in particular, while the attainment of performance goals requires performing better than others (normative competence), the attainment of mastery goals will be dependent on mastery of the task (absolute competence) or self-improvement as compared with one's previous knowledge (intra-personal competence; Ames, 1984; Dweck & Elliott, 1983; Maehr, 1983). Consequently, individuals will rely on different criteria to determine whether competence is attained, and whether the outcome stemming from task or activity completion can be considered as a success or a failure; indeed, while mastery-oriented individuals will pay attention to temporal comparison information (i.e. comparing one's outcome with preceding ones), performance-oriented individuals will rely on normative comparison information (i.e., comparing one's outcome with that of peers) before drawing conclusions regarding competence attainment.

The two types of achievement goals have been presumed to engender various achievement-oriented behaviors as well as to influence various outcomes such as affects, task construal, persistence, and performance. Hence, the endorsement of mastery goals has been associated with a wide range of positive outcomes, such as high intrinsic motivation and interest for the task or activity, seek for challenge, and high persistence when facing obstacles or failure—an overall profile thought to favor learning and knowledge acquisition and to quiet concerns associated with performance and abilities (Ames & Archer, 1988). Performance goals, on the other hand, have been assumed to focus individuals on the issue of ability relative to that of others, leading them to perceive learning as "a means to an end" (Nicholls, 1984, p. 340) and to avoid challenge—unless one's perception of ability and chances to be successful is high (Bandura & Dweck, 1985, unpublished manuscript cited by Dweck, 1986).

Building on this first dichotomy, Elliot and colleagues (Elliot, 1999; Elliot & McGregor, 2001) introduced the concept of competence *valence*, arguing that competence can be construed in either positive terms (success, competence attainment) or in negative terms (failure, incompetence). This additional dimension allows to make a clear distinction between on the one hand appetitive competence strivings—e.g., in academic settings, students mainly focused on the attainment of positive outcomes, such as high grades or the mastery of challenging tasks—and, on the other hand, avoidance competence strivings—e.g., students concerned about preventing the occurrence of negative outcomes, such as avoiding to perform below the pass mark or to forget what has been learned during a past semester. Hence, more recent conceptualizations have incorporated this additional distinction, namely between approach (i.e., striving to attain a desirable final end state) and avoidance (i.e., striving to avoid an undesirable final end state) motivations (Elliot, 1999; Elliot & Harackiewick, 1996; Pintrich, 2000), which gave rise to the 2 X 2 achievement goal model. This model intersects the mastery and performance goal distinction with the approach versus avoidance tendencies, which leads to four separate goals, namely mastery-approach goals (i.e., striving for self-improvement or task mastery), mastery-avoidance goals (i.e., striving for not losing one's abilities or for avoiding learning failures), performance-approach goals (i.e., striving for outperforming peers and demonstrate one's competences), and performance-avoidance goals (i.e., striving for avoiding doing worse and appearing less talented than others; Elliot & McGregor, 2001). Since its inception, this model has received a large support—in particular through abundant empirical research, which has confirmed that the four goals are respectively associated with different processes and outcomes (see Elliot, 2005, for a review). Therefore, the work presented in this dissertation relies on this conceptualization, and adopts the definition of achievement goals formulated by Hulleman, Schrager, Bodmann, and Harackiewick (2010): “a future-focused cognitive representation that guides behavior to a competence-related end state that the individual is committed to either approach or avoid” (p. 423).

The impact of achievement goal commitment on achievement-relevant processes and outcomes has been widely studied among various achievement domains (for a review, see Van Yperen, Blaga, & Postmes, 2014). In particular, research has extensively investigated three institutional contexts, namely educational settings (be it among elementary school pupils or college students; Butler, 1992; Harackiewicz, Barron, Tauer, & Elliot, 2002), professional areas (Janssen & Van Yperen), as well as sports domain (Roberts, 2001; VandeWalle, Brown, Cron, & Slocum, 1999). In this dissertation and from now on, we will specifically focus on research carried among educational settings.

While mastery-approach goals have been linked with positive achievement outcomes such as intrinsic motivation, persistence after failure, and challenge seeking (Barron & Harackiewicz, 2000; Harackiewicz, Barron, Pintrich, et al., 2002; Urdan, 2004), mastery-avoidance goals have been associated with fear of failure and disorganization (Conroy & Elliot, 2004; Elliot & McGregor, 2001). Similarly, performance-avoidance goals have been linked with a broad range of maladaptive outcomes such as anxiety, self-handicapping, and work disorganization (Elliot & Church, 1997; Midgley & Urdan, 2001; Wolters, 2004). Finally, and as was alluded to at the beginning of this introduction, behaviors and academic outcomes stemming from performance-approach goals (referring to the desire to outperform others and appear talented)[1] depict a less straightforward profile, which has sparked a debate that is still ongoing within the achievement goal literature. Before accounting for this controversy in more details, we will first present findings that have clarified the antecedents and consequences of performance-approach goal endorsement in academic settings[2].

1.2. The antecedents of performance-approach goals

Can the endorsement of performance-approach goals be indirectly promoted by environmental or dispositional features? We now discuss why characteristics from the educational

[1] It should be noted that this conceptualization of performance-approach goals, which includes two distinct sub-components—that is, a normative sub-component—“outperform others”—and an appearance sub-component—“demonstrate one’s competences”) has sometimes been subject to debate. In particular, Harackiewicz, Barron, Pintrich, Elliot, and Trash (2002) urged researchers to favor a conceptualization exclusively focusing on the normative component, arguing that “self-presentation has nothing to do with competence per se, and competence should be at the core of any achievement goal construct” (ibid, p. 639). In this dissertation, we have nonetheless chosen to opt for a definition that considers both sub-components as essential and indivisible parts of performance-approach goals, since we contend that the visibility of social comparison as well as the preponderance of teachers’ assessment in the grading system render appearance concerns closely linked to normative concerns. For instance, one’s normative success is partly dependent on judgment from the teacher or assessment body, which places important stakes on others’ opinion regarding one’s competences.

[2] In the present dissertation, we exclusively focus our investigation on performance-approach goal endorsement’s cognitive consequences; for this reason, we will no further evoke nor make assumptions regarding the question of how the other achievement goals may influence academic outcomes and performance.

system—whose functioning puts significant weight on grades and selection—as well as inter-individual differences in conception of intelligence, can play a major role in students' drive to outperform others and appear talented.

1.2.1. The role of institutional practices

Beyond the *educational* function of academic structures such as colleges and universities—whose goal is to promote learning, to increase students' knowledge and develop their skills and abilities—the omnipresence of testing and grades (Butler & Nisan, 1986; Covington & Omelich, 1984; Ryan & Weinstein, 2009) makes their *selective* function most salient in students' eyes. In particular, tests and exams lead teachers and examiners to attribute a worth, most often through the use of grades, concerning the quality of a performance. Beyond providing a feedback about one's competence (the midpoint of the evaluation scale being a potential normative standard), grades also provide information regarding one's ranking as compared to others (i.e., social comparison information), which necessarily entails that some students will be more successful than others (Elliot & Moller, 2003). Hence, because these grades are "meant to be of value to students" and carry with them information regarding their chances to "get into desired future educational settings and occupations that employ grades as part of their selection procedures" (Deutsch, 1979, p. 393), they represent more than mere information about competence and course mastery, as students are fully aware of grades' more or less direct consequences on their academic progress and curriculum.

Some researchers have noteworthy pointed out the negative impact of grades on students' autonomy, by arguing that grades could be perceived as controlling (Butler & Nisan, 1986; Deci & Ryan, 1985; Pulfrey, Darnon & Butera, 2013; Ryan & Weinstein, 2009) and generate pressure to attain a valuable outcome. In particular, Pulfrey, Buchs and Butera (2011) claimed that within the traditional grading system used in most educational settings, "students receiving grades are in a position of relative powerlessness in the grade attribution process, depending in many cases on another individual, the teacher" (p. 685), which is in contradiction with the characteristics of autonomous motivation and hence potentially elicits negative affects (Smith, Sinclair, & Chapman, 2002) and feelings of pressure (Deci & Ryan, 1987).

In particular, self-determination theory (Deci & Ryan, 1985), which explores the reasons underlying actions and achievement-directed behaviors, discriminates between autonomous motivations—referring to behaviors that are driven by interest and values—, and controlled motivations—referring to behaviors that are driven by external rewards, punishments, or self-esteem-based pressures. While the former has often been found to foster quality of learning as well as enjoyment during the activity execution, the latter has been associated with various negative outcomes such as lower learning, lower persistence, and anxiety (Ryan & La Guardia, 1999; Ryan, Stiller, & Lynch, 1994). Research carried out by Deci, Spiegel, Ryan, Koestner and Kauffman (1982) brought evidence that the institutional focus on graded assessment and performance is prone to influence teachers' behaviors, through leading them to be more controlling. In particular, these authors manipulated instructions given to teachers before a teaching session (half of them were told they would have to make sure their students performed up to high standards, while the other half did not receive this pressure), and found evidence that teachers belonging to the first group endorsed a more controlling teaching style—through more directing, praising, and criticizing behaviors—as compared to their counterparts from the control group, which in turn lowered students' feelings of autonomy through increasing their focus on grades.

Furthermore, self-determination theory has pointed out that evaluative environments can favor a motivation based on ego involvement among students, where self-esteem becomes dependent on the attainment of positive evaluations and high grades—thereby putting interest for the task and enjoyment in second place (DeCharms, 1968; Plant & Ryan, 1985). Notably, these considerations have been further backed up by Butler's work (Butler, 1987, 1988, 2006; Butler & Nisan, 1986), which has extensively investigated the consequences of evaluative styles on students' intrinsic motivation and goal adoption. In particular, Butler and Nisan (1986) reported that participants expressed lower levels of intrinsic motivation following the reception of grades, as compared to a condition that had provided participants with task-related comments on their performance; furthermore, Butler (1988) showed that, while the obtaining of high grades fostered subsequent high levels of interest for the task, this interest was only maintained by grade anticipation and disappeared as soon as the activity ceased to be rewarding. More directly relevant for the present contention is the finding reported by Butler (2006), who explored whether the kind of assessment anticipated could influence pupils' goal orientation during task completion. Participants were first told that they would be provided either with temporal evaluation (informing them regarding their score change as compared with previous ones), normative evaluation (informing them about their score as compared with others' performance), or no evaluation. Results revealed that, while the anticipation of temporal evaluation enhanced self-reported mastery goal adoption, the anticipation of a normative evaluation heightened performance goal adoption—a finding that shed light on the importance of features of the immediate learning context on goal orientation.

Because high grades and normative superiority over the other students is commonly represented as the key that opens the door to future high-profile employment opportunities and social prestige, students are fully aware of the importance of rising above their counterparts and distinguishing themselves in the teachers' eyes so as to gain access to the most valued diplomas. Interestingly for this contention, research carried out by Darnon and colleagues (Darnon, Dompnier, Delmas, Pulfrey, & Butera, 2009; Dompnier, Darnon, Delmas, & Butera, 2008) demonstrated that, while psychology students do perceive strong endorsement of performance-approach goals as associated with low desirability (that is, as susceptible to make them appear as less likeable in the eyes of teachers and peers than a weak performance-approach goal adoption), they simultaneously perceive normative goal endorsement as positively related with social utility; in other words, students fully understand that success at university requires them to achieve above others and prove their abilities to the assessment body, and not merely to learn and progress.

Hence, the selective function of academic institutions implicitly promotes the endorsement of performance-approach goals, thereby leading students to give importance and pay significant attention to their grades and ranking. Confronting the normative structures of educational systems with their learning function (supposed to rather entail mastery-approach goal adoption), Elliot and Moller (2003) underlined that "when normative evaluation is the primary emphasis in a learning environment, it will evoke a host of motivational concerns (e.g., self-presentation, self-validation, self-protection) that disrupt mastery-approach goal pursuit" (p. 347). What these lines interestingly suggest is that a strongly competitive learning environment might somehow divert students from the desire to gain knowledge through instead activating esteem-based, self-appearance concerns. Sommet, Pulfrey and Butera (2013) indeed found support for this contention, by assessing whether the use of *numerus clausus* in higher education could impact students' motivation and impair their learning. Academic selection that are based on *numerus clausus* represents an exacerbated form of normative selection, as it corresponds to the selection of a predefined number of candidates who will be allowed to move up to the next year, on the basis of their rank rather than their absolute performance. This category of selection hence generates negative interdependence of competence among students, since the success of some candidates will be at the expense of others. Three experiments confirmed that *numerus clausus* policies, through making it salient that success depends on others' performance (i.e., an external and incontrollable factor), lowered students' feelings of self-efficacy (i.e., perceived capability to successfully perform a task or behavior; Bandura, 1977), which in turn decreased their endorsement of mastery goals (Experiments 1 and 2) and impaired task learning (Experiment 3).

Put together, the aforementioned research pinpoints that the omnipresence of graded assessment and selection educational settings exert a powerful influence on students' intrinsic motivation and indirectly favor the endorsement of a performance goal orientation.

1.2.2. Implicit theories of intelligence

Goal orientation is also partly shaped by individuals' theory of intelligence, that is, their implicit representation of the nature of ability. In particular, Dweck and colleagues have proposed that while some children can develop an incremental conception of intelligence—which leads them to perceive that abilities are malleable, controllable, and can be developed through efforts—, some children rather turn towards an entity theory of intelligence—which favors a view of abilities as fixed, uncontrollable, and unaffected by work and efforts (Dweck, 1999). Such divergences have been shown to shape individuals' motivation and achievement goals, as well as to impact various academic outcomes such as behaviors in the face of failure and learning.

As far as achievement goals are concerned, some findings have consistently associated the entity theory with normative goal pursuit and the incremental conception with learning (i.e., mastery) goal endorsement. Indeed, Dweck and Bempechat (1983) reported a result highlighting that incremental-oriented students showed preference for challenging classroom environments that favor learning goals (i.e., classroom environments described as "hard, new, and different so I could try to learn from them"), while entity-oriented students appeared to prefer environments making it easy to secure high grades ("fun and easy to do, so I wouldn't have to worry about mistakes"). In line with this finding, Dweck and Bempechat explored how inter-individual differences regarding conceptions of intelligence could shape feelings of satisfaction and high self-esteem in scholastic settings. Their data interestingly highlighted that entity-focused students felt smart when they were accurate, when they outperformed their peers, or when they succeeded easily—while incremental-oriented students rather felt smart when experiencing challenge and performing hard tasks.

Furthermore, in order to directly investigate the causal relationship between intelligence conception and achievement goal adoption, Dweck, Tenney, and Dinces (1982, unpublished manuscript reported by Dweck & Leggett, 1988) carried out an experimental study among children that first manipulated either an entity versus incremental theory of intelligence, and then measured how likely they were to turn toward learning versus performance goals. Their results confirmed that children who had been primed toward the incremental conception of intelligence selected learning goals at a higher extent than those who had read the entity priming.

These results interestingly suggest that individuals who have developed a representation of intelligence as fixed and unaffected by efforts strongly favor a focus on grades, normative strivings, and avoidance of challenge; indeed, complex tasks might entail difficulties and errors, which are interpreted as a lack of abilities and can therefore be threatening, while easy tasks more likely entail error-free success and allow demonstration of competence. Hence, as Dweck and Leggett (1988) put it, "for the entity theorist, self-esteem will be fed by performance goals" (p. 266).

1.3. The consequences of performance-approach goal endorsement

An abundant amount of research has explored the academic consequences of performance-approach goal endorsement. Does the striving to outperform others and appear talented actually prove to be a beneficial—or inimical—form of regulation in the classroom, and does it promote success in one's scholastic endeavors? In this part, we review literature that has explored the impact of performance-approach goals on three categories of academic outcomes, namely task-related outcomes, social behaviors, and academic achievement.

1.3.1. Performance-approach goals and task-related outcomes

Some research provides information on the consequences performance-approach goal adoption carries regarding task processing and task focus. In this section, we focus on literature—mostly carried among college or university students—that have investigated the impact of performance-approach goals on deep versus surface task learning, reactions in the face of setbacks, and cheating intentions and behaviors (which can arguably be seen as a maladaptive way to deal with the task).

Performance-approach goals and learning strategies

When assessing the impact of achievement goals on different learning strategies that students can adopt during the learning process, researchers traditionally distinguish between surface learning strategies—based on methods such as rehearsal and rote memorization—and deep learning strategies—based on more demanding techniques such as elaboration and reflection upon the material to be learned (Entwistle, 1988). For example, a French student revising his English lessons can choose either to focus on merely memorizing every words from a vocabulary list by rote (surface learning) or to integrate each of these words in relevant sentences and investigate the conceptual contexts in which they can accurately be used (deep learning).

The relationship between achievement goals and learning strategies has mostly been assessed in the classroom, through the use of self-reported measures. As far as performance-approach goals are concerned, striving for normative performance has quite often been found to be associated with students' preference for surface processing of course content (Elliot & Moller, 2003). Hence, in a set of studies carried out among undergraduate students, Elliot, McGregor and Gable (1999) tested whether self-reported adoption of performance-approach goals during the academic year was linked with the use of deep processing strategies (assessed through items such as "I treat the course material as a starting point and try to develop my own ideas about it") and surface processing (e.g., "I study for this course by memorizing the definitions at the end of each chapter of the text") of course content; while no significant relation was observed between performance-approach goals and study strategies in Study 1, Study 2 found performance-approach goals to be positive predictors of surface processing. Similarly, Harackiewicz, Barron, Tauer, Carter and Elliot (2000) found that students who reported a strong endorsement of performance-approach goals were more likely to report the use of rehearsal (i.e., superficial) strategies (as measured through items such as "When studying for this class, I read my class material to myself over and over again"); moreover, they found no link between performance-approach goals and the use of elaboration (that is, deep) strategies (e.g., "When I am studying a topic, I try to make everything fit together").

It is however worth noting that other researches obtained less straightforward patterns. Thus, Wolters (1998) found no relationship between college students' reported performance goal orientations (e.g., “The main reason I do my work in this class is because we get grades”) and the use of rehearsal (surface) versus elaboration (deep) strategies. Howell and Watson (2008) reported a positive correlation between performance-approach goal adoption and the reported use of deep processing strategies (assessed with the items developed by Elliot et al., 1999), but no significant link between performance-approach goals and surface processing. A similar result was found by Liem, Lau and Nie (2008), who reported performance-approach goal endorsement to be a positive predictor of the use of deep (but not surface) strategies. It is also worth noting that Al-Emadi (2001) reported performance-approach goal adoption as positively associated with both the reported use of surface and deep learning strategies.

Hence, while achievement goal research commonly depicts performance-approach goal endorsement as triggering a preference for surface rather than deep processing strategies when performing tasks (see Elliot and Moller, 2003), it is important to underline that this pattern has not systematically been found.

Attribution of failure and seeking vs. avoiding challenging tasks in the face of setbacks

In the section devoted to implicit theories of intelligence, we have already mentioned that performance-oriented individuals, because they tend to perceive intelligence as a fixed rather than incremental concept, are consequently more prone to interpret failure or the experience of difficulties as a lack of abilities—a view that could lead them to helplessness and withdrawal behaviors. In line with this contention, Ames and Archer (1988) found that a perceived performance-focused classroom environment (assessed among junior high school students with items such as “Students want to know how others score on assignments”) was associated with reported attribution of failure to a lack of abilities and to task difficulty rather than to efforts—leading the authors to comment that “attributing failure to lack of ability, in addition to the tendency to see the work as too difficult, reflects a maladaptive motivational pattern that is not likely to support subsequent effort” (p. 265).

Elliott and Dweck (1988) further explored the influence of achievement goal pursuits on helpless responses after the experience of failure; participants were fifth-grade children that were first asked to perform a geometric task for which one’s own accuracy was difficult to estimate—a feature that actually allowed authors to manipulate a bogus feedback. Indeed, following task completion, participants were either told that they had low ability or high ability for this task; all participants were however told that they could increase their knowledge and skills. They then read instructions that were designed to prime either a mastery or a performance focus, and then performed a similar task for which they had beforehand been allowed to choose the level of difficulty, and during which they received a (bogus) failure feedback. Results demonstrated that for performance-oriented participants who had previously received a feedback of low ability, the following failure feedback reception elicited greater feelings of helplessness (attributions for failure to a lack of abilities, negative affects) as compared to participants from the mastery-focused condition. More importantly, even for participants who had received a feedback mentioning they had high abilities, performance-oriented participants preferred to skip a possibility to increase their skills (through choosing complex task solving that would entail public errors), and rather chose easy or moderately challenging tasks that would easily ensure a high score.

Cheating intentions and behaviors

In June 2012, a press article published in *The New York Times* indirectly addressed the question of high school pressure over grades and competition for college admissions through focusing on the increasing trivialization of "study drugs" taking among high school students, and expressed concern that stimulants such as amphetamines and methylphenidates (which are typically prescribed for attention deficit hyperactivity disorder) were more and more routinely taken by performance-focused students who wish to be able to "study late into the night, focus during tests and ultimately get the grades worthy of their prestigious high school in an affluent suburb of New York City" (Schwartz, 2012). As a female-student of 16-year old from Minneapolis put it, "everyone is competing against each other for scholarships and it definitely gives you an extra edge over students who don't take it" (Schwartz, 2012). In a nutshell, no matter if the means is unethical, unfair, and even harmful to health: success and performance matter most, whatever the cost.

In particular, cheating in school has became a growing phenomenon teachers and authorities have to deal with, since 70 to 90 per cent of students admit having cheated during an exam or for a written work prior to graduating from high school (McCabe, Trevino, and Butterfield, 2001)—a frequency that have constantly grown since the 1960s. One may wonder the role of performance-approach goal adoption in this trend; indeed, could it be that the desire to reach excellence and academic success actually underlie the use of such dubious methods at school? Interestingly for this contention, Pulfrey and Butera (2013) developed a hierarchical motivational model proposing that in educational settings, adherence to self-enhancement values (referring to the desire for normative success and dominance over others through achievement and power; Schwartz, 2007) should predict the condoning of cheating – a link that would crucially be mediated by both the adoption of performance-approach goals and the motivation to gain social approval. To test this model, they asked higher-education students to complete questionnaires which aimed to measure self-enhancement values (e.g., "it is important to me to be ambitious"; "it is important to me to be the one who makes decisions/leads"; Schwartz, 2006), performance-approach goals ("It is important for me to do better than other students"; Elliot & McGregor, 2001), as well as condoning of cheating (e.g., "I can understand it if some students copy off others"); the motivation to gain social approval was assessed through Ryan and Connell's (1989) controlled motivation with introjected regulation scale (e.g., "I study because I want the teacher to think I am a good student"). Results validated the full path model, as analyses confirmed that the more students adhered to self-enhancement values, the more they reported being motivated to gain social approval and endorsing performance-approach goals—this in turn leading them to higher condoning of cheating.

A close reading of the literature also reveals an indirect performance-approach goal-cheating relationship, as classroom environments have been found to influence students' cheating behaviors. Interestingly, Anderman and Midgley's (2004) findings from longitudinal data revealed that self-reported cheating behavior of middle school students had increased for students who had moved from low performance-oriented to more performance-oriented math classes during the same period. Similarly, Anderman, Griesinger and Westerfield (1998), as well as Murdock, Hale and Weber (2001), reported a positive correlation between middle school students' perception of classroom environment as strongly promoting performance goal-orientation and self-report cheating behavior.

Anderman et al. (1998) additionally tested the relationship between self-reported cheating behaviors (e.g., "I use cheat sheets when I take science tests"), use of deep-level study strategies (e.g., "when I make mistakes in science, I try to figure out why"), self-handicapping strategies (e.g., "some students put off doing their schoolwork until the last moment so if they don't do well on their work, they can say that is the reason"), and school worry (e.g., "I worry about whether my teachers think I am as smart as other kids in my class"); their results interestingly revealed a positive link between self-reported cheating behaviors and use of self-handicapping strategies, as well as a negative relationship between self-reported cheating behaviors and deep-level strategies, suggesting that cheating behaviors are not compatible with deep and strenuous work of course content and are dictated by outcome-concerns and the need to succeed at all costs. Support for this contention also emerged from the positive correlation between self-report cheating and worries about one's performance—a finding which is in accordance with work reporting a positive relationship between cheating and fear of failure (Calabrese & Colchran, 1990), and between cheating and test anxiety (Malinowski & Smith, 1985).

These empirical findings indeed bring converging evidence that the adoption of performance-approach goals, as well as performance-oriented classroom environments, do promote unethical intentions and cheating behaviors—a strategy that arguably offers the advantage of allowing students to guarantee a high score while simultaneously save the expense of a deep and strenuous work on course content. As underlined by Anderman et al. (1998), "by cheating, a student also can appear to do well on a test or an assignment and thus maintain the outward appearance of doing well" (p. 90). This also suggests that while performance-driven students attach so much importance on getting high scores and attain normative achievement, they might prefer to allocate most of their resources and attention to the implementation of efficient cheating behaviors that will assure them success at the test and attainment of the desired end state, rather than to engage in a deeper, more costly, and more hazardous process of learning.

1.3.2. Performance-approach goals and interpersonal behaviors

Since the pursuit of performance-approach goals involves normative strivings (i.e., aiming to outperform others) as well as the desire to appear competent to others, one may wonder which consequences it carries for collaborative work and social interactions with peers—since educational settings often entail interpersonal exchanges (e.g., help-seeking behaviors) and sometimes encourage cooperation (e.g., group works). Does the "competitive essence of normative goals" (Senko et al., 2011, p. 35) have an influence on such behaviors? In this section, we review the consequences of performance-approach goals on social desirability, on perception of others, on cooperation and information sharing intentions and behaviors, and on regulation preferences in the face of disagreement with a peer.

Social desirability

How is a strong endorsement of performance-approach goals likely to be perceived by others, be they teachers or peers? Research that has investigated the social value attached to the endorsement of achievement goals has demonstrated that the higher a student's self-reported adoption of performance-approach goals, the less likeable he/she will be perceived, highlighting the low social desirability associated with its pursuit (Darnon et al., 2009). In particular, data obtained from university psychology teachers pointed out the fact that performance-approach goal endorsement is not promoted in teachers' official discourse—who prefer to lay the emphasis on the educational function of the university structure and thus promote mastery-approach goals (Darnon et al., 2009, pilot study 1). Follow-up studies interestingly revealed that psychology students perceived a peer allegedly highly committed to the pursuit of performance-approach goals as less likeable (i.e., "pleasant", "likable", "nice") than a target described as only weakly endorsing this goal. However, the former was notably judged as having higher chances to succeed at University ("likely to succeed", "smart", "competent")—thus reflecting the social utility of normative strivings within educational structures that (for most of them) make grades and normative achievement salient. Put together, these findings highlight the low social desirability associated with performance-approach goal endorsement, which is perceived as the demonstration of appetitive and ambitious aspirations while modesty is generally preferred (Schlenker & Leary, 1982).

Perception of others

Some findings bring important indications suggesting that normative strivings favor the perception of others as threats rather than informational and helping supports. In a study carried out in the classroom, Ryan and Pintrich (1997) explored the relationships between achievement goal endorsement, perception of other classmates, and help-seeking behaviors. Striving to beat others was measured through items assessing what they labeled "relative ability goals" (e.g., "I would feel successful in math if I did better than the other students in the class"); path analyses revealed that this measure was positively associated with others perceived as threat regarding help seeking situations (assessed through items such as "I think other kids might think I am dumb when I ask a question in math"), which in turn led to more self-reported avoidance of help seeking (e.g., "if I need help to do a math problem I skip it"). This result convincingly points out how the fear that one's difficulties of course comprehension might be interpreted by classmates as weaknesses and as a proof of low abilities (which echoes aforementioned research linking normative strivings with conception of intelligence as fixed rather than malleable), and hence foster negative judgments from them, discourage help seeking behaviors—thereby potentially preventing progress and learning.

Information exchange and cooperation intentions and behaviors

In academic as well as professional contexts, information exchange and cooperation with peers might be crucial in order to attain optimal performance and task mastery, since others can be in possession of crucial information or knowledge that we lack. In particular, the benefits of cooperative learning and goal structures on learning and performance has been well-documented (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Johnson & Johnson, 1989; 1999); however, some researchers have pinpointed how achievement goals and motivation can moderate cooperation intentions as well as help-seeking behaviors (Harris, Yuill, & Luckin, 2008; Poortvliet, Janssen, Van Yperen, & Van de Vliert, 2007; 2009; Poortvliet & Darnon, 2013), in particular by showing that being outcome-oriented leads individuals to adopt "a cautious approach that contrasts the intended spirit of collaborative learning" (Senko et al., 2011, p. 35). Could it be that cooperation with others and resource sharing are perceived as conflicting with normative strivings and working against performance-approach goal-attainment? Before further discussing the mechanisms underlying this phenomenon, we will shortly describe some of these findings.

Two experiments carried by Poortvliet et al. (2007) were designed to test the consequences of achievement goals on information exchange with a coactor during task solving. In Experiment 1, participants were first asked to complete a complex task called the Winter Survival Exercise (WSE, Johnson & Johnson, 2000), basically describing a scenario of plane crashing during which 12 items have been saved, and requiring participants to rate these items from the least to the most useful so as to find the best possible ranking. Participants had to elaborate a first ranking, and were then informed that they would exchange their solution with another (actually bogus) participant. Just before this information exchange, they read achievement goal instructions that aimed to manipulate either performance-approach goals ("perform better on your second ranking as compared to the other's ranking") or mastery-approach goals ("perform better on your second ranking as compared to your first ranking"); the experimental design also included a control (no-goal) condition. Next, participants sent their first ranking to the supposed coactor, received the coactor's ranking (which actually corresponding to experts' solution, and was thus of high-quality), and lastly had the opportunity to make modifications before submitting their final ranking.

Importantly, participants had the possibility to make modifications of their first ranking before sending it to the other participant; the authors used the computed difference between their real ranking and the one they actually sent as a measure of "openness in information giving". Results for this variable confirmed their hypothesis: participants in the performance-approach goal condition were less prone to exchange information regarding their own ranking as compared to participants both in the mastery-approach goal and no-goal conditions. The authors also computed differences between the (high-quality) ranking participants had received from the pretended coactor and their final ranking, so as to measure the extent to which they had used the other's information; in accordance with their hypothesis, participants in the performance-approach goal condition made more use of the coactor's high-quality information than participants in the mastery-approach goal condition (a marginally significant difference, p = .06) and in the no-goal condition. These findings were replicated and extended in Experiment 2, by showing that when the information provided by the coactor was not high- but low-quality, participants in the performance-approach goal condition proved to use it less than participants in the remaining conditions. Moreover, the detrimental effect of performance-approach goals on openness in information giving that was highlighted in Experiment 1 and replicated in Experiment 2 was found to be mediated by participants self-reported exploitation orientation (i.e., the motivation to obtain more information than they give during the exchange). Taken as a whole, this research brings a first evidence that performance-approach goal pursuit undermines task-related information sharing with others, and additionally demonstrates that outcome-oriented participants adopt a cautious and suspicious approach toward material they receive from others: hence, they tend to make use of it more so than mastery-oriented individuals, but only when these information are high-quality.

Poortvliet et al. (2009) bring additional noteworthy information to this finding by testing whether the influence of achievement goals on cooperation intentions with others could also depend on individuals' current ranking (i.e., whether they rank among the best, average, or worst performers); in this study, after completion of the WSE task, participants were given a (bogus) ranking that was said to be developed on the basis of a top-100 resulting from earlier responses given by previous participants, informing them that they were occupying either the 96th (i.e., low), the 51th (i.e., intermediate), or the 4th (i.e., high) position. They were additionally told that they would be given the opportunity to exchange task-related information with another participant who was ranked just after them (i.e, either the 97th, 52th, or 5th position) before proposing a final individual solution to the WSE task. They then read the achievement goal manipulation (performance-approach goal versus mastery-approach goal instructions) and finally filled questionnaires designed to measure their cooperation intentions with the other participant, as well as their reciprocity orientation (i.e., if I send useful information to the other, s/he will send me useful information back). Results highlight that, while for participants in the mastery-approach goal condition the reported cooperation intention linearly decreased as ranking information was high, participants in the performance-approach condition reported lower cooperation intentions both when ranking was low and high, as compared to intermediate. The same pattern was found for the reciprocity orientation variable.

This finding is consistent with the view that competition is especially salient when one is very close from being either the best or the worst achiever (see Garcia, Tor, & Gonzalez, 2006). In such situations, manipulated here through the reception of either a low- or high-position feedback, the pursuit of performance-approach goals entailed a lower willingness to exchange information and cooperate with coactors, who might indeed be represented as threats and competitors rather than informational supports. Conversely, participants who were primed with mastery-approach instructions and received a low ranking feedback indicated high intentions to cooperate, suggesting a perception of coactors as potential helps and sources of information rather than adversaries.

Another noteworthy finding stemmed from the research reported by Toma and Butera (2009), which demonstrated that a competition manipulation (which put the emphasis on performance-approach goal pursuit) occurring before the completion of a group decision making task led to more strategic withholding of important and useful information than a cooperative manipulation, which in turn led to lower group decision quality. Interestingly, Experiment 2 showed that this effect of competition on strategic information sharing was mediated by mistrust toward other group members, as measured through items such as "were you suspicious about other group members?"—a result confirming that when in a competitive mindset, the fear of being exploited by others motivated participants to protectively keep crucial information for themselves, at the risk of compromising optimal task completion.

Put together, these findings depict cooperation as antagonistic to normative strivings—a conclusion in accordance with the existence of negative interdependence in competitive settings (Deutsch, 1949, 1962); indeed, the pursuit of performance-approach goals makes it salient that the goal of performing better than others will be reached only if others precisely fail to do so. Given that cooperation and information sharing could provide others with decisive information susceptible to make them superior, performance-approach goals thus lead to cautious behaviors and tend to favor strategic information sharing.

Regulation of socio-cognitive conflict

Inter-individual differences in points of view and knowledge can result in disagreement between students when working together on a task or exercise resolution, a situation that has been labeled socio-cognitive conflict (Buchs, Butera, Mugny, & Darnon, 2004; Doise & Mugny, 1984)—the "cognitive" component referring to the task content and solution accuracy which is called into question during the disagreement, while the "social" component refers to the confrontation between individuals. Because socio-cognitive conflict is likely to favor reflection and re-assessment of one's point of view through consideration of the coactor's diverging opinion, an abundant literature has underlined its positive potential on learning (Doise & Mugny, 1984; Doise, Mugny, & Pérez, 1998). However, disagreement with others, which involves doubts regarding one's own understanding of the problem, entails a certain degree of uncertainty that individuals might be motivated to reduce. In particular, researchers have identified two different conflict regulation strategies, as individuals can either choose to go back to the problem's content and reconsider their answer—a strategy which is focused on the task and referred to as "epistemic regulation"—or try to protect their own perceived competence through proving that their answer is accurate and the others' is not—a strategy focused on competence demonstration and referred to as "relational regulation" (Butera, Darnon, & Mugny, 2010; Doise & Mugny, 1984; Mugny, De Paolis, & Carugati, 1984).

While the former regulation strategy appears to occur in non-competitive contexts (Butera & Mugny, 2001; Johnson, Johnson, & Smith, 2000), the latter regulation strategy rather stems from competitive and evaluative situations that put the emphasis on social comparison and the importance to appear more competent than others (Butera & Mugny, 1995; Johnson, Johnson, & Tjosvold, 2000; Quiamzade & Mugny, 2009), and has notably been associated with less progress and learning (Doise & Mugny, 1984); this interestingly suggests that a preference for relational (rather than epistemic) conflict regulation could lead performance-approach goal-oriented individuals to lose the benefits of socio-cognitive conflict on acquisition of knowledge and task progress when facing disagreement with one (or more) coactor(s).

Direct evidence for this contention has been found by Darnon, Muller, Schrager, Pannuzzo, and Butera (2006), who demonstrated that while mastery-approach goal endorsement predicted epistemic conflict regulation, the pursuit of performance-approach goals was associated with relational conflict regulation. In a first experiment, introductory psychology students were first asked to answer a questionnaire dealing with a Social Psychology experiment studied in class a few months before, and were then asked to report their achievement goals using the Elliot and McGregor's (2001) scale (three items respectively measured performance-approach and mastery-approach goals). The next step of the study then required participants to imagine a debate with another student who would be proposing a diverging interpretation of the experiment they had been questioned about in the first questionnaire. They were asked to imagine what the interaction would look like, and to later report which conflict regulation strategy they would opt for. Results demonstrated that the more participants had reported pursuing performance-approach goals, the more they chose a relational conflict regulation; conversely, the more they had reported endorsing mastery-approach goals, the more they opted for an epistemic conflict regulation. A second experiment replicated this finding with both the implementation of a real conflicting situation and the use of a different (purposefully more subtle) measure of conflict regulation strategy, which asked participants to report their perceived self-competence ("how much do you think you understood the text well?") as well as to rate their coactor's competence ("how much do you think your partner understood the text well?"). As was expected, the more participants reported pursuing performance-approach goals, the higher they rated their own competence, illustrating the desire to assert one's abilities (i.e., relational conflict regulation); conversely, the pursuit of mastery-approach goals was positively associated with their partner's competences' rating—denoting that mastery-oriented participants were more prone to recognize the coactor's point of view and abilities (i.e., epistemic conflict regulation).

As far as relational conflict regulation is concerned, Sommet, Darnon, Mugny, Quiamzade, Pulfrey, Dompnier and Butera (2014) proposed a further distinction between on the one hand competitive relational regulation (motivated by the wish to assert one's competence and validate one's opinion as more accurate than that of the coactor) and, on the other hand, protective relational regulation (triggered by the wish to protect one's competence by complying to the other's opinion, in an attempt to avoid failure during direct confrontation). In particular, they claimed that while the former strategy should be predicted by performance-approach goal adoption, the latter strategy might rather stem from the endorsement of performance-avoidance goals. Their results confirmed this hypothesis, and underlined that the pursuit of normative strivings triggers a concern with validation of one's accuracy and superiority through the disconfirmation of the coactor's proposition during direct confrontation—a competitive approach leading individuals to give no credit to the rivals' points of view. A different tendency emerged with performance-avoidance goals, which rather motivated individuals to comply with the other's opinions.

Taken as a whole, these findings underline the detrimental consequence of performance-approach goals on socio-cognitive conflict regulation, in particular because performance-approach goals focus individuals on competence and appearance concerns rather than on task content and knowledge construction. Darnon, Butera and Harackiewicz (2007) have explored which consequences this pattern carries for task learning. In particular, they argued that the beneficial impact of a coactor's disagreement on learning—that should be apparent under mastery-approach goal pursuit—could be jeopardized under performance-approach goal pursuit. Participants were asked to work on a common text in cooperation with a coactor—an interaction that was presented as "computer-mediated"—and were informed they would individually perform a Multiple Choice test dealing with the text understanding at the end of the experiment. Moreover, achievement goals were previously manipulated through explicit instructions: while participants in the mastery-approach goal condition were asked to try to "acquire new knowledge that could be useful to [them], to understand correctly the experiments and the ideas developed in the text, and to discover new concepts (…)", instructions from the performance-approach goal condition asked participants to try to "perform, to be good, to get a good grade on the Multiple Choice Test, to prove [their] abilities, and to show [their] competencies

(…)"; additionally, a control condition, with no specific goal instructions, was included. Participants then read the text and started interacting with the (actually bogus) coactor about the text; the coactor's pre-recorded answers entailed either agreement or disagreement. At this point, participants had the opportunity to return to the text and write a reply to their partner if they wished. Six items measured participants' perceived uncertainty (e.g., "my partner's answer made me think that I had not understood the text well"). Finally, participants completed a Multiple Choice Test designed to assess the text understanding through complex questions requiring knowledge transfer. The same test was submitted to participants 1-2 weeks later; because both scores were strongly correlated, they were aggregated and labeled as the "learning" variable.

The analyses confirmed that while learning did not differ as a function of achievement goal conditions in the case of interactions with an agreeing partner, in the case of disagreement, participants from the mastery-approach goal conditions obtained a significant higher learning score as compared to those from both the performance-approach goal and the no-goal conditions. Moreover, self-reported uncertainty was higher in the case of a disagreeing (as compared to agreeing) partner, which led participants to more often return to the text and reply to the partner; however, those returns to the text proved to enhance learning only in the mastery-approach goal condition—a result that the authors interpreted in the light of work dealing with conflict regulation strategies. Indeed, while returns to the text might have been used as a way to ensure and reinforce one's understanding of the text meaning—i.e., epistemic regulation of conflict—in the case of mastery-approach goal pursuit, it might have been rather used as a way to check that one is right (and the coactor is wrong) in the case of performance-approach goal pursuit—i.e., relational conflict regulation—, a pattern that is consistent with the aforementioned findings from Darnon et al. (2006) and would prove to be disadvantageous for learning. This result thus interestingly confirms that being outcome-focused can jeopardize the beneficial consequences of socio-cognitive conflict on learning as acknowledged by Doise and Mugny (1984). Finally, another noteworthy finding which stems from this research concerns the pattern obtained for the no-goal (i.e. control) condition, which replicated the one obtained for the performance-approach goal condition, a result that the authors interpreted as extra evidence that normative comparisons constitute the "dominant norm in a university context" (p. 68), which performance-approach goal instructions simply reinforced.

1.4. Performance-approach goals and academic achievement

What about performance-approach goals and academic performance? Is there evidence that being committed to pursue normative performance and trying to appear talented to others actually favor scholastic success? A conspicuous amount of studies have explored this issue, and investigated whether the adoption of performance-approach goals is positively related to academic achievement and exam success. In particular, a close look at the literature investigating this relationship reveals that it has preferentially been tested in real-life educational settings, through the use of longitudinal designs, basically connecting students' self-reported achievement goal endorsement (collected during the academic semester) with their final exam grades. Thus, for example, Harackiewicz, Durik, Barron, Linnenbrink and Tauer (2008), in an attempt to investigate the achievement goals-performance relationship among college students, set up a longitudinal study taking place within the context of an introductory course of psychology; as a first step, three weeks after the beginning of the semester, participants were asked to fill a questionnaire designed to measure their goal endorsement for psychology courses (all items were rated on a 7-point scale). In particular, performance-approach goals were assessed via normative items such as "It is important for me to do well compared to others in this class". Then, upon completion of the semester, the authors were given access to students' final grade; they additionally collected these students' grades seven semesters after the completion of this introductory course. Regression analyses revealed that students' self-reported endorsement of performance-approach goals positively predicted both first semester grades as well as grades obtained at a later stage of their academic training.

What emerges from the achievement goal literature consistently echoes this result. Indeed, performance-approach goal adoption, as measured through students' self-reports, has most often been found to be positively associated with academic performance (Barron & Harackiewicz, 2003; Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Elliot & McGregor, 1999, 2001; Elliot et al., 1999; Harackiewicz, Barron, Tauer, & Elliot, 2002; Harackiewicz, Durik, Barron, Linnenbrink, and Tauer, 2008; for reviews, see Elliot, 2005; Senko, Hulleman, & Harackiewicz, 2011). Notably, the robustness of this relationship has been corroborated by its replication among various student populations and courses, since it has been found among college students (Church, Elliot, & Gable, 2001; Elliot & Church, 1997; Elliot et al., 1999; Elliot & McGregor, 2001; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000) but also middle school students (Skeelvik, 1997; Wolters, Yu, & Pintrich, 1996), in large introductory courses (Elliot & Church, 1997; Pekrun, Elliot, & Maier, 2009) as well as more advanced seminars (Barron & Harackiewick, 2003; Darnon et al., 2009). Also important to note, the positive impact of performance-approach goal endorsement has also been replicated with various final exam types, ranging from evaluations based on multiple-choice exams (Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Harackiewicz, Barron, & Elliot, 1998; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000), to evaluations based on more demanding essay writing, presentations, and project implementations (Barron & Harackiewicz, 2003; Barron, Schwab, & Harackiewicz, 1999; Darnon et al., 2009)—an important observation which confirms that performance-approach goals' positive effect on grades and academic performance is not limited to tests that assess surface learning and rote memorization, and also extend to more complex tasks that require deep level of understanding, processing and integration of the course content.

1.5. Concluding comments

In reviewing research from the literature studying the positive versus negative nature of performance-approach goals, Elliot and Moller (2003) started by acknowledging the existence of a long-lasting "disagreement among achievement goal theorists regarding the beneficial or inimical nature of performance-approach goals" (p. 339). Indeed, this debate that is still ongoing (see Harackiewicz, Barron, et al., 2002; Senko et al., 2011) is constantly fueled by opposing findings stemming from performance-approach goal research—depicting a complex profile that we believe is made salient through the empirical findings we have reviewed so far.

Performance-approach goals, whose endorsement is implicitly valued by institutional practices, entail a strong focus on outcomes and normative performance, seemingly to the detriment of a deep exploration of the task or activity: indeed, normative strivings have been often found to entail surface learning (a pattern that however remains unclear and that will be discussed again later), avoidance of challenging tasks so as to avoid appearing incompetent, and cheating behaviors. Performance-approach goals might thus foster behaviors that appear in contradiction with the learning process, by putting more emphasis on competence demonstration than on long-term knowledge acquisition and growth.

As far as social interactions with peers are concerned, research consistently associates performance-approach goals with maladaptive outcomes, a result which comes as no surprise since these goals "entail striving against others", a "form of striving [that] may cause direct relational difficulties" (Elliot & Moller, 2003, p. 345) and are, notably, poorly valued in terms of social desirability. Indeed, being performance-focused leads individuals to perceive others as threats, avoid help seeking when facing difficulties, favor self-serving information exchange as well as relational conflict regulation in the face of a disagreeing partner. Interestingly, when discussing the impact of achievement goals on help giving and information sharing, Poortvliet and Darnon (2013) suggested that performance-approach goals—contrary to mastery-approach goals which focus students on themselves, through striving for self-improvement—entail a focus "on others, by aiming for interpersonal superiority", which might lead to less "constructive social effects in terms of help-giving" (p. 16). These lines notably suggest that pursuing performance-approach goals necessarily directs a part of individuals' attention toward social comparison information—an attention allocation which is not necessarily adaptive since others' performance is a highly unpredictable and uncontrollable factor, and that is most likely to foster a perception of others as threats while at the same time compromising the positive potential of cooperation with others on learning. Support for this contention emerges from research investigating the social and cognitive consequences resulting from a confrontation between two competent peers, a situation that has been shown to activate threatening social comparison processes based on the belief that only one answer can be correct—thus implying that one's competence reaffirmation requires the other's error (negative interdependence of competences). It has been shown that such a context leads individuals to deny the other's high level of competence, even if they have been provided with a feedback ostensibly stating that both share an equally high level of competences (Butera & Mugny, 2001; Quiamzade & Mugny, 2009)—a protective strategy used to reduce the identity threat stemming from the possibility of being outperformed.

However, and despite these maladaptive patterns, performance-approach goals have regularly been associated with academic success and exam performance—which highlights the paradox mentioned above: while these goals favor the implementation of maladaptive behaviors, notably in contradiction with the learning process, they do however not alter students' exam performance, and even appear to enhance it—a striking pattern that still fuels the debate of whether performance-approach goals should be encouraged or not in educational settings (see Harackiewicz, Barron, Pintrich, et al., 2002; Midgley, Kaplan, & Middleton, 2001).

2. Evaluative contexts and performance

We have previously discussed why the selection processes which are in place in the realm of university life might focus most students on the strive for academic performance in order to get the highest grade possible, rise above others, and distance themselves from their peers in the teachers' eyes—which corresponds to the adoption of performance-approach goals. Importantly, we have also argued that such a strive for academic excellence can put a tremendous pressure on students' shoulders—as success in academic curricula is commonly associated with success in life and access to high-profile jobs, and carries important consequences for the individual's self-esteem. While we have so far focused on literature assessing the academic consequences of performance-approach goals, we will now review another part of the literature that, interestingly for our contention, has examined the cognitive consequences of evaluative pressure on performance. We indeed claim that this recent work that has extensively investigated the cognitive mechanisms at play when individuals perform under high pressure might provide a fresh approach on the issue of performance-approach goal consequences on task focus and performance.

2.1. When striving for excellence is counter-productive: The "choking under pressure" phenomenon

Can the execution of well-proceduralized skills be prone to be undermined by a high-pressure context, that is, an evaluative context that puts the emphasis on high stakes and on the importance to perform at a high level? In other words, can circumstances under which excellence matters the most ironically hamper the chance to perform at one's best?

2.1.1. Impact of pressure on action-based skills: First evidence of the phenomenon

First evidence of performance fragility under pressure has been demonstrated by Baumeister (1984), who conducted a set of experimental studies testing how various pressure sources modify attentional resources allocation toward a motor task execution. Participants were asked to perform a "roll-up" game requiring fine motor skills and hand dexterity, as well as visual-motor coordination. Following a training set, pressure to perform at a high level was manipulated either by leading participants to perform the task under the scrutiny of a confederate who had ostensibly performed better (versus lower) at the same task (Experiment 4) or by promising a financial reward for each trial achieved above a given (and noticeably high) criterion (Experiment 5). Results indicated that performance was lowered in those high-pressure conditions as compared to the control ones; importantly, a similar performance impairment was observed under increased self-awareness conditions, that is, under conditions designed to focus participants' attention on their own gestures and internal processes during performance ("please be aware of your hands while performing the task"). Baumeister thus concluded that high-pressure contexts, by raising the individual's desire to excel at the task, increased self-consciousness as an attempt to assert control over its correct execution and ensure success, a process that proved to be counter-productive for sensorimotor processes; this explanation has consequently been labeled the *explicit monitoring theory*.

Hence, it seems that such an attempt to exert explicit monitoring over task execution ironically jeopardizes performance for skill-focused tasks. Why? The explicit monitoring theory bases its reasoning on the proceduralization principle, according to which the optimal execution of automatic or over-practiced (i.e., automatized) motor tasks do not necessitate the engagement of much attentional resources and mainly run outside of conscious awareness (Logan, 1988; Schiffrin & Schneider, 1977; Singer, 2002)—a characteristic that allows experts to keep most of their attentional resources for high-level, controlled task processes such as action planning and adaptation to the actual environment, and leads them to excellence. When proceduralized, skills that are composed of small and independent unit sequences are actually integrated into one single unit or chunk, thereby rendering its implementation more fluent and almost automatic. According to Masters (1992), pressure dramatically increases self-awareness and attention devoted to gestures execution, which breaks the sequence automatization and triggers a "de-automatization" (defined by Deikman (1969, p. 31) as the "undoing of automatization presumably by reinvesting actions and percepts with attention") of the sequence, resulting in impaired performance.

While these first investigations of pressure's impact on performance were notably focused on motor activities, other research has followed that aimed at investigating whether a similar impairment could be observed under academic testing situations.

2.1.2. Academic testing situations and the distraction hypothesis

Could the explicit monitoring theories be similarly transferable to a high-pressure situation involving the completion of an intellectual task instead of a motor one? In the previous section, we have reviewed literature showing that the deleterious impact of high-pressure contexts on motor performance is attributable to the explicit monitoring of proceduralized, controlled skills that usually do not require much attention in order to be effectively implemented. How about the execution of complex, higher-order cognition such as mathematical problem solving or fluid reasoning?

Performing complex or novel cognitive tasks necessitates the intervention of working memory, referring to a dynamic memory system which Miyake and Shah (1999) have defined as "those mechanisms or processes that are involved in the control, regulation, and active maintenance of task-relevant information in the service of complex cognition" (p. 450). This definition underlines that beyond their direct role in task execution—through allowing the temporary and active storage of a limited amount of task-relevant information—, working memory resources are also in charge of preventing distractive and task-irrelevant material from entering consciousness (Baddeley & Hitch, 1974; Cowan, 2001; Engle, 2001).

While working memory has given rise to diverse conceptualizations (for a review, see Miyake & Shah, 1999), researchers investigating the impact of situational constraints on cognitive performance most often rely on the multi-component system developed by Baddeley & Hitch (1974) and later revised by Baddeley (1986, 2000); considered as one of the most influential models, it proposes to differentiate a main component—labeled the central executive and responsible for crucial activities such as knowledge retrieval from long-term memory, selective and divided attention, updating, and task switching—, from two peripheral and independent systems respectively in charge of the verbal and the visuo-spatial material processing. It is also important to mention that one of the working memory's most crucial features lies in its limited capacity (Norman & Bobrow, 1975), which constrains the amount of information that can be simultaneously processed, and results in a decline of efficiency and performance if the demands of the situation exceed the individual's cognitive resources capacity (Navon, 1984). Importantly, this cognitive limit varies among individuals, and is strongly predictive of achievement on a wide range of complex cognitive activities such as learning, reasoning, as well as academic success (Alloway & Alloway, 2009; Engle, 2002; Hambrick & Engle, 2003).

Returning to the choking under pressure phenomenon, Beilock, Holt, Kulp and Carr (2004) have tested the hypothesis that a high-pressure context should consume part of the individual's working memory resources, by generating "anxiety-induced worries that decrease task-relevant processing resources" (Beilock et al., 2004, p. 586), leading to a decrease in task performance. This *distraction hypothesis* hence claims that pressure should constrain individuals to allocate their limited working memory resources both to the task solving and to the management of the high-stake situation and its associated outcome worries. In order to test this hypothesis, Beilock et al. (2004) asked participants to solve a series of arithmetic problems under either a low- or a high-pressure situation. They chose Gauss's modular arithmetic task, described to be "advantageous as a laboratory task because it is unusual and hence its learning history can be controlled", while at the same time remaining "similar to the kinds of math problems encountered in the real world" (Beilock et al., 2004, p. 586). Basically, this cognitive task requires participant to judge the validity of problems such as $72 \equiv 39 \pmod{4}$, which appear individually on the computer screen. Solving such problems necessitates two mental steps: first, participants have to subtract the second number from the first, before dividing the intermediary result by the mod number. If the final result is a whole number, the statement is true; if the final result is a decimal number, the statement is false. Participants have to mentally solve each problem and give their answer (true vs. false) through pressing two different keys on the computer keyboard. Crucially, Beilock and colleagues varied the complexity of problems, in order to contrast the effects of pressure for low-demand problems (soliciting only limited resources to be efficiently solved) and high-demand problems (requiring higher working memory resources). This manipulation allowed them to directly test the distraction hypothesis, which implies that a divided-attention situation should harm performance only for the most resource-demanding problem solving.

Following completion of a baseline block of problems, half of participants read the high-pressure scenario, which mentioned three different sources of pressure, namely (a) monetary rewards (participants were told they would receive 5$ if they succeeded in improving their previous performance by 20 per cent), (b) peer pressure (they were told that for this upcoming block solving, they would work in pair with another participant and both would have to improve their performance by 20 percent to gain the reward; they were moreover informed that the other participant with whom they had been paired had already completed the block and successfully improved as required), and (c) social evaluation (participants were told they would be videotaped while performing the task so that math teachers and professors could examine their performance). This scenario was not given to participants in the low-pressure group, who were simply asked to perform another set of problems similar to the baseline block.

The distraction hypothesis posits that pressure should tax a significant part of working memory resources, which should be detrimental specifically for the solving of tasks heavily relying on working memory; indeed, given the limited capacity of the working memory system (Norman & Bobrow, 1975), a divided-attention situation should jeopardize high-demand (but not low-demand) task solving. Results confirmed this hypothesis: indeed, as compared to the non-pressure condition, the pressure scenario led to a decrease in performance for high-demand problems, but not for low-demand (that is, easy) problems, thus validating the distraction hypothesis. Furthermore, Beilock and colleagues (2004) demonstrated in a follow-up experiment that the deleterious impact of pressure on high-demand problem solving was alleviated if these problems had previously been practiced 50 times—which lowered the demand placed on the working memory system through automatizing these items' solving; hence, because the primary task suddenly necessitated only little resource mobilization, the divided-attention situation induced by the evaluative pressure did not exceed participants' limited resources capacity and still allowed them to optimally perform on mathematical problems solving.

This research by Beilock et al. (2004) represents first evidence of the choking under pressure phenomenon on a cognitive task, by demonstrating that a high-pressure context can impair cognitive performance by activating concerns related to the situation and its consequences. DeCaro, Rotar, Kendra and Beilock (2010) sought to further investigate these first findings and proposed to test that pressure to perform at one's best should specifically consume verbal resources, through generating a phonological inner language focused on concerns and worries about the situation. To illustrate this hypothesis, let us briefly imagine a student who is taking a high-stake exam that is particularly decisive for his future; because various sources of pressure (e.g., the desire to perform optimally, to rise above the other students, to please his/her parents, to impress the professors, to secure a high-profile job, and so on) might be at play, this student might be prone to uncontrollably activate—during the exam completion—outcome-related thoughts reflecting worries about the situation and its consequences (e.g., "this test is really important…", "I really have to succeed…"), or doubts regarding his current performance and competence (e.g., "Am I competent enough to succeed?", "I should work faster…"). Because such concerns take the form a verbal inner speech, this activation would specifically deplete the limited verbal resources of working memory—referred to as the phonological loop in Baddeley's (1986, 2003) multicomponent model of working memory—and consequently interfere with a task that heavily solicits the same limited resources, since both pressure management and task solving would draw on the same reservoir.

To test this hypothesis, DeCaro and colleagues asked participants to solve the same modular arithmetic task as used by Beilock et al. (2004), but varied the solicitation of verbal resources in the task, through manipulating the problems' design. In order to do this, they relied on previous work from Beilock, Rydell, & McConnell (2007), which had demonstrated that the solving of modular arithmetic problems that were presented horizontally relied more heavily on the verbal component of working memory than problems that were presented vertically (see Figure 1). More specifically, vertically-designed problems allow individuals to mentally simulate their solving as if operations were set on paper: hence, more demands are placed on the visuo-spatial component of working memory, and the need to rely on verbal resources is alleviated as compared to the solving of horizontally-designed problems. It is however important to note that horizontally- and vertically-presented problems do not differ regarding their difficulty: their solving equally relies on executive resources, and only differs regarding the engagement of working memory peripheral systems (verbal and visuo-spatial resources; Trbovich & LeFevre, 2003; Beilock et al., 2007).

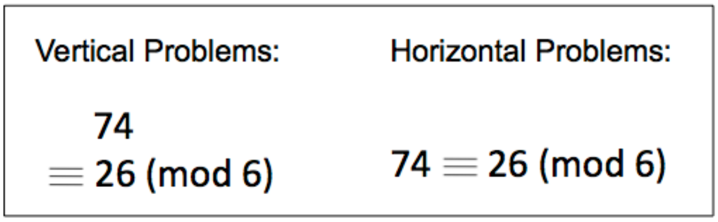

Figure 1.

Examples of vertically-presented and horizontally-presented modular arithmetic problems used in DeCaro et al.'s (2010) experiment.

The study reported by DeCaro et al. (2010) required participants to solve both horizontally- and vertically-presented modular arithmetic problems either under low- or high-pressure condition (instructions were similar to those used by Beilock et al., 2004). The deleterious consequence of evaluative pressure on performance was expected to appear for high-demand horizontally-presented problems (thereby replicating the results obtained by Beilock and colleagues, 2004), but not for high-demand vertically-presented problems; additionally, the authors included a variable designed to alleviate the depletion of verbal working memory resources, through asking half of participants to say out loud each of the mental steps involved in their solving. This manipulation was designed to help participants focus their phonological resources on task solving and quiet the inner speech that was hypothesized to be triggered by the pressure induction. Results confirmed their hypothesis: the negative impact of pressure was indeed replicated in the case of horizontally-designed problems solving, but did not appear on vertically-designed problems solving. Moreover, the "talk-aloud" condition proved to be a good remedy to pressure's negative effects: indeed, contrary to the "no-talk aloud" condition, participants who had been led to verbalize each step of their problem solving did not experience the interfering effect due to the high-pressure manipulation.

Finally, one additional interesting result stemmed from this research. At the very end of the experiment, participants were required to fill in a "thought-listing questionnaire", requiring them to write down everything that they remembered having thought about while they were performing the last set of problems. The reported thoughts were then coded and divided into five different categories. Data analyses showed that participants in the high-pressure condition, as compared to those in the low-pressure condition, reported more worries and concerns about performance (e.g., "I felt nervous because I didn't want to let my partner down by not improving"), as well as more thoughts about the performance situation (e.g., "What I would do with $5"), but also reported less thoughts related to the task solving (e.g., "Subtracting then dividing"), which is consistent with the general hypothesis underlying the Choking Under Pressure phenomenon – namely, that concerns about the performance situation consume a significant part of resources therefore no longer available for task processing. Also worth of note is the result that participants in the "no-talk aloud" condition, as compared to those in the "talk-aloud" condition, reported more general distress-related thoughts (e.g., "Is this over yet?"), as well as more off-task thoughts ("What am I doing this week-end?"); these patterns suggests that participants who verbalized mental calculations did manage to quiet mind wandering and activation of thoughts irrelevant to the experimental setting. Interestingly, thought-listing reports prove here to be an interesting method that provides some precious information regarding participants' thought content during the task solving. Indeed, it nicely completes the pattern obtained on the performance variable, by demonstrating that pressure to perform at one's best lowers considerations about task solving and generates worries regarding performance and its consequences.

2.2. The threatening potential of coaction and social comparison

Evaluative contexts most often entail the presence of coactors (that is, individuals who are simultaneously performing the same task or taking the same test), who thus represent potential sources of social comparison (Baron, Moore, & Sanders, 1978). Experimental research carried out by Muller and Butera (2007; Muller, Atzeni, & Butera, 2004) has aimed to assess whether the direction of social comparison during coaction could generate a threat to social evaluation and thereby impact task processing. More specifically, building on the social facilitation/inhibition effect (Bond & Titus, 1983; Zajonc, 1965, 1980) that highlighted the sometimes inhibiting, sometimes facilitating consequences of the presence of a coactor on performance, they proposed to test whether considerations regarding the coactor's level of competence as compared to one's own level could be at play during coaction and consequently divert attention away from the task at hand. In particular, they hypothesized that the presence of a more competent (i.e., upward comparison situation) or potentially more competent (i.e., mere coaction with no information relative the other's performance) coactor should represent a threat to self-evaluation, hence activating worries and ruminative thoughts about one's self-competence that might consume attentional resources, thereby no longer available for the task. Furthermore, this distraction was hypothesized to trigger an attentional focusing phenomenon (Baron, 1986), as resources reduction should lead the individual to focus more on cues that are central for the task while neglecting peripheral cues—a phenomenon that should not be observed when dealing with a less competent, and thus not threatening, coactor (i.e., downward comparison situation).

In order to test this attentional hypothesis, the authors chose to rely on a target detection task elaborated by Treisman and colleagues (see Treisman & Schmidt, 1982) that basically requires participants to detect a target (a *$* symbol, involving the association of a leaning *S* and a leaning bar—the central cues) among its primitive features (the leaning *S* and the leaning bar), that were individually displayed along with distractors (vertical and horizontal bars, representing peripheral cues). Items containing these stimuli were each displayed for a very brief time—70 ms—on the screen. Half of these items actually contained the target (non-conjunctive items) while half did not (conjunctive items). What usually happens to participants facing this task is a phenomenon called "illusory conjunction", which refers to the tendency to mistakenly put together the two primitive features that constitute the target, and thereby detect the *$* while it is actually absent from the item. The authors reasoned that if coaction indeed has the potential to co-opt attentional resources by compelling the individual to manage both the task and reflections associated to the coactor's presence, then this should trigger an attentional focusing phenomenon, leading the individual to focus his/her available attention on central cues to the detriment of peripheral cues. This attentional focusing effect should consequently reduce the occurrence of illusory conjunctions, as participants should allocate less attention to distractors, that is, peripheral cues, to the benefit of central cues processing.

To test this hypothesis, the authors set up an experimental design that manipulated two between-participant variables, namely the coactor's physical presence and the direction of social comparison (Muller & Butera, 2007, Experiment 1). Hence, participants were asked to complete the target detection task described above either in the physical presence (another participant was completing the same task in the same cubicle) or absence of the coactor; following completion of a first block, participants were then given a (bogus) social comparison information regarding both their own score and the coactor's. In particular, participants received either an ostensibly higher score as compared to the coactor (downward social comparison), either an ostensibly lower score (upward social comparison), or no information regarding social comparison (without social comparison condition). The attentional focusing phenomenon (predicting a lower proportion of illusory conjunction) was hypothesized to occur in the experimental conditions supposed to elicit self-evaluation threat, that is, when participants had to deal either with a more successful coactor—whether or not physically present—(upward social comparison), or with a potentially better off coactor ("without social comparison/coactor present" condition, referring to the mere coaction condition). Results indeed confirmed this hypothesis: following the social comparison feedback, the conjunctive error rate proved to be lower in the aforementioned conditions as compared with conditions in which participants had to deal with a coactor who performed lower (downward social comparison), that is, who did not represent a threat to self-evaluation, and with the control ("without social comparison/coactor absent") condition.

This finding interestingly highlights how work in coaction, carrying with it social comparison information that can be used for self-evaluation (Baron, 1986; Muller et al., 2004; Sanders, Baron, & Moore, 1978), can lead individuals to waste part of their attentional resources managing worries and considerations related to the fear of being outperformed by others. In particular, dealing with allegedly or potentially more competent others threatens self-evaluation, in that it puts into question the individual's own level of competence and activates concerns that will uselessly consume attention. This work thus brings evidence that social comparison information can affect the way individuals allocate their attentional resources during task solving, which in turn has consequences on task processing and performance.

2.3. When confrontations between competent peers become threatening: the conflict of competences

In a previous section, we have explained why disagreement between two coactors driven by performance-approach goal pursuit often leads to the adoption of a relation conflict regulation strategy (i.e., the wish to assert one's point of view as superior to that of the coactor) which in turn proves to be detrimental to task learning. One interesting line of research has further investigated the specific case of confrontation between two competent peers—that is, between individuals displaying (or led to believe that they do) a high degree of competence—and demonstrated that such a context can actually erode task performance, by hindering decentering and integration of information (corresponding to the benefits, in terms of task solving, that should normally result from the interaction with another competent peer; Mugny, Butera, & Falomir, 2001).

In an attempt to explore the mechanisms underlying this phenomenon called *conflict of competences*, Quiamzade and Mugny (2009) carried out a set of studies for which they first induced feelings of high competence (by giving each participant a bogus positive feedback), and then introduced a conflict of competences with an equally successful (bogus) coactor (the source of influence) during an aptitude task. The authors then measured social influence as the tendency to use the coactor's diverging answer to discover the task's accurate solution—which had precisely been elaborated so as to require integration of the source's answer. Results demonstrated that by default, conflict of competences elicited an implicit representation of the task based on negative interdependence of competences, which implies that "each person's competence is based on a need for self-correctness and the other's errors" (p. 653). In other words, divergent opinions were not represented as complementary, and one's accuracy thus necessarily required the other's mistake. This negatively interdependent social comparison context consequently triggered a threatening perception of the coactor—whose equal level of expertise indeed makes eligible to be accurate, and therefore superior to the target. Crucially, the findings confirmed that this threat to the self blocked social influences processes, preventing participants from finding the accurate task solution. Moreover, this detrimental mechanism disappeared in conditions including a decentering procedure, i.e., a manipulation that emphasized situations under which seemingly incompatible diverging answers could be actually complementary, and underlined that taking into account opposing answers could be fruitful.

Also relevant is the finding obtained by Selimbegovic, Quiamzade, Chatard, Mugny and Fluri (2007), who investigated the role played by counterfactual thinking (i.e., backward considerations about what one might have done differently) during conflict of competences, and in particular whether it might erode task performance. A first study demonstrated that conflict of competences led participants to generate more subtracting counterfactual thinking (e.g., what they should have avoided doing in the first two tasks to achieve better performance) than additive counterfactual thinking (e.g., when they should have done in the first two tasks to achieve better performance); it should be noted that the latter is known to be beneficial to performance (Roese, 1994). In a second experiment, in addition to the manipulation of a conflict of competences, the authors manipulated the activation of either additive, subtractive, or no counterfactual thinking, before asking participants to perform a verbal task similar to the one for which the conflict had been induced. Results demonstrated that performance at that final task was lower in both the condition with mere manipulation of conflict of competences and the condition that additionally induced a subtracting counterfactual thinking, as compared to the condition with additive counterfactual thinking. Relying on literature suggesting that additive—more than subtractive—counterfactual thinking may benefit performance by facilitating generation of future-oriented strategies (Roese, 1994), the authors concluded that by default, conflict of competences entailed the activation of ruminative, uncertainty concerns regarding one's correctness, a counter-productive process that did "not induce a performance-improving psychological state" (p. 159).

Taken together, the literature on *conflict of competences* interestingly highlights how social comparison processes triggered by the desire to outperform a threatening (since equally competent but disagreeing) coactor can hinder task processing and search for consensus, as preservation of one's high competence and reputation is at play.

2.4. Concluding comments

This section has proposed to review the literature exploring the cognitive costs of evaluative situations, and has described research showing that contexts where the importance to succeed is made salient, and performance is made visible, can trigger a distractive process reducing resources available for the task, through the activation of concerns related to the desired final outcome (choking under pressure), threatening social comparison information (work in coaction), or the confrontation with an equally highly-competent peer who could turn out to be superior (conflict of competences).

We contend that this literature has the potential to provide a fresh approach on the study of the academic consequences of performance-approach goals, especially by bringing to light the necessity to examine the cognitive mechanisms at play during its pursuit. Indeed, we have already mentioned that pursuing the desire to outperform others and appear talented puts a strong emphasis on the attainment of excellence (importance to get high grades, to rise above others), makes visibility—among the assessment body, but also peers or parents—of the final outcome salient (thus potentially eliciting self-presentation concerns), and additionally gives a significant weight to the others' performance, given that their superiority will endanger one's performance-approach goal attainment.

All of these performance-approach goal-attainment concerns would be very likely to consume resources and divert attention away from the task at hand—an hypothesis that, so far, remains surprisingly untested.

3. Could performance-approach goals impair cognitive performance? Our approach

Two of the lines of research we have reviewed above, namely achievement goals (with a focus on performance-approach goals) and evaluative pressure, have developed into very active and prolific areas, but so far have remained independent from each other. As a brief reminder, we have examined the various outcomes associated with performance-approach goal endorsement, which led us to highlight a paradox: while the pursuit of normative performance has often been associated with maladaptive and potentially deleterious academic outcomes (cheating, use of surface processing, relational conflict regulation, low cooperation intentions, others perceived as threats), performance-approach goals have quite constantly been found to be positive predictors of academic achievement and exam performance (for a review, see Senko et al., 2012). This inconsistency has paved the way to vivid debates regarding whether it is the "maladaptative or politically incorrect" features (Hidi & Harackiewicz, 2000, p. 169) or rather the "positive potential" of this goal (see Harackiewicz, Barron, Pintrich, et al., 2002; see also Elliot & Moller, 2003, for a discussion regarding the benefits and disadvantages of performance-approach goals in academic contexts) that should be emphasized, that is, whether performance-approach goals should be labeled as a positive or rather damaging motivation in academic settings.

Moreover, we have examined another part of the literature that has extensively documented how evaluative pressure compromises attention and performance: under high-stake situations, the pressure to excel, or the danger to be outperformed by a coactor or an equally competent peer, generate distractive concerns and doubts regarding self-evaluation that divert part of working memory resources away from the task (Muller & Butera, 2007; Schmader & Beilock, 2012); hence, when facing a complex task solving, worries about the situation and its consequences ironically jeopardize the individual's chances to optimally perform.

Thus, we propose to build a bridge between these two different research areas, and test whether the endorsement of performance-approach goals is susceptible to generate goal-attainment concerns that would divert part of the individual's attention away from the task to be solved. Why should that be so? Indeed, such an hypothesis lies in contradiction with the conspicuous amount of research that have consistently depicted performance-approach goals as positively related to achievement and academic success (Barron & Harackiewicz, 2003; Darnon, Butera et al., 2009; Elliot & McGregor, 1999, 2001; Elliot et al., 1999; Harackiewicz, Barron, Tauer, & Elliot, 2002; see also Senko et al., 2011, for a review). Furthermore, even recently, Senko et al. (2011)—assessing the criticism suggesting that performance goals may undermine achievement, in particular because they may interfere with task focus—concluded: “This criticism is not supported” (p. 37).

In this third section, we will first briefly review literature that have assessed the consequences of goal pursuit on cognitive processing, in particular the impact of goal endorsement on thought content and goal-related information detection and processing. Then, building on this literature, we will try to disentangle the seemingly contradictions lying between our hypothesis—performance-approach goals may impair performance—and empirical evidence stemming from the majority of the literature on achievement goals, by contrasting long-term settings (e.g., a semester context) with short-term settings (e.g., a complex cognitive task solving). In particular, we will argue that if the pursuit of normative performance indeed entails the activation of performance-approach goal-attainment concerns, then such an activation might have selective consequences on performance depending on the setting in which it takes place—interfering when full task focus is required (the complex cognitive task solving), but potentially adaptive in long-term contexts, where frequent goal activation could favor the implementation of strategic behaviors most appropriately oriented towards performance-approach goal achievement. Then, as a third step, we will detail the reason why we claim that the lack of empirical evidence highlighting a distractive potential of performance-approach goals on performance might be due to the lack of stringent experimental research testing this hypothesis. Finally, we will introduce an overview of the experimental research that will be presented in more detail in the empirical section of this dissertation.

3.1. The consequences of goal pursuit on goal-related information accessibility

3.1.1. Goal pursuit enhances the accessibility of goal-related concepts

Klinger’s (1975, 2009) Current Concerns Theory claims that once set, goals become *current concerns* that will remain active in memory until they are reached or abandoned. This results in an increased sensitivity to material, constructs, or environmental stimuli that are related to these goal concerns. Klinger (1998) found support for this hypothesis using an experimental setting that placed participants in a dichotic listening situation, during which two different speeches (one that was related to participants’ current concerns, the other that was not) were simultaneously displayed in each ear. Interestingly, results showed that participants did pay more attention to the speech that was related to their current concerns than to the irrelevant one. A research by Nikula, Klinger and Larson-Gutman (1993) brought additional information and showed that words related to individuals’ current concerns, as compared to unrelated words, entailed greater arousal—as measured by skin conductance—, suggesting that such goal-related information are “affectively arousing” (Bock & Klinger, 1986, cited by Gollwitzer & Moskowitz, 1996, p. 375).

Such a frequent activation in memory does not come without a cost, as conscious thoughts about the goal necessarily consume attention and cognitive resources; this activation however generally proves to be highly functional, as noted by Förster, Liberman and Higgins (2005, p. 221), since "heightened accessibility of goal-related constructs helps to detect stimuli in the environment that are necessary for efficient goal pursuit and thus contributes to the likelihood of goal achievement". In his work on mindsets, Gollwitzer (1996; Gollwitzer & Moskowitz, 1996) similarly posits that once individuals become committed to a given goal, they will activate relevant cognitive orientations and procedures that will help them to easily detect goal-associated cues in the environment and ultimately support goal attainment.

Förster et al. (2005, Experiment 1) tested this assumption, and asked participants to look through several series of pictures; they assigned half of them the goal to detect a specific combination of two pictures (a picture of glasses followed by a picture of scissors) that would appear only once during the experiment, while the remaining participants were not assigned any specific goal. Participants had to look at four series that each contained 30 pictures, and the critical combination always appeared in the third block. The experimenters measured the accessibility of goal-related constructs on four occasions—following each block completion—through a lexical decision task. To succinctly describe it, this task—which is traditionally presented to participants as a filler task in order to prevent suspicion—implies the presentation of words and non-words that are individually displayed on the screen, and merely requires participants to discriminate words from non-words by pressing two distinct keys on the keyboard. Faster lexical decisions on words that are semantically associated to a given concept—as compared to words that are non-related to it—have been acknowledged to illustrate a greater accessibility of this concept in mind (Dijksterhuis & van Knippenberg, 1999; see also Neely, 1991, for a review). In the present experiment, a number of words were associated to glasses (e.g., read, professor, sun)—that is, the first item of the critical combination—while the remaining words were not.

As was expected, before its detection, faster response latencies on those glasses-related words were found for participants pursuing the goal to detect the glasses-scissors combination; more specifically, greater accessibility of goal-related construct was found on the lexical decision task that followed the second (but not the first) block—showing that the increase in goal accessibility did not emerge immediately after goal setting. Furthermore, and most importantly, once the combination being searched for had been displayed, this accessibility disappeared. Such findings bring confirmation that becoming committed to a goal enhances the detection of stimuli that are associated with its pursuit, a phenomenon that persists until goal is attained; indeed, such a goal-accessibility aims at being functional during goal pursuit but would however uselessly occupy attention once the objective has been reached, and is thus logically inhibited after goal attainment.

3.1.2. Is goal hyper-accessibility always functional? The importance of goal level of construal

The previously reported research notably manipulated a rather concrete goal (i.e., finding a picture combination), thereby entailing a concrete representation of the goal during its pursuit. It should however be noted that while real life settings indeed involve such concrete goal pursuits (e.g., looking for one's car keys that are missing), human life also entails the pursuit of longer-term, superordinate goals whose attainment can be highly important for self-definition (e.g., getting a diploma, or maintaining a good physical condition). These *higher-order goals* are thus inextricably tied with personal, self-defining strivings. Importantly, a higher-order goal can be represented at different levels of abstraction, depending on whether one is momentarily focused on its general purpose, consequences, and meaning (high-level, abstract representation) or rather on the means and concrete features (low-level, concrete representation) of its pursuit. Closely related to this statement is Construal-Level Theory (Liberman & Trope, 2008; Trope & Liberman, 2010), which posits that the different levels of mental construal individuals form of an action, event or goal are closely related to their psychological proximity. In particular, low-level construals focus individuals on the "here and now", while high-level construals allow to project actions in the future (Liberman, Trope, McCrea, & Sherman, 2007); notably, Liberman & Trope (2008) made it salient that the notion of psychological distance can equally refer to various distance dimensions—be it spatial distance, temporal distance, social distance (e.g., self versus other), or hypotheticality. These various dimensions of psychological distance thus reflect "different ways in which objects or events can be removed from the self", and imply that "farther removed objects are construed at a higher (more abstract) level" (p. 1202).

Representations at low- versus high-levels are distinct; moreover, depending on the context, they will have various consequences on behavior and goal progress (see Carver & Scheier, 1998; Liberman, Sagristano, & Trope, 2002; Nussbaum, Trope, & Liberman, 2003). Let us take the example of pursuing the goal of writing a book chapter for a scientific handbook. Adopting a high-level representation of such a long-term goal will focus the individual on considerations associated with the meaning and consequences of one's actions and behaviors (e.g., the desire to appear competent towards peers, the expected impact this chapter might have in the field of concern), while a low-level representation will rather generate reflections about the means and concrete processes that will have to be implemented (e.g., the implementation of a plan, the reflections about which relevant scientific references should be gathered up).

On the one hand, abstract construals have been demonstrated to have the advantage of strengthening stability and consistency of behaviors directed toward its pursuit—especially if its attainment is strongly self-defining and personally important (Carver & Scheier, 1998). Moreover, high-level (as compared with low-level) construals have been shown to trigger higher self-control when facing distractions (Fujita, Trope, Liberman, & Levin-Sagi, 2006). This represents a major benefit, since higher-order goal pursuits generally entail long-term efforts and persistence and often have to overcome barriers and obstacles and to not be conflicting with other goal pursuits; important goals thus have to be shielded from distractions and from (less important) competing goal intentions (Kuhl, 1983, 1984). Hence, returning to our previous example, the scholar who will frequently activate considerations related to the importance of contributing to the field, or have high expectations about the chapter's impact on his/her career, might find it easier to focus his/her efforts and energy at ardently working at the chapter's writing in the long run.

However, it is interesting to note that McVay and Kane (2010)—consistently with Watkins (2008)—claim that because the activation of goal-related thoughts and concerns consumes attention, their admittance into awareness has to be regulated in a top-down manner, "at least in some contexts, so that environmental cues are not unopposed in their influence on thought content" (McVay & Kane, 2010, p. 189). This reasoning is based on the idea that current concerns related to the pursued final end state (i.e., high-level considerations) might disrupt concrete task execution and intense concentration—sometimes labeled *flow*—and thereby jeopardize performance (Leary, Adams, & Tate, 2006). In accordance with this assumption, Vallacher and Wegner's (1989) Action Identification Theory posits that the activation of high-level construal thoughts should not disturb the execution of automatized, non resource-consuming activities such as car driving or handwriting (since such actions only require a slight mobilization of attention to be efficiently implemented), whereas processing at a lower level of construals should be more appropriate when facing complex or novel activities or contexts. Thus, returning to our previous example, when working at the chapter's writing—which indeed represents a complex cognitive task simultaneously requiring information retrieval in long-term memory, coherent organization of concepts, linguistic formulation as well as summarization capabilities—, one should only admit concrete and task-focused thoughts and information into awareness (e.g., "how will I organize the structure of this chapter?"), since considerations regarding the meaning, implications and consequences of the action (e.g., "how will this chapter be welcomed by my peers?") are irrelevant and therefore disruptive for task solving (Vallacher & Wegner, 1987). Consistent with these considerations, research on goal striving has demonstrated the benefits of implementation intentions—i.e., a form of concrete construal intended to specify when, where, and how a goal-directed action should be performed ("If situation *X* is encountered, then I will perform behavior *Y*")—on efficient goal completion and performance (Brandstätter, Lengfelder, & Gollwitzer, 2001; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006), especially when facing complex rather than easy goals, as well as under high cognitive load (Brandstätter et al., 2001), by "automatizing the initiation of a distinct goal-directed response in the presence of a certain critical situation" (ibid., p. 958).

Also worth mentioning, Emmons (1992) additionally suggests that the adoption of a low-level (as compared to a high-level) representation of goals allows to more easily determine to what extent one is really progressing toward goal achievement, since "the more abstract the goal, the less clear it will be as to what outcomes are acceptable as instances of goal attainment" (p. 297). Moreover, the pursuit of low-level, concrete goals provides more frequent feedback indicating regular progress (Emmons & Kaiser, 1996), which has been associated with the experience of positive affects and higher well-being (Bandura & Schunk, 1981; Carver & Scheier, 1990).

3.1.3. Goal pursuit in the face of failure or major obstacles: the case of rumination

What if an important, higher-order goal is not attained or if the individual experiences difficulties or encounters major obstacles to its attainment? The Goal Process Theory of Rumination (Martin & Tesser, 1989) posits that a lack of progress toward meaningful goals is susceptible to trigger ruminative thoughts, which basically result in the automatic hyper-accessibility of information and thoughts related to the goal (Beckmann, 1994; Goschke & Kuhl, 1993; Rothermund, 2003). In particular, the intensity of rumination will be contingent on the importance of the unattained goal, which implies that frustration in attainment of goals that are considered as central to the self might entail major rumination. It is important to note that while ruminative thinking is directed toward goal-attainment and thus aims at facilitating the individual's progress toward the desired end state (Carver, 1996; Martin & Tesser, 2006), it has the potential to trigger constructive as well as deleterious consequences, depending on whether it enables or not the individual to generate concrete solutions in order to overcome difficulties (Wicklund, 1986; Wrosch, Scheier, Miller, Schultz, & Carver, 2003). However, rumination is most of the time depicted as a counter-productive process that entails negative affects and depressive symptoms, while unproductively consuming attentional resources (Brunstein & Gollwitzer, 1996; McIntosh & Martin, 1992). Also worth mentioning are the findings reported by Brandstätter and Schüler (2013) who studied the consequences resulting from the accumulation of setbacks and failure undermining goal progress (a critical phase they labeled *action crisis*). In particular, they demonstrated that such circumstances heightens the salience and cognitive accessibility of goal-related costs and benefits, suggesting that an action crisis leads individuals to start again weighting the pros and cons of goal striving—a deliberative process that normally takes place at a prior stage, namely the pre-decisional phase, of goal setting (Gollwitzer, 1990).

Koole, Smeets, van Knippenberg and Dijksterhuis (1999) provided an interesting empirical confirmation that failure to reach an important higher-order goal can trigger ruminative thinking; in particular, they manipulated situations where participants were provided with a (bogus) failure feedback on an intelligence test, arguing that frustration regarding the higher-order goal of demonstrating intelligence should be threatening for individuals' self-esteem and hence entail ruminative thinking. Thus, in order to measure the accessibility of goal-related thoughts right after the goal frustration, the authors set a lexical decision task, taking place a few minutes after the failure feedback reception. This accessibility task basically required participants to discriminate between words and non-words appearing individually on the screen; crucially, a proportion of words were related to the concept of intelligence (e.g., smart) while the remaining words were neutral (e.g., kind). As was expected, response latencies were significantly shorter for words related to intelligence than for neutral words, a difference that appeared only for participants who had previously received a failure feedback, thereby indicating a higher accessibility of words related to the frustrated goal. This finding is interesting regarding two aspects. First, it demonstrates the question of competence and intelligence as a central, higher-order self-defining goal that is susceptible to trigger worries and rumination if unsatisfying and disappointing information are received. Second, it interestingly brings evidence that important goals that are left unsatisfied will keep on occupying the mind and consume attentional resources even after the triggering event has occurred.

3.2. When could performance-approach goal accessibility be beneficial to goal-attainment?

In the previous section, we have seen that goal pursuit entails higher accessibility of goal-related content, an hyper-accessibility that can prove functional—by heightening detection of cues and stimuli that are related to goal-attainment, and frequently activating related concerns in mind. Let us now return to performance-approach goals. While it seems reasonable to posit that the pursuit of performance-approach goals generates *current concerns* related to the desire to attain normative superiority over the other students (i.e., aiming to outperform others) and to the wish to appear competent (i.e., aiming to demonstrate one's abilities), one can wonder what consequences such concerns carry for individual's cognitive processing, behaviors and, ultimately, performance when facing evaluative contexts. Indeed, evaluative contexts represent the key part of achievement assessment, and thus the best opportunity for performance-approach goal-driven students to reach the goal of attaining normative performance and proving their competences. We have mentioned above why and how goal activation can be functional, but also sometimes disruptive for goal attainment, depending on features such as the specific demands of the situation (i.e., the nature of the task or activity to be performed) as well as the level of construal (low- versus high-level) of goal representation. In the light of these considerations, we contend that activating performance-approach goal-attainment concerns might similarly entail beneficial as well as disruptive consequences depending on the context under which goal pursuit takes place, as well as specificities of the task or activity to be performed, eventually influencing normative goal attainment.

In which aspects and under which circumstances could the frequent activation of performance-approach goal-related concerns be adaptive and functional for goal achievement and actually favor normative performance and success? And why? In this section, we present arguments suggesting that the pursuit of performance-approach goals in an academic context could actually favor the implementation of behaviors and strategies adaptively oriented towards the obtaining of high grades and normative superiority over the other students—which would in turn be beneficial to goal attainment. In particular, since it is performance—more than learning—which is at the heart of performance-approach goal pursuit, its frequent activation in mind should trigger an increase in students' attention toward clues and indications associated with teachers' expectations—hence helping them to focus their work and efforts on contents that are the most valued by the examiners. Moreover, this frequent activation may help students to implement a strategic work and reviews of exams so as to get high grade while avoiding strenuous work. Finally, it might additionally support the implementation of self-control mechanisms. Crucially, such benefits (vigilance, heightened self-control) of performance-approach goal accessibility would be particularly relevant in long-term settings as, for example, the long-term setting of an academic semester.

3.2.1. A heightened vigilance toward teachers' expectations

In the first part of this introduction, we have reviewed research demonstrating the existence of a positive link between performance-approach goal adoption in the classroom and self-reported surface processing of course content (Elliot et al., 1999; Harackiewicz et al., 2000); however, we have also mentioned some research that failed to replicate this pattern (Howell & Watson, 2008; Liem et al., 2008; Wolters, 1998), and/or reported a positive relationship between performance-approach goals and the use of deep processing strategy (Al-Emadi, 2001; Howell & Watson, 2008; Liem et al., 2008).

Senko and colleagues (Senko, Hama, & Belmonte, 2013; Senko et al., 2011; Senko & Miles, 2008) proposed to resolve these inconsistencies and claimed it might prove fruitful to focus not only on *how* students choose to study (the depth of learning measurement, opposing surface to deep processing, that we have detailed above) but also on *what* students choose to study. In particular, they argued that pursuing performance-approach goals might foster a vigilant approach focusing students' attention on the material that is the most likely to be tested in evaluations—since cues (such as teachers' hints regarding the most important material or study guides) might "indicate the topic knowledge and skills that the teacher values and is likely to assess on the exams and assignments" (Senko et al., 2011, p. 40). Indeed, given that the achievement of normative performance, which requires obtaining high grades and performing above others, is dependent on teacher-set criteria, it might prove particularly adaptive for performance to channel one's efforts towards the study of content that is the most susceptible to be evaluated.

Senko et al. (2013) tested this vigilance hypothesis—which they labeled the "learning agenda" hypothesis—in an online survey that asked university students to report their achievement goals (using the achievement goal-questionnaire, revised version, Elliot & Murayama, 2008), their exam preparation strategies (including the measurement of rehearsal—surface learning—and elaboration—deep learning—strategies), as well as their vigilance toward the course topics that were the most important and likely to be assessed in the exams. This last measure had been developed by the authors and included items such as "I tried to figure out what the professor thought was important because it gave me clues about which topics were tested on the exam"; "I tried to prioritize the topics that are most likely to be on the exam, regardless of how interesting I found them"). As was hypothesized, not only performance-approach goal endorsement predicted the use of surface learning strategy, but it also predicted a vigilant approach regarding the teachers' expectations and the most valued material. This latter relationship was not observed when looking at mastery-approach goal endorsement. Thus, this result interestingly highlights how being performance-oriented strategically directs individuals' attention toward clues and hints present in the environment that could serve goal attainment.

The authors had furthermore developed and included a measure assessing study flexibility, that is, the extent to which students reported strategically adapting their studying approach in order to fit the course specific demands (e.g., "my study technique changed from class to class, based on how deeply the teacher wanted us to delve into the course material"). Interestingly, a hierarchical regression analysis showed that while performance-approach goals were not directly related to students' study flexibility, a second step of the model highlighted a positive relationship between self-reported vigilance and study flexibility, indicating that performance-approach goals actually indirectly predicted strategic studying by first sparking a more vigilant attitude.

Is this vigilant approach profitable? In other words, does it benefit performance? Indeed, since such a heightened sensitivity to the most valuable material serves the motivation to rise above others, it should crucially help students to obtain high grades. In a follow-up study, Senko et al. (2013) set up a similar online procedure and additionally collected participants' grades during their final exams. In addition to successfully replicating study 1's findings, their results demonstrated that performance-approach goal adoption positively predicted the obtaining of high grades, and that this relationship was partly mediated by students' vigilance. In particular, the vigilant approach that stemmed from performance-approach goal endorsement enhanced performance, but only for students whose appraisal regarding teachers' most valued topics was correct—thereby pointing to the crucial role of students' clear-sightedness regarding the topics that should be prioritized.

To summarize, even if the learning agenda hypothesis still needs to be further investigated, we contend that such results actually confirm the importance of strategic learning and course processing for students pursuing norm-based goals, and additionally provides a convincing explanation regarding why performance-approach goal adoption in the classroom context often predicts performance. Indeed, allocating attention at detecting the material that is the most valued by teachers—and at trying to guess how teachers want an essay to be written or test questions to be answered, so as to learn to "write and think and speak the way you are taught, the way teachers, parents, and community members believe will lead to future success" (Pope, 2001, p. 15)—has the potential to favor high grades while potentially avoiding rigorous and deep work of the whole course content. As Deutsch (1979) put it, “a reasonable degree of conformity to the values of those who dispense grades appears to be a necessary, though not a sufficient, condition for high-marks” (Deutsch, 1979, p. 393). We believe that since performance-approach goal endorsement is indirectly promoted by institutional practices—especially the selective function of the educational system (see Darnon et al., 2009)—, it is coherent to reason that its pursuit in long-term settings might accurately direct students’ attention toward relevant strategies and cues, to the advantage of its attainment (i.e., the achievement of high grades and ranking).

3.2.2. Greater self-control

The frequent activation of performance-approach goal-related concerns is also likely to facilitate the implementation of self-control (that is, regulatory mechanisms) in the face of opposing action tendencies and low-level distractions. In particular, there is some evidence showing that the activation of a situation’s high-level construals, by making salient its superordinate, central features, and general meaning, leads to stronger self-control than when the individual activates the situation’s low-level (i.e., subordinate, secondary) features. Hence, Fujita et al. (2006, Experiment 3) asked participants to complete a construal level priming, and generate superordinate category labels of word targets, for the high-level condition, versus subordinate exemplars, for the low-level condition. They subsequently asked the participants to rate the extent to which they would be willing to participate in studies that were all described to carry positive high-level benefits (e.g., gain knowledge about one’s health), but being at the same time either costly and painful (for half of the studies—therefore representing a self-control conflict), or completely painless (for the other half—entailing no self-control conflict). As was expected, participants who had been primed to high construal levels reported greater behavioral intentions to engage in activities that would require self-control than those primed with low levels. Additional studies (Fujita et al., 2006) confirmed that when an activity’s high-level benefits were valued, the activation of high-level construals benefited to self-control implementation, and distractions as well as low-level temptations were more likely to be ignored so as to favor the completion of the most meaningful activities.

This result is consistent with the literature studying self-control behaviors as instrumental to the pursuit and successful attainment of goals that have long-term benefits but short-term costs, especially because such strivings might at some point be conflicting with competing tendencies or behavioral impulses that are “at odds with a person’s overarching goals and values” (Emmons, King, & Sheldon, 1993, p. 528). As such, self-control is often depicted as an “important key to success in life” that, when successfully implemented, contribute to “physical health, psychological well-being, longevity, occupation attainment, relationship satisfaction, and several other desirable outcomes” (Schmeichel & Inzlicht, 2013, p. 272). Indeed, it has for instance been identified as essential to delay of gratification (that is, the ability to forego short-term satisfactions so as to effectively pursue more distal rewards), an ability that is commonly associated with positive outcomes such as academic success (Mischel, Shoda & Rodriguez, 1989). Notably, Kuhl's theory of Motivational Maintenance (1985, 1986), in an attempt to account for the mechanisms underlying successful protection of high-level goals from competing action tendencies, has pointed at the role of *motivational control*, described as a strategy leading individuals to reflect upon and focus on the positive outcomes that might stem from the long-term goal pursuit, in order to enhance its desirability and thus favor action tendencies directed toward its completion. Such a strategy appears to be in line with the assumption that resistance to alluring conflicting impulses (e.g., a dieter attending a party surrounded by appealing food) is facilitated by the conscious activation of the higher-order goal's salience and desirability (e.g., focusing on one's improved jogging performance), since "exercising self-control requires acting in line with ones' central, superordinate, and global considerations in the presence of more locally tempting alternatives" (Liberman & Trope, 2008, p. 1205).

In educational settings, students' academic motivation represents a guiding, high-level feature of their scholastic life that, when highly valued, should represent a major concern and frequently occupy their mind, together with more low-level, subordinate concerns that regularly compete for attention and prioritization. In particular, as far as performance-approach goal pursuit is concerned, high-level concerns dealing with the desire to succeed at the exams and outperform peers might sometimes enter in competition with low-level, short-term action tendencies such as going out with friends for a drink or finishing to read an absorbing novel, which represent here distractions from the superordinate goal pursuit. The aforementioned reflections regarding self-control interestingly suggests that when facing such conflicting goals, the salience of high-level features of a superordinate goal in the individual's mental content should lead to its prioritization over subordinate, low-level concerns—thereby favoring its pursuit and completion. This might represent a major benefit, given that shielding important goal strivings from competing (and less important) goal intentions is an essential part of the goal pursuit process (Kuhl & Beckmann, 1994) that helps its attainment.

3.3. When could performance-approach goal accessibility be detrimental to goal-attainment?

After a focus on the benefits that might stem from the frequent activation of performance-approach goal concerns, we now present arguments suggesting that recurrently thinking about one's desire to rise above others and appear competent might also carry important negative consequences for task focus and jeopardize optimal performance. In particular, since grades and social comparison are at the core of performance-approach goal pursuit, goal focus might elicit concerns that are largely irrelevant for the task solving, and heighten stakes perception as well as consequences associated with the desired outcome, thus unproductively diverting attention away from task processing. Crucially, such distractive consequences of performance-approach goal accessibility would be particularly true when facing complex or novel activities.

3.3.1. Performance-approach goals and the distraction hypothesis

In a previous section, we have detailed the deleterious consequences of evaluative pressure on cognitive performance (Beilock et al., 2004), as well as the mechanisms involved in this impairment, namely the distraction hypothesis. Hence, because the individual has to deal both with the task solving and with concerns related to the situation and its potential consequences, cognitive resources—which are limited—are not sufficient anymore to allow the task's full processing and ensure optimal performance. We claim that the distraction hypothesis could similarly apply to situations where students are committed to the pursuit of performance-approach goals, as the strive for normative success and for others' positive judgment regarding one's competence might similarly be prone to create considerations related to chances to attain the desired outcome and its consequences. Importantly, in the case of complex or novel task solving that require full attention, this guiding goal's hyper-accessibility would thus interfere with full focus on the task and impair its processing.

This reasoning is consistent with the assumption of the aforementioned action identification theory (Vallacher & Wegner, 1987) that novel or difficult tasks processing should be optimal under concrete construal (e.g., specific means, intermediate operations) activation, but should, on the contrary, be disrupted if thoughts about higher-order goals invade consciousness (see also Leary et al., 2006). In light of this literature, we contend that considerations associated with performance-approach goal pursuit might have the potential to disturb the smooth continuity of task processing and focus attention away from the immediate task demands of the present context, through leading the individual to dwell on task-irrelevant concerns such as the imagined implications of success and/or failure. To put it in other words, thinking that one has to obtain a high grade and perform better than others so as to appear as a high-achiever might, in the context of an immediate and demanding task solving, ironically jeopardize chances to attain normative performance.

3.3.2. The stakes behind normative strivings

Striving for the attainment of normative performance and positive judgments from teachers and peers carries important implications for self-esteem, for while success can entail positive outcomes such as pride, access to a diploma, and access to an implicitly positive status (i.e., that of high-achiever), failure or underperformance can imply negative consequences for the self, such as shame, regret, or depreciation from others (Dweck & Leggett, 1988). Thinking about the consequences such outcomes might imply will possibly render stakes associated with performance-approach goal-attainment most salient—especially during testing situations, where performance is evaluated and visible. The uncertainty related to chances of achieving a satisfying final outcome could hence carry major distractive costs. A significant part of uncertainty might also be triggered by social comparison processes, which are encouraged and reinforced by the presence of grades, ranking, and selection processes (Covington, 1992; Levine, 1983; Thorndike, 1913). In a previous section, we have presented empirical evidence showing that evaluative contexts involving coaction are threatening for self-evaluation and consume attentional resources—even in the absence of information regarding the coactor's performance, since the coactor could prove to be superior (Muller & Butera, 2007). Importantly, the normative component of performance-approach goal pursuit makes social comparison information crucial, as the successful attainment of performance-approach goals is necessarily dependent on others' performance (i.e., negative inter-dependence with others, Deutsch, 1949). This implies that even if one's own performance proves to be good (for example, getting a 5.5 out of 6 grade), the goal will remain unattained if most of other students get a 6 on the same test. Peers' competence hence represents an important—and notably uncontrollable—feature involved in performance-approach goal pursuit, which is likely to elicit worries and vainly invade awareness during task solving—a reasoning that echoes Brophy's words, stating that "concerns about peer comparisons or competition are likely to distract [students] from a focus on doing what is necessary to get ready for the test" (Brophy, 2005, p. 167).

While these considerations are applicable to the general student population, we suggest that pressure to reach outstanding performance and achieve above peers might be higher for a specific population of students, namely those who are the most used to reach high grades and outperform others. In particular, the aforementioned major concerns that we argue could stem from performance-approach goals might be amplified for high-achieving students, since they additionally need to preserve or improve their favorable status relative to others as well as to satisfy teachers' and parents' high expectations. Research carried out among students attending high-performing high schools indeed confirms that they are fully aware of the pressure to compete and maintain high achievement for college admission (Conner, Pope & Galloway, 2009; Galloway, Conner & Pope, 2013; Pope, 2001) and express concerns related to parents' standard which often implies that "anything but the highest grade is a failure" (Galloway et al., 2013, p. 505). Performance-approach goal pursuit might thus carry higher stakes and thereby trigger even more interfering thoughts for high-performing students.

To sum up, being committed to the pursuit of performance-approach goals might be costly in the sense that its hyper-accessibility is susceptible to activate interfering content associated with normative goal-attainment concerns. It is interesting to note that this hypothesis—the interfering potential of performance-approach goals—has sometimes been suggested in the literature. For example, McGregor and Elliot (2002) proposed the idea that the "instrumental importance of the outcome and the threat appraisals these goals were hypothesized to generate may undermine total engagement in the study process" (p. 385), a reflection that echoes Elliot and Moller's consideration that performance-approach goals "seem to be particularly susceptible to becoming intertwined with disruptive motivational concerns such as self-presentation, self-validation, and self-protection" (Elliot & Moller, 2003, p. 349).

However, this distraction hypothesis has yet to receive empirical support. Assessing this issue through an extensive review of the existing findings, Senko et al. (2011) recently came to the conclusion that, so far, there was a "dearth of evidence for the task distraction hypothesis." (p. 33). While such a conclusion seemingly disconfirm our prediction regarding the potential interfering consequences of performance-approach goal pursuit on task focus and performance, we will now explore the reason why we believe that this hypothesis should however not be discarded and may still require further assessment.

3.4. A dearth of evidence in favor of the distraction hypothesis: Is the issue settled?

Longitudinal research investigating the impact of performance-approach goals on exam performance and academic achievement is abundant and, as mentioned in a previous section, has allowed observing quite consistently that the more students report adopting performance-approach goals in their studies, the higher their grades during final exams (for reviews, see Harackiewicz, Barron, Pintrich, et al., 2002; Murayama & Elliot, 2012; Senko et al., 2011). Relating this result with our aforementioned reasoning regarding the hypothesized beneficial versus detrimental consequences of normative goal hyper-accessibility, we contend that such longitudinal designs present characteristics that allow the implementation of adaptive long-term strategies while at the same time making it difficult, if not impossible, to assess the distraction hypothesis that we suppose to be at play when one strives for excellence. In other words, the positive goal-performance relationship consistently observed in most of the longitudinal studies may reflect the benefits of long-term and strategic goal-directed behaviors, rather than reveal the sheer impact of performance-approach goals on cognitive performance.

Indeed, the time lag occurring between performance-approach goal measurement and final exams potentially paves the way to strategic mechanisms that may prove adaptive—that is, help students to direct their efforts and cognitive resources toward the most valued behaviors or material's study, which would favor the obtaining of high grades while avoiding to spend time on non-valued material (i.e., the learning agenda hypothesis and the "vigilant" approach developed by Senko et al., 2013). Moreover, such a performance-based motivation might also foster unethical and cheating behaviors—a reasoning that is reinforced by existing experimental evidence of this link (Pulfrey & Butera, 2013)—, as well as more superficial learning processes, thus making it possible to ensure high scores for exams, but at the same time jeopardizing long-term knowledge retention and growth.

With these considerations, we however do not aim to suggest that the performance-approach goal-achievement link reported in longitudinal studies is spurious. In particular, we consider important to make a clear distinction between achievement, learning, and cognitive performance—a differentiation that is indeed crucial for the following of our reasoning. In academic settings, tests and exams are meant to assess students' *learning*, that is, the extent to which they have correctly understood, memorized, and integrated the material that has been studied during classes. In this respect, tests represent an essential assessment tool, which is used to determine students' *achievement* through the attribution of grades. Hence, *achievement* symbolically represents the final outcome that assigns a competence-related value to students' exam performance, and thus are "the most widely accepted measure of academic performance" (Harackiewicz, Barron, Pintrich, et al., 2002, p. 642) that most of the aforementioned longitudinal studies carried out in classroom settings have relied on to measure academic achievement.

However, we suggest that final grades do not merely reflect students' *learning*, since—as argued above—the implementation of strategies, such as superficial processing of course content, vigilance, or cheating, might also contribute to the final outcome; in other words, *achievement* would not strictly represent cognitive engagement in course content studying. This last point is essential, since it allows understanding why *achievement* should necessarily be distinguished from *cognitive performance*, this latter term representing the product of cognitive immersion and engagement of cognitive resources in task processing (Kahneman, 1973; Norman & Bobrow, 1975). If we refer to the functioning of the educational system, whether a high-achiever reaches exceptional test performance through deep and effortful studying or through effortless cheating, the institutional setting will anyway consider him a high-achiever—a characteristic that led Covington (2000) to suggest that "achievement per se, even superior performances, may be less important to the larger objectives of schooling than the means by which superior status is achieved" (p. 177).

As argued above, testing the distraction hypothesis necessarily entails the assessment of cognitive performance, which consequently leads us to turn away from methods used in longitudinal settings and from the usual *achievement* measurement. We thus choose to turn towards experimental settings, which should prove more suitable to test the sheer cognitive consequences stemming from performance-approach goal adoption. Indeed, eliminating the time lag occurring between goals and performance measurement should allow eliminating the influence of those adaptive strategies that we suspect to be at play in academic achievement as measured in longitudinal settings. Moreover, as was previously mentioned, evidence for an interfering impact of normative striving is more likely to emerge during novel or complex task solving; importantly, experimental settings additionally present the advantage to allow controlling this feature so as to confront participants with a task difficult enough to be sensitive to an interfering manipulation.

So far, very little experimental studies have investigated the performance-approach goal-achievement link (see Van Yperen, Blaga, & Postmes, in press); moreover a close examination of these experiments points to some shortcomings that prevent from drawing any conclusion on the relationship between these goals and performance. Indeed, while Senko and Harackiewicz (2005) found that a performance-approach goal manipulation led to higher performance at a Boggle puzzle task solving as compared to a mastery-approach goal manipulation, the authors acknowledged that this task was "only moderately complex" (p. 1751) and thus unlikely to suffer from a divided-attention situation. The same issue emerged from findings reported by Senko and Harackiewicz (2002); they used a similarly moderately complex "Nina" puzzle task but found no effect of performance goal manipulation of performance. Elliot, Shell, Henry and Maier (2005) conversely relied on a more complex cognitive task. They reported that both performance-approach goal and mastery-approach goal manipulation led to a higher performance as compared to a performance-avoidance manipulation; however, the absence of any control (no-goal) group makes it difficult to conclude any beneficial or detrimental impact of the manipulated achievement goals.

3.5. Overview of the research

The general aim of the present work is to assess whether the pursuit of performance-approach goals entails goal-attainment concerns that should reveal disruptive for task focus (and ultimately performance).

In the light of the above reflections, we have explored three specific lines of research that aim to test this general hypothesis. The first one (Experiments 1, 2, 3, and 4) will aim to test the interfering potential of performance-approach goal pursuit during completion of a complex cognitive task solving; this line of research will also allow directly testing whether normative strivings can generate outcome concerns that carry distraction and endanger task focus. Then, the second line of research (Experiments 5 and 6) will further explore this distraction, in particular by focusing on inter-individual differences in working memory capacity (i.e., the reservoir of cognitive resources), and test the hypothesis that performance-approach goal endorsement carries more stakes and goal-attainment concerns for individuals who are the most used to perform well academically (i.e., high-working memory capacity individuals), thereby being—ironically—more interfering for those individuals who have more resources to succeed. Finally, the third line of research (Experiment 7), carried out in a natural (that is, classroom) setting, will aim to explore the extent to which students' performance-approach goal endorsement is associated with the implementation of study strategies that are directed toward exam success rather than regular learning.

Building its reasoning on the literature reviewed above, our first line of research challenges findings stemming from longitudinal methods—depicting performance-approach goals as positive predictors of academic success—, and tests the hypothesis that aiming to outperform others in an evaluative context might lead individuals to activate, simultaneously to the task solving, some concerns related to performance and chances to achieve the desired outcome. Being non-relevant for effective task solving, such concerns would consequently consume a significant part of working memory resources in a counter-productive manner, thereby reducing the amount of cognitive resources available for the task at hand and impairing complex cognitive task performance.

Within the context of our first line of research, we have explored two questions. First, we have sought to find evidence for the interfering effect of performance-approach goals on cognitive performance and to explore its underlying mechanisms; more specifically, we have suggested that performance-approach goal pursuit might divide cognitive resources allocation between, on the one hand, the storage, processing, and retrieval of task-related information, and, on the other hand, the activation of task-irrelevant outcome concerns (Hypothesis 1). Experiments 1, 2, and 3 were designed to test this hypothesis. The first experiment aimed to demonstrate performance-approach goals' interfering effect; to that purpose, we manipulated performance-approach goals through implicit priming and assessed whether performance for complex problems was impaired as compared to a control (i.e., no goal) condition. Experiment 2 was then designed to assess which specific category of working memory resources were depleted by performance-approach goal pursuit; more specifically, using a different goal manipulation (i.e., explicit instructions, validated by Darnon, Harackiewicz, Butera, Mugny, & Quiamzade, 2007), we tested that these outcome concerns that we hypothesize to be activated following a normative goal pursuit indeed generate a distractive inner speech drawing specifically on the limited verbal resources of working memory. We then run Experiment 3 in order to further explore the content of such inner speech, so as to find empirical confirmation that performance-approach goals' hyper-accessibility in mind is actually involved in performance impairment; to this purpose, we used Wegner's (1994) theory of thought suppression in order to create conditions that explicitly primed hyper-accessibility of a either neutral or performance-approach goal-related content, and assessed how these different primes impacted performance.

The second part of this first line of research has been designed to test the hypothesis that performance-approach goals might activate high-level goal construal considerations related to the intended end-state, and thereby be represented in an abstract rather than concrete way (Hypothesis 2a); hence, thoughts about high-level characteristics of the goal, because of their non-relevance regarding the task and the various steps implied in its resolution, should distract individuals' attention away from task-related processes, i.e. low-level means directed towards effective task execution (Hypothesis 2b). Experiment 4 was designed to test these two hypotheses; to this purpose, we relied on Construal Level Theory (Liberman & Trope, 2008; Trope & Liberman, 2010) in order to manipulate the degree of abstraction associated with performance-approach goals, and additionally assessed task focus through a thought-listing questionnaire.

Could it be that the pursuit of performance-approach goals generates higher levels of concerns and interference for individuals who are the most used to succeed? Our second line of research investigates this question, by testing whether the activation of interfering thoughts and worries related to performance-approach goal-attainment might vary as a function of inter-individual differences in working memory capacity. In particular, since high-working memory capacity individuals are the most cognitively efficient in complex tasks and thus used to perform well at higher-order cognitive activities and academic work, we reasoned that they might be concerned with the preservation of their "high-achiever" status, more so than their low-working memory capacity counterparts (Hypothesis 3). We tested this hypothesis in two experiments; as for the first line of research, these were carried out in a laboratory setting, so as to assess participants' cognitive performance in the most stringent manner. First, Experiment 5 had been run in order to seek evidence that performance-approach (but not non-normative) goal manipulation may be more detrimental for the performance of high- (as compared to low-) working memory capacity individuals. Then, Experiment 6 was run in order to further explore this result, and in particular to assess the role played by concerns regarding chances to attain performance-approach goals in such a finding. Accordingly, we manipulated the presence vs. absence of a bogus ranking feedback—either average or very high—prior to performance-approach goal manipulation, a manipulation that aimed to generate confidence vs. uncertainty regarding the chance to subsequently get a high score and outperform others. Additionally to performance assessment, we also measured the activation of status-related thoughts in order to further test whether performance-approach goal pursuit could lead high-working memory capacity participants to activate concerns related to their high-status preservation.

Finally, while the first and second lines of research have been carried out in the laboratory, our third line of research proposes to explore the consequences of performance-approach goal pursuit in a real—that is, classroom—setting, with the purpose of testing the assumption that longitudinal field studies allow the emergence of strategic behaviors. As presented above, most of the literature on achievement goals that has so far explored the link between performance-approach goals endorsement and performance has opted for the use of longitudinal methods—by correlating students' self-reported achievement goal endorsement with their final exam performance. Thus, we decided to explore the role of students' strategic studying on exam performance, and in particular to investigate how evaluations and exams schedule impact tactical studying as a function of students' pursuit of performance-approach goals. Hence, we argued that evaluations and assessments, because they are in most cases scheduled ahead either by professors (during the academic year) or authorities (for standardized tests), might give outcome-focused pupils the possibility to concentrate their resources and efforts on pre-evaluation periods rather than to work regularly throughout the academic period. This strategy might then favor a good performance—but what if an evaluation is not planned ahead? Could these performance-oriented students still perform optimally in the case of unanticipated tests, i.e., pop quizzes? We run Experiment 7, which took place in a high school context, in order to answer this question. We first measured students' performance-approach goal endorsement in a course context, and later on manipulated evaluative test announcement (scheduled vs. pop quiz) following normal class lessons. This manipulation allowed us to test whether the positive link between performance-approach goal endorsement and test performance is dependent on test announcement and anticipation—a result that would provide important new insight regarding the characteristics of classroom environment, and could explain why performance-approach goal pursuit is often found to predict good performance and academic success in longitudinal research.

EMPIRICAL PART

CHAPTER 1

Performance-Approach Goals Deplete Working Memory and Impair Cognitive Performance

Performance-Approach Goals Deplete Working Memory and Impair Cognitive Performance

Abstract

Although longitudinal studies have consistently shown the positive impact of performance-approach goals (i.e., the desire to demonstrate one's abilities and outperform others) on academic success, they might allow some strategic behaviors such as cheating and surface studying, leaving open the question of the sheer impact of performance-approach goals on cognitive performance. We argued that the pressure to outperform others might generate outcome concerns and thus deplete working memory resources available for the activity, thereby hindering cognitive performance. Three studies carried out in a laboratory context confirmed this hypothesis. During a demanding cognitive task, performance-approach goal manipulation hampered performance (Experiment 1), by generating distractive concerns that drew on the limited verbal component of working memory (Experiment 2). Moreover, this interference was shown to be specifically due to the activation of performance-approach goal-related thoughts during the task solving (Experiment 3). Together, the present results highlight the distractive consequence of performance-approach goals on cognitive performance, suggesting that cognitive resources allocation are divided between the storage, processing and retrieval of task-relevant information, and the activation of normative goal-attainment concerns.

Keywords : performance-approach goals, working memory, performance, modular arithmetic problems

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Performance-Approach Goals Deplete Working Memory and Impair Cognitive Performance

The desire to succeed at University constitutes an increasingly predominant concern for students, as illustrated by recent findings from the Higher Education Research Institute (American Freshman Survey, 2010) that highlighted a constant rise of students' rating of their own drive to achieve. One may wonder whether this trend is good news, and a potentially beneficial precursor of future performance of students. At first sight, the answer seems to be positive: Within the abundant amount of studies that have examined the link between students' achievement goals—the purpose of achievement activity (Elliot & Sheldon, 1997)—and academic success, most have identified performance-approach goals (i.e., the desire to outperform others and demonstrate one's abilities) as positive predictors of academic success (e.g. Senko, Hulleman, & Harackiewicz, 2011). However, in reviewing the literature, it is striking to notice that this link has mainly been assessed through longitudinal designs, linking achievement goal endorsement during the academic year to final grades (e.g. Barron & Harackiewicz, 2003; Elliot & Murayama, 2008; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997). Noteworthy, the time lag between these two measures potentially paves the way to some strategic mechanisms, such as cheating and surface studying, which have been shown to be associated with performance-approach goals and have the potential to lead to good grades (Elliot, McGregor, & Gable, 1999; Murdock & Anderman, 2006). The present research uses an experimental setting to study for the first time the question of the sheer impact of performance-approach goals on cognitive performance.

Positive and Negative Outcomes of Achievement Goals

In academic contexts, achievement goals are acknowledged as having a notable impact on students' achievement emotions (Pekrun, Elliot, & Maier, 2009) as well as perception of stakes and challenges, thereby affecting the way students work and prepare to exams (Ames, 1992; Dweck, 1986; Nicholls, 1984; for a review, Senko et al., 2011). This literature distinguishes mastery-approach goals (i.e., the desire to enhance one's abilities and competences), that have been shown to yield positive effects on intrinsic motivation, persistence after failure, challenge seeking, as well as deep processing of information (Ames & Archer, 1988; Dweck & Leggett, 1988; Grant & Dweck, 2003; Meece, Blumenfeld, & Hoyle, 1988), from mastery-avoidance goals (i.e., the desire to avoid stagnating in one's abilities and competences), frequently associated with fear of failure (Conroy & Elliot, 2004). A further distinction concerns performance goals, which also differ as a function of their orientation (Elliot, 1997, 1999; Elliot & Church, 1997; Elliot & Harackiewicz, 1996); indeed, performance-avoidance goals, that define the desire to avoid being outperformed by others, are generally associated to low levels of interest, high anxiety, and work disorganization (Elliot & Church, 1997; Wolters, 2004). Conversely, outcomes associated to performance-approach goals are more controversial.

In this section, we discuss the impact of performance-approach goals on various outcomes with the exception of task performance, which constitutes the main focus of the present research and will be addressed in the next two sections. Indeed, while some studies have found positive effects on challenge construal, competence evaluation, self-efficacy and self-esteem (for a review, see Elliot & Moller, 2003), others have linked performance-approach goal adoption to behaviors that can be considered as potentially maladaptive for achievement-related outcomes. Thus, students motivated to demonstrate competence and abilities through exam success tend to be more focused on the outcome and the way to reach a high score than on a deep and complete understanding of the course content (Jagacinski & Nicholls, 1987; Sansone, 1986). Butler's (1992) findings provided strong evidence to this contention: She asked twelve-year-old participants to achieve a drawing task after the induction of either mastery or performance-approach goals. At the end of the experiment, participants were given the opportunity to access information about the task and the outcome. Results revealed that performance-approach goal participants, unlike mastery goal participants, spent more time consulting outcome information (i.e., the way to compute one's own score) than task information (different ways to execute the task).

Additionally, a great deal of empirical evidence pinpointed that performance-approach goal endorsement leads students to perceive others as a threat (Ryan & Pintrich, 1997), to be less inclined to share information with exchange partners (Poortvliet, Janssen, Van Yperen, & Van de Vliert, 2007), and, in disagreement situations, to reject the other's opinion in order to impose one's own point of view (Darnon, Muller, Schrager, Pannuzzo, & Butera, 2006). Finally, performance-approach goals have often been associated to a decline in intrinsic motivation, a preference for easy tasks, low persistence after failure, and an increase of negative affects (Dweck & Leggett, 1988, Grant & Dweck, 2003; Harackiewicz, Manderlink, & Sansone, 1984; Linnenbrink, Ryan, & Pintrich, 1999; Mangels, Butterfield, Lamb, Good & Dweck, 2006; Van Yperen, 2003).

Performance-Approach Goals and Task Performance: Longitudinal Studies

Surprisingly, in view of the aforementioned deleterious consequences, research has consistently shown a positive link between performance-approach goals and academic achievement (Barron & Harackiewicz, 2003; Cury, Elliot, Da Fonseca, & Moller, 2006; Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Elliot & Church, 1997; Elliot & McGregor, 1999, 2001; Harackiewicz et al., 1997; Harackiewicz, Barron, Tauer, & Elliot, 2002; Sideridis, 2005). The peculiarity of this research is that the performance-approach goals-achievement link has been mainly assessed through correlational measures: Goals are measured via self-reported questionnaires – either at the beginning of the term or a few days before sitting the exams - and their relationship with actual exams performance is then examined. We argue that reliance on longitudinal methods based on self-reported goals, although granting the external validity typical of field studies, may hide two important phenomena.

Firstly, recent research has demonstrated that students are fully aware of the social value attached to endorsement of achievement goals, in particular their potential to signal social desirability and social utility (Darnon, Dompnier, Delmas, Pulfrey, & Butera, 2009; Dompnier, Darnon, & Butera, 2009); relevant for the present research, students who strongly endorse performance-approach goals, although perceived as low in likability, are also perceived as highly likely to do well at University. Thus, participants' answers to achievement questionnaires can be influenced by self-presentation concerns.

Secondly, a longstanding line of research has shown that performance-approach goals are often related to surface processing of course content (Elliot et al., 1999; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000) and cheating behaviors (Murdock & Anderman, 2006; Anderman & Danner, 2008; Sage & Kavussanu, 2007; Van Yperen, Hamstra, & van der Klauw, 2011). Such strategies may, especially in longitudinal studies, blur the interpretation of the goal-performance link. Indeed, final academic exams, which constitute the performance measure in most of the longitudinal studies, are usually announced; this may allow some students to strategically plan their preparation. Choosing one of the above-mentioned strategies may prove adaptive, as it might lead to get an optimal grade while avoiding strenuous work.

Performance-Approach Goals and Task Performance: Experimental Studies

In order to address these shortcomings, a few studies have been conducted in experimental settings. Senko and Harackiewicz (2005, Study 2) tested whether performance goal inductions could have a positive effect on cognitive performance, measured with a boggle puzzles task; the results confirmed their hypothesis. However, as the authors acknowledged, the task to be solved was rather easy, and consequently not prone to be weakened by any pressure interference. Using a similar task (Nina puzzles), Senko and Harackiewicz (2002) found no effect of performance goal induction on cognitive performance. Other researches (Barron & Harackiewicz, 2001; Elliot, Shell, Henry, & Maier, 2005) went beyond this limitation through the use of more complex cognitive tasks, involving mathematics calculations or verbal abilities. Elliot et al. (2005) found that both performance-approach and mastery goal inductions led to higher performance than performance-avoidance goal induction. Barron and Harackiewicz (2001) assessed performance both before and after goal manipulation, but none of them affected the final score.

In sum, even if the above results do not allow concluding on the relationship between performance-approach goals and cognitive performance, they provide crucial indications on the important issues to address. First, the importance of manipulating performance-approach goals to avoid social desirability biases in self-set goals. Second, reducing the lag between goal manipulation and assessment of cognitive performance, to avoid the development of alternative strategies to cope with the test. Third, choosing a task that is difficult enough to be affected by an interfering manipulation. Finally, the inclusion of both a baseline performance measure (prior to any goal manipulation), and a no-goal control group appears crucial to reveal any detrimental effect consecutive to the performance-approach goal induction. Hence, we claim that an experimental setting that would successfully address these four critical points should allow a new and crucially important clarification regarding the real cognitive consequences of performance-approach goal endorsement.

When Evaluative Pressure Creates a Dual-Task Situation

Why, then, could it be that performance-approach goals yield a negative impact on cognitive performance? Performance-approach goals refer to normative evaluation, and to the desire to achieve above the others. Interestingly for our contention, a prominent trend of empirical research has highlighted the harmful effects of experimentally induced evaluative pressure on cognitive performance (Baumeister, 1984; Beilock & Carr, 2001; Beilock & Carr, 2005; Beilock, Kulp, Holt, & Carr, 2004; DeCaro, Rotar, Kendra, & Beilock, 2010; Gimmig, Huguet, Caverni, & Cury, 2006). Beilock et al. (2004) used Gauss' modular arithmetic tasks to assess mathematical problem solving under evaluative pressure. Each participant performed both low- and high-demand problems, before and after being confronted with either a low- or high-evaluative pressure manipulation; the latter was based on monetary incentives and social evaluation. Results showed that evaluative pressure impaired performance only for high-demand problems, that is, problems that relied heavily on working memory. Hence, in a high-stake situation, participants failed even though they precisely desired to succeed. This paradoxical outcome revealed the interfering consequences of high expectations on task solving. The hypothesis, supported by the authors and called the *distraction hypothesis*, ascribes such performance impairment to a temporary depletion of working memory resources; indeed, pressure, by creating a dual-task environment, simultaneously asking to control execution of the task and manage performance worries, divides the cognitive resources otherwise devoted solely to primary task performance.

Working memory can be defined as a memory system that is used for both the temporary and active storage of a limited amount of task-relevant information, and the inhibition of distractive and task non-relevant material (Cowan, 2001; Engle, 2001; Miyake & Shah, 1999). One of the most influential models of working memory, proposed by Baddeley and Hitch (1974), and then revised by Baddeley (1986, 2000), conceives of working memory as a multi component system, including an attentional component, the central executive, and two peripheral and independent systems. The central executive is responsible for many crucial activities, such as knowledge retrieval from long-term memory, selective and divided attention, updating, task switching (Baddeley, 1996; Engle, 2002). The two peripheral systems, i.e. the phonological loop and the visuospatial sketchpad, are respectively responsible for the verbal and visuospatial information storage. The limited capacity of working memory (Norman & Bobrow, 1975) consequently leads the individual to a decrease in performance if the activity to be performed solicits more cognitive resources than available. Moreover, in dual-task situations, two different activities will have to share this limited resources in order to be simultaneously performed; if both tasks no longer have the quantity of resources they usually require, their solving will be impaired and performance will consequently decline (Navon, 1984).

Threatening contexts, such as evaluative situations, might place the individual in a situation comparable to a dual-task, where distractive thoughts associated to performance and final outcome would consume cognitive resources thereby no longer available for the task at hand. Studies exploring the stereotype threat phenomenon sustain this hypothesis. Hence, Schmader and Johns (2003) showed that cognitive performance of a stereotyped population (i.e., women regarding maths abilities) was poorer after stereotype activation as compared to conditions that did not activate the threatening stereotype, and that this decrease was mediated by working memory capacity. In particular, relying on Baddeley's (1986) working memory model, Beilock, Rydell and McConnell (2007) argued that stereotype threat manipulations might draw on the limited verbal component of working memory by generating worries that express in a verbal, linguistic mode. The authors drew on the dual-task paradigm assumption to hypothesize that if both task solving and performance concerns management were consuming verbal resources, demands might exceed the amount of available verbal resources, therefore leading to an impairment of the task solving. Hence, these authors varied the design of the to-be-solved arithmetic problems (Trbovich & LeFevre, 2003) in order to manipulate the solicitation of verbal working memory during task solving, and showed that a threatening condition was more harmful for performance when the task heavily relied on the verbal component than when it relied on the visuospatial component. In sum, threatening situations would deplete cognitive resources by activating outcome-related concerns that interfere with task-focus by diverting part of the attention away from the task at hand (see also, Muller & Butera, 2007; Sarason, 1984; Seibert & Ellis, 1991).

Returning to performance-approach goals, we argue that students whose goal is to secure a high score and to distance themselves from the rest of the class might similarly experience outcome-related concerns whose management will consequently consume part of their cognitive resources. This reasoning led us to claim that performance-approach goal manipulation occurring in an experimental setting might turn out to be detrimental for cognitive performance if the task heavily solicits working memory resources.

To date, this contention has never been submitted to a stringent experimental test. Interestingly, even recently, Senko et al. (2011, p. 37)—when assessing the criticism suggesting that performance goals may undermine achievement, in particular because they may interfere with task focus—found no empirical support for this claim and concluded: "This criticism is not supported". However, none of the studies used to reach this conclusion include the four criteria listed in the previous section. Studying the effects of performance-approach goals on cognitive performance in such an experimental laboratory setting might constitute a stringent test of the distraction hypothesis, likely to fuel the above debate.

Hypotheses and Overview

We conducted three studies to test the impact of performance-approach goals on the availability of working memory resources during arithmetic calculation. Our general hypothesis is that the adoption of performance-approach goals might focus a part of the individual's working memory resources on performance-approach goal-related outcome concerns; consequently, the activation of the goal to be reached might shift part of the cognitive resources away from the task at hand. Thus, cognitive resources allocation would be divided between the storage, processing and retrieval of task-relevant information, and the activation of goal-related outcome concerns; this division of attention would be deleterious if the activity to be solved solicits high-demands on working memory. In order to test this hypothesis, we used a laboratory context that provided the aforementioned requirements: We manipulated performance-approach goals, assessed cognitive performance immediately following the goal manipulation, included both a baseline performance measure (prior to any goal manipulation) and a no-goal control group, and choose a task that is difficult enough to be affected by an interfering manipulation, a modular arithmetic task (Beilock et al., 2004; Beilock et al., 2007).

Experiment 1 was designed to test whether indeed activating performance-approach goals could interfere with arithmetic problem solving. Experiment 2 tested the hypothesized process, that is whether this interference was due to the activation of an inner language focused on goal-related concerns, drawing on the limited verbal working memory component. Finally, Experiment 3 tested whether it is specifically the activation of performance-approach goal-related content that drives the interfering effect of performance-approach goals.

Experiment 1

Method

Participants. Forty-eight undergraduate and graduate students enrolled in engineering, medicine, political and social sciences, arts and humanities, law, and business curricula in a French-speaking Swiss University volunteered in the experiment. Four participants were removed from the analyses, one because of misunderstanding of the task instructions, and three because of the very short response times (inferior to 2,500 ms) in their answers, regardless of problem difficulty, suggesting a lack of involvement in the task. The final sample consisted of 44 participants, 27 female and 17 male students, with a mean age of 21.82 (*SD* = 2.27), who were randomly assigned to one of the two experimental conditions (24 and 20 participants in control and performance-approach goal conditions, respectively).

Task and procedure. The task performed by participants was the same used by Beilock et al. (Beilock & Carr, 2005; Beilock et al., 2004). The entire experiment was displayed on a computer. First, written instructions introducing the task informed participants that they would have to judge the validity of horizontally-presented modular arithmetic problems such as 17 $\equiv$ 5 (mod 6). To solve these problems, the participant's task was to subtract the second number from the first (i.e., here, 17-5) and then to divide the obtained result by the last number. If the final result is a whole number, the statement is true; if the final result is a decimal number, the statement is false. Participants were asked to solve problems as quickly and as accurately as possible and, when they had found an answer to the item presented on the screen, to press the corresponding key (V for True and F for False) on the keyboard. They were instructed to respectively rest their right and left index fingers on these two keys during the whole experiment.

After a fixation point of 500 ms, a modular arithmetic problem such as the one described above appeared and remained on the screen until the participant responded. The problem was then removed and a feedback (i.e., the word "Correct" or "Incorrect") was provided for 1,000 ms. The subsequent problems were individually displayed after a 1,000 ms inter-trial break.

All participants performed two blocks of 24 modular arithmetic problems each. In order to vary the problem's difficulty, each block comprised 8 low-demand problems requiring a single-digit no-borrow subtraction operation, such as 7 $\equiv$ 2 (mod 5), 8 problems with intermediate attentional demands requiring a double-digit no-borrow subtraction operation, such as 19 $\equiv$ 12 (mod 7), and 8 high-demand problems requiring a double-digit borrow subtraction operation, such as 51 $\equiv$ 19 (mod 4). More precisely, high-demand problems, which imply larger numbers and borrow subtraction operations, require higher working memory resources, because participants have to both calculate and retain more intermediate results (DeStephano & LeFevre, 2004). Half of the problems within each demand level were true, half were false. Each problem was presented only once; presentation order within each block was randomized.

The first block of problems (phase 1) served as a baseline measure of modular arithmetic performance for each participant. In order to avoid activating any performance- related thought during this first block, it was presented as a training block. Participants were simply asked to solve the problems as quickly and accurately as possible.

After this, participants completed a short task that aimed to activate, or not, performance-approach goals. To eliminate suspicion, it was presented as a filler task designed to rest their mind from mathematic calculations. This task involved twenty-five words that appeared individually either on the inferior or on the superior part of the screen, and were randomly repeated twice. After a fixation point that appeared in the middle of the screen during 500 ms, each word remained during 1,000 ms, and was separated from the following word by a 1,000 ms blank screen. The participants' task was simply to detect the spatial location of the words and to indicate it by pressing two different keys. A pilot study carried out with 10 participants drawn from a separate but comparable sample had previously been conducted, in order to select words most associated to performance-approach goals. In this pilot study, participants were first provided with a definition of performance-approach goals; then, they were asked to judge the extent to which 29 words – that were selected by the experimenter on the basis of the theoretical definition of performance-approach goals – were related to performance-approach goals, on a scale ranging from 1 (*not related at all*) to 7 (*totally related*). We finally retained the 20 words with the highest mean scores, which ranged from 4.8 to 5.8.

Hence, returning to the present experiment, participants in the experimental group had to judge the spatial location of twenty words related to performance-approach goals (e.g., *superiority, success, pride*), plus five filler words that were neutral regarding performance (e.g., *screen, newspaper, language*). For participants in the control condition, words were all neutral regarding performance-approach goals. The full list of words is available from the authors.

After completion of this task, participants were to solve a second block of modular arithmetic problems. Finally, participants were debriefed and thanked.

Dependent variable. In order to examine the influence of performance-approach goal induction on problems performance, we computed a difference score, by subtracting the percentage of accuracy in phase 1 (pre-manipulation) from the percentage of accuracy in phase 2 (post). A positive difference in performance thus refers to an increase in performance from phase 1 to phase 2. Additionally, to make sure that the accuracy results were not the product of a speed–accuracy trade-off, we added the difference in response time (phase 2 – phase 1) as a covariate in all analyses, for the three experiments.

Results

Participants solved low-, intermediate-, and high-demand modular arithmetic problems. We conducted the same analysis for each level of difficulty, as a control, although the hypothesis only concerned high-demand problems. A preliminary 2 (condition: control, performance-approach goals) X 2 (gender) ANCOVA on the accuracy difference score for high-demand problems revealed a significant main effect of gender, $F(1, 39) = 22.80$, $p < .001$, $PRE = .37$, [1] showing that difference in performance was higher for male participants than for female participants. However, as gender did not interact with the experimental manipulation ($F < 1$), this variable was not retained for further analysis. Further preliminary analyses were conducted for both accuracy and response time, with problem answers (true *vs* false) entered as an additional factor. Because no interaction with this variable appeared to be significant across all three experiments, we did not include it for further analysis, in any of the experiments.

A one-way analysis of covariance (ANCOVA) revealed a significant difference between the control and the performance-approach goal induction groups, $F(1, 41) = 4.23$, $p < .05$, $PRE = .09$. As can be seen in Figure 1, means are in the expected direction, as difference in performance was lower for the performance-approach goal group ($M = -8.12$, $SD = 20.39$) than for the control group ($M = 2.08$, $SD = 16.76$). The covariate did not yield any significant effect.

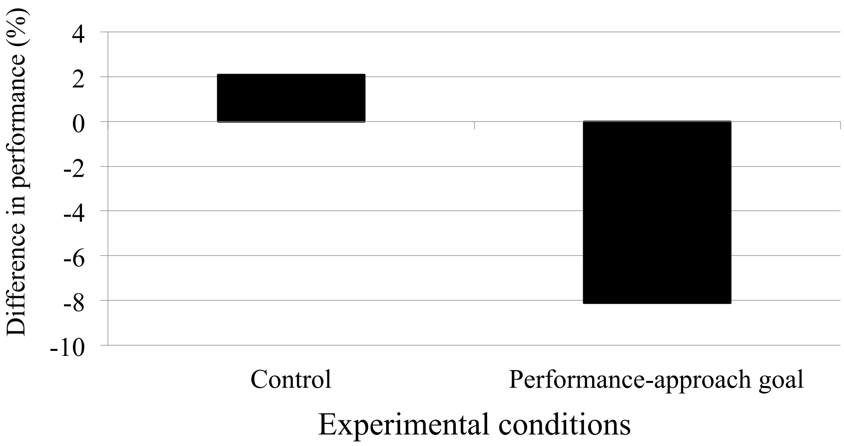

Figure 1.
Experiment 1: Mean difference in performance (%) for high-demand problems, as a function of experimental conditions

Given that solving both intermediate- and low-demand problems only solicits a minor amount of resources (cf. Beilock et al., 2004), no effect of goal manipulation on difference in performance was expected. The same ANCOVA conducted on these items led to non-significant effects (all *Fs* < 1)[2]. Finally, it should be noted that control and performance-approach groups did not differ in terms of pre-manipulation accuracy (*t*s < 1 for low- and intermediate-demand problems; $t(42) = 1.57$, $p = .12$ for high-demand problems).

Discussion

We designed this experiment in order to examine the effect of performance-approach goals on a task whose performance is prone to decrease if a part of attentional resources is consumed by the activation of task-irrelevant thoughts. Individuals had to solve modular arithmetic problems that varied as a function of their demands in working memory. If we focus on results for high-demand problems, the implicit induction of performance-approach goals, through supraliminal presentation of words predominantly associated to performance and success, impaired the practice benefit experienced by the control group between phase 1 and phase 2. Thus, Experiment 1 confirms that the mere activation of performance-approach goals distracts the participants from the arithmetic calculation and therefore leads to a decrease in performance.

Experiment 2

We assumed that the impairment of performance due to performance-approach goals, actually observed in Experiment 1, could be due to a divided-attention situation, where both performance-approach goal manipulation and the task solving would draw on the same resources. More specifically, performance-approach goal induction might deplete verbal working memory resources, by activating verbal outcome concerns; this should specifically interfere with a task that heavily solicits the same limited resources. Hence, in order to test this implication, we varied the solicitation of verbal resources in the task, and manipulated the design of modular arithmetic problems; we based our reasoning on Beilock et al.'s (2007) results, that demonstrated a higher implication of verbal resources when solving horizontally- rather than vertically-presented problems. Indeed, a vertical presentation allows the individual to mentally simulate arithmetic problem solving as if operations were set on paper (see Figure 2), which puts more demands on visuospatial resources and thereby alleviates the need to rely on verbal resources. Importantly, vertical and horizontal problems were assumed to be of equal difficulty, as they require similar executive resources in working memory and they only differs as per the solicitation of working memory peripheral systems (Trbovich & LeFevre, 2003; Beilock et al., 2007). Results by Beilock et al. (2007) provided experimental support to this idea, by asking participants to simultaneously solve horizontally- and vertically-designed problems while maintaining a phonological load in memory (i.e., a verbal secondary task). As a result, while baseline accuracy (without secondary task) did not differ as a function of problem design, the accuracy of horizontal problems was impaired by the dual-task setting, as compared to the accuracy of vertical problems. Hence, this material was retained to test our hypothesis regarding the impairment of verbal working memory after performance-approach goals manipulation. Additionally, to insure that the findings in Experiment 1 were not method-dependent, we used a different performance-approach goal manipulation, through explicit instructions. In sum, we expected a condition by design interaction, whereby a lower difference in performance should appear after performance-approach goal manipulation, as compared to participants in the control group, more so when solving horizontally-, rather than vertically-designed problems.

Method

Participants and design. One hundred and nineteen students volunteered in this experiment. The sample consisted of French-speaking Swiss undergraduate and graduate students enrolled in political and social sciences, arts and humanities, law, and business curricula. Five participants were dropped from the analyses, one because of suspicion about the instructions, three because they spent an extremely short time reading the slide that contained performance-approach goal instructions (less than 5,000 ms), and one because of misunderstanding of the task instructions. Thus, the final sample consisted of 114 students, 76 female and 38 male students, with a mean age of 22.02 (*SD* = 3.88), who were randomly assigned to one of the four experimental conditions (*N*s between 26 and 33 per condition). There were two between-participants variables, namely instruction (performance-approach goal, control), and problem design (horizontal, vertical).

Task and procedure. The procedure was similar to that of Experiment 1: After being introduced to modular arithmetic problem solving through written instructions, participants were asked to solve a first block of problems that was presented as a training block. Then, participants in the control groups were simply informed that they were going to be performing another set of problems, and that their performance would now be recorded. The participants of the experimental conditions were given extra instructions aiming at inducing performance-approach goals; to this effect, we used Darnon, Harackiewicz, Butera, Mugny and Quiamzade's (2007) performance-approach goal intructions, who found in a pilot study that these instructions enhanced the adoption of performance-approach goals as measured with the Elliot and McGregor (2001) questionnaire. They thus read the following instructions, which appeared on the screen:

During the recorded part of the task, the experimenters will assess your performance. It is important for you to be proficient, to perform well and to obtain a high score, in order to demonstrate your competence. You should know that a lot of students will do this task. You are asked to keep in mind that you should try to distinguish yourself positively, that is, to perform better than the majority of students. In other words, what we ask you here is to show your competencies, your abilities.

After this, they had to perform a second block of problems.

We also varied the design of the modular arithmetic problems between participants. Approximately half of the participants had to solve horizontally-presented problems, while the other solved vertically-presented ones (see Figure 2). Each block consisted of 24 problems, dividing into 12 low-demand and 12 high-demand problems. Half of the problems within each demand level were true, half were false. Presentation order within each block was randomized for each participant, and each problem was presented only once across the entire experiment.

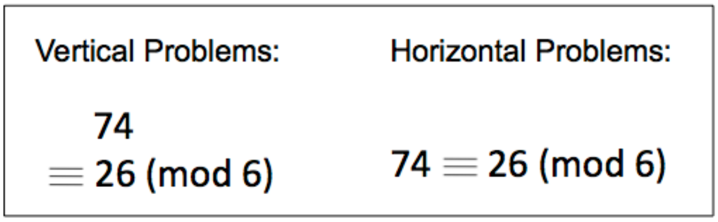

Figure 2.

Examples of vertically-presented and horizontally-presented modular arithmetic problems used in Experiment 2.

After the two blocks, we asked participants to perform a lexical decision task (Koole, Smeets, van Knippenberg, & Dijksterhuis, 1999), which was presented as an unrelated filler task designed to measure the speed of words recognition. This task was actually a manipulation check that aimed to test the efficacy of our goal induction, through the accessibility of words related to performance-approach goals in comparison with filler (neutral) words. Participants were told that letter strings would appear individually in the center of the screen, and were asked to press, as quickly and accurately as possible, the left key if it was a non-word, and the right key if it was a word; 1,000 ms after the key was pressed, the next letter string appeared. In total, 64 items were randomly presented, among which 32 were non-words, and 32 were existing French words; this latter category consisted of 16 words related to performance-approach goals (e.g., *success*), drawn from the set used in Experiment 1, and 16 filler words (e.g., *journal*). Words and non-words were matched for length. Response latencies were recorded, as well as responses; errors (3.6% of the responses, 1.7% for words) were removed from the analysis. Finally, participants were debriefed and thanked.

Results

Manipulation check: Lexical Decision Task. For each participant, both responses (word or non-word) and response times for each item were recorded. In order to reduce skewness in the distribution, response times longer than 1,000 ms were excluded from the analysis (Koole et al., 1999). We submitted the mean response latencies for words related or non-related to performance-approach goals to a 2 (condition: control, performance-approach goal induction) X 2 (word type: performance, neutral) mixed-model ANOVA with repeated measures on the second factor. The analysis revealed the significant interaction between condition and word type that should be expected in case of efficacy of our manipulation, $F(1, 102) = 4.28$, $p < .05$, $PRE = .04$; indeed, words related to performance were identified faster than words non related to performance, more so for participants in the performance-approach goal induction group than for those in the control group. Means are reported in Table 1. Additionally, simple effect analysis revealed that words related to performance were detected faster than neutral words after performance-approach goals manipulation, $F(1, 102) =$

4.12, $p < .05$, $PRE = .04$, while there was no significant difference in control groups, $F < 1$. This result supports the efficacy of our induction, which appeared to activate performance-approach goals in memory.

Table 1.

Experiment 2: Mean Response Latencies on the Lexical Decision Task as a Function of Goal Induction and Type of Words (Standard Deviations in Parentheses).

	Induction	
Type of words	Performance-Approach Goal	Control
Non-related to Performance-Approach Goals	675 (66)	669 (75)
Related to Performance-Approach Goals	661 (66)	674 (86)

Difference in performance. We first conducted a preliminary analysis that included gender as a factor; as neither main nor interaction effects appeared to be significant, this variable was not retained for further analysis.

A 2 (condition: control, performance-approach goal condition) X 2 (design: horizontal, vertical) ANCOVA on the computed difference of performance for high-demand problems revealed a significant main effect of condition, $F(1, 109) = 5.30$, $p < .03$, $PRE = .05$, showing that difference in performance was higher in control conditions than in performance-approach goal conditions. Moreover, the predicted interaction was significant, $F(1, 109) = 4.36$, $p < .04$, $PRE = .04$. As can be seen in Table 2, means are in the expected direction: while our goal manipulation did not affect the solving of vertically-presented problems, when solving horizontally-designed problems a lower difference in performance was observed in participants confronted with the performance-approach goals manipulation, as compared to participants in the control group. The covariate did not yield either main or interaction effects. Simple effects analysis revealed that the effect was significant for the horizontally-designed problems, $F\ (1, 109) = 9.08$, $p < .004$, $PRE = 0.07$, while it was not for vertically-presented problems, $F < 1$. The ANCOVA conducted on low-demand problems led to non-significant effects (all $Fs < 1$). Again, baseline (phase 1) accuracy scores did not differ across experimental conditions ($F < 1$ for high-demand problems, $F(3, 84) = 1.03$, $p = .38$ for low-demand problems). Also, accuracy for high-demand problems in phase 1 did not differ as a function of problems design ($t < 1$).

Table 2.

Experiment 2: Mean Difference in Performance (%) for High-Demand Problems, as a Function of Goal Induction and Problem Design (Standard Deviations in Parentheses).

	Problem design	
Induction	Vertical	Horizontal
Performance-approach Goal	6.55 (16.25)	1.60 (13.13)
Control	6.82 (15.09)	14.20 (15.64)

Discussion

Experiment 2 had two primary goals. First, by using another goal induction (i.e., explicit instructions), we sought to replicate the detrimental effect of performance-approach goal activation that was obtained in Experiment 1. Secondly, in order to unveil the process at the origin of this interference, and in particular its verbal nature, we aimed to demonstrate that the desire to succeed, by activating an inner speech associated to outcome concerns, would specifically impair the processing of a task that heavily draws on verbal working memory resources, as compared to a task for which the verbal requirements have been reduced, and where both task and worries would draw on different resources.

If we focus on horizontally-presented problems, which was the design used in Experiment 1, the detrimental effect of performance-approach goals on high-demand problems was replicated with a different manipulation, that is, explicit instructions emphasizing the final score and the importance of performing better than the other participants. Indeed, this instruction substantially decreased the difference in performance observed in the control group. For participants who solved problems for which the requirement of verbal resources was lower (i.e., vertically-presented problems), this difference was not significant.

Experiment 3

Experiment 3 sought to replicate and extend the previous two studies, by assessing to what extent the verbal interference observed in Experiment 2 is really caused by the activation of performance-approach goals content. The main innovation in the present experiment was the use of thought suppression to manipulate accessibility of performance-approach goal-related thoughts. According to Wegner’s (1994) findings, trying to get rid of a precise thought ironically tends to increase its accessibility. This ironic effect is posited to be caused by a disruption of the monitoring process (a controlled process whose function is to search for distractive thoughts), while the supervision process, that searches for the unwanted thought presence in mental content to point out suppression failure, is automatic and thus not prone to be disrupted by any additional load. This disruption should trigger the hyperaccessibility of the unwanted mental content (see Wenzlaff & Wegner, 2000; Wegner, 2009, for a review).

On the basis of this literature, we used thought suppression instructions to enhance accessibility of either neutral or performance-approach related content. If, as we assume, performance-approach goals' harmful effect on performance is really due to its interfering content, a condition that merely manipulates performance-approach goals, as well as a condition that experimentally generates its hyperaccessibility (through a thought suppression instruction) should be more detrimental to performance than a control condition and a condition that additionally generates accessibility of a performance-neutral topic. In other words, the thought suppression manipulation was designed to reveal that the activation of performance-approach goal-related content is actively responsible for the distractive effect reported in both experiments 1 and 2.

Method

Participants. Participants were 98 students attending a French-speaking Swiss University, enrolled in political and social sciences, law, arts and humanities, and business curricula. Four participants were dropped from the analyses because they spent an extremely short time reading the slide that contained performance-approach goal instructions (less than 5,000 ms). Another participant was removed of the analyses because he had not fully understood the instructions. Finally, five other participants were removed because of their short mean response time (lower than 2,500 ms) whatever the problem difficulty, which was associated to a high rate of errors and suggested a lack of involvement in the task. The final sample consisted of 88 students, 83 female and 5 male students, with a mean age of 24.08 (SD = 4.88); 6 participants did not report their age. All participants were randomly assigned to one of the four experimental conditions (Ns between 20 and 24 per condition).

Procedure. Participants solved two blocks of 24 modular arithmetic problems that were all horizontally-presented. Participants in the control group were simply informed that they were to perform another set of problems, and that their performance would now be recorded. Individuals in the three other conditions were given extra instructions, which aimed at inducing performance-approach goals and were similar to those given in Experiment 2. After these instructions, participants in the performance-approach goal-only condition solved the second set of problems. For the two remaining conditions, extra instructions were given. In the performance-approach goal plus goal hyperaccessibility condition, participants were given the following instruction:

To sum up, your score will be judged by experimenters, and you will get access to it at the end of the experiment. Try to succeed the best you can, and to obtain a high final score. Because you will be given your rank compared to the other participants, try also to outperform others.

It is now time to start and focus on the task. Now that you have read the above information, try to leave it aside. From now and for the duration of the exercise, try not to think that you must obtain a high score. You shall also try to eliminate all thoughts that are associated to your rank compared to the other participants. For example, try not to think about your wish of being better than others. [3]

An identical suppression instruction was given to the fourth group, except that the thoughts to be suppressed were focused on a neutral topic:

In this experiment, we also try to have regard for characteristics of the material we use, in order to ensure that it does not impact problems' readability. The sizes of problems, as well as the brightness of the screen, have been controlled, in order to insure readability. These precautions aimed to set a favorable environment for task solving.

It is now time to start and focus on the task. Now that you have read the above last information, try to leave it aside. From now and for the duration of the exercise, try not to think about graphic characteristics of problems. You shall also try to eliminate all thoughts that are associated to the cast and location of stimuli. For example, try not to focus your attention on the brightness of the screen.

This last condition was established to focus thought suppression on a neutral and performance-irrelevant matter. We chose to focus the neutral thought suppression instruction on screen brightness and graphic characteristics of stimuli in order to obtain an instruction that is neutral regarding performance, but at the same time directly connected to the experiment participants were performing, like the performance-approach goal suppression instruction. Then, all participants solved the second block of problems. Finally, they were debriefed and thanked.

Results

We again assessed the interference due to the manipulations by subtracting phase 2 accuracy from phase 1 accuracy (in %). Then, in order to test our model, we used a linear regression analysis. To predict the difference in performance due to the experimental manipulation, we tested three orthogonal contrasts. The first represents the planned comparison that tests the model; the remaining contrasts are a set of orthogonal contrasts testing the residual variance. The first contrast testing the planned comparison was "1 -1 1 -1", respectively associated with control, performance-approach goal-only, performance-approach goal with neutral topic hyperaccessibility, and performance-approach goal with performance-goal hyperaccessibility conditions. The second and third orthogonal tests (respectively, "1 0 -1 0" and "0 1 0 -1") assessed the residual variance. According to Judd and

McClelland (1989), if the first contrast fits the data, it should yield a significant effect and the orthogonal contrasts should not be significant. Additionally, we entered the centered mean difference of response time (phase 2 – phase 1) for high-demand problems as a control, as well as the interactions between this term and the three contrasts (Yzerbyt, Muller, & Judd, 2004). This linear regression analysis revealed that the first contrast (i.e., the model) was significant, $B = 4.33$, $t(80) = 2.10$, $p < .04$, $PRE = .05$. Conversely, the two other orthogonal contrasts were not significant (respectively, $B = 0.50$; $t < 1$, and $B = -3.30$, $t(80) = -1.17$, $p = .25$). As can be seen in Figure 3, means are in the expected direction: In both performance-approach goal-only ($M = -3.26$, $SD = 21.06$) and performance-approach goal plus goal hyperaccessibility ($M = 3.12$, $SD = 14.39$) conditions, participants experienced a lower difference in performance as compared to participants in both performance-approach goal plus neutral topic accessibility ($M = 8.12$, $SD = 20.79$) and control ($M = 8.93$, $SD = 20.97$) conditions. The covariate did not yield either main or interaction effects. The same analysis conducted on low-demand problems led to non-significant effects. As in the two previous studies, baseline accuracy for low- and high-demand problems did not differ as a function of conditions (Fs < 1).

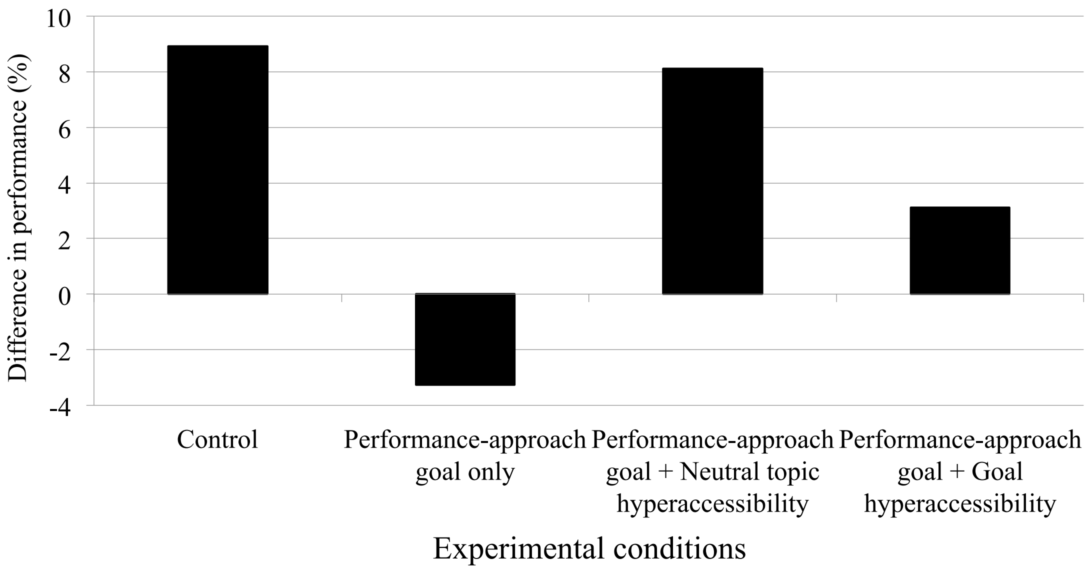

Figure 3.
Experiment 3: Mean difference in performance (%) for high-demand problems, as a function of experimental conditions.

Discussion

The two previous experiments revealed a detrimental effect of performance-approach goal induction; however, even though the Lexical Decision Task included in Experiment 2 brought a first proof of performance-related thought activation throughout the experiment, Experiments 1 and 2 gave no direct evidence that the observed impairment of performance was really due to performance-approach goals' accessibility. Experiment 3 was designed to assess to what extent the activation of goal-related thoughts during the task was indeed responsible for the performance decrease. As expected, the difference in performance between pre- and post-manipulation blocks was higher for both the control group and the condition that asked participants to suppress neutral information in addition to performance-approach goal induction, as compared with both the condition that merely manipulates performance-approach goals and the condition that additionnally asked participants to try to suppress these goals' content during the task. Hence, results confirmed our hypothesis, suggesting that the hyperaccessibility of performance-approach goal-related concerns – that we hypothesized to be triggered by the mere performance-approach goal manipulation, and that we explicitly manipulated in condition 4 through thought-suppression instructions – played a major role in the decrease of performance that we observed in these two conditions.

Thus, the use of a performance-related thought suppression instruction, which was based on Wegner's (2009) rebound effect, appears to be particularly advantageous as it helps clarifying the mechanisms responsible for performance decrement under performance-approach goals instructions. This result adds crucial information to our reasoning, as it suggests that the verbal interference detected in Experiment 2 is caused by intrusive thoughts related to performance accessibility and outcome concerns. Such performance-related thoughts focus part of the limited working memory resources out of the task at hand, thereby decreasing performance on high-demand items.

General Discussion

The present research was conducted to assess whether an assigned performance-approach goal can interfere with mathematical problem solving and impair cognitive performance. Even if frequently associated with some negative outcomes, such as lower information giving to partners (Poortvliet et al., 2007), a decline in intrinsic motivation (Van Yperen, 2003), and others perceived as a threat (Ryan & Pintrich, 1997), longitudinal studies have often reported performance-approach goals to be positive predictors of academic achievement. However, strategic behaviors such as self-presentation concerns (Darnon, Dompnier et al., 2009), cheating (Van Yperen et al., 2011), or surface processing (Harackiewicz et al., 2000), identified as associates of performance-approach goals, might cast some doubts on the causes of the observed relationship; hence, we considered critical to test this question in a laboratory setting, designed to directly compensate these limitations. We relied on the literature that studies the distracting impact of evaluative pressure (Beilock et al., 2004) and threatening contexts (Beilock et al., 2007; Schmader & Johns, 2003) to provide indirect support for our hypotheses that the endorsement of norm-driven performance-approach goals could compel individuals to divide their cognitive resources between outcome concerns and task processing, this divided-attention situation being detrimental to task processing.

Findings from the three studies reported above confirmed our hypothesis, and consistently demonstrated the detrimental impact of performance-approach goal induction on mathematical problem solving. Notably, this effect was replicated with two different categories of induction, as the decrease in performance was observed both after supraliminal words presentation designed to prime performance-approach goals (Experiment 1) and after explicit instructions (Darnon et al., 2007) known to motivate participants to endorse performance-approach goals (Experiment 2 and 3). Moreover, results obtained on the lexical decision task (Experiment 2), designed to test performance-approach goals' accessibility in memory, corroborates the efficacy of the latter manipulation.

As far as process is concerned, this preformance-approach goals interference was found to deplete verbal resources of working memory (Experiment 2); indeed, the deleterious effect consecutive to performance-approach goal manipulation was no longer obtained when problems were vertically-presented, that is, when the verbal demands of problems solving were reduced. This finding is consistent with previous results obtained with stereotype threat (Beilock et al., 2007) and performance pressure (DeCaro et al., 2010) manipulations, therefore corroborating the hypothesis that our goal manipulation consumes phonological resources, which appears to be particularly problematic if the activity one simultaneously performs also relies on the verbal component of working memory. Results observed in Experiment 3 add precious information, by demonstrating, through the use of thought suppression instructions (Wegner, 1994), that this internal language consecutive to our goal manipulation essentially deals with concerns associated with the content of performance-approach goals. Hence, besides confirming the hyperaccessibility of goal-related content during the task solving, Experiment 3 also points out its interfering impact on performance.

The reported detrimental consequence of performance-approach goals on cognitive performance might appear disconcerting, especially in light of previous evidence obtained from a large amount of longitudinal studies (Senko et al., 2011, for a review; see also Darnon, Butera et al., 2009), that observed a positive relation between students' endorsement of performance-approach goals and grades on final exams. However, we argue that such divergent results, far from being contradictory, precisely stem from methodological differences. More specifically, we chose to conduct this research in a laboratory setting to control for variables that we suspected to interfere in longitudinal studies, and that were not prone to intrude into a short-term experimental study.

Firstly, on the basis of previous work pointing out how self-presentation concerns can motivate students to fake their answers to achievement goals questionnaire (Darnon, Dompnier et al., 2009), we opted for an experimental induction of performance-approach goals. Secondly, the modular arithmetic task is "advantageous as a laboratory task" (Beilock et al., 2004, p. 586), as it is unknown to the participants before they are introduced to it at the beginning of the experiment. The importance of this characteristic is worth mentioning for two reasons. On the one hand, it minimizes the influence of a priori knowledge on performance, and on the other hand, it enables to obtain a precise measure of learning, via the practice benefit assessed through the evolution between the first and the second block. Results revealed that, as predicted, endorsing a performance-approach goal, as opposed to a no-goal (i.e., control) condition, did substantially impede the performance improvement consecutive to training.

Thirdly, from a methodological perspective, modular arithmetic problems are known to be difficult enough to be sensitive to a distractive manipulation. This point was of importance as former experimental research that examined the link between manipulated goals and performance used moderately complex tasks (Senko & Harackiewicz, 2002, 2005) whose solving failed to be impacted by any induction. Our results confirmed that as far as high-demand problems were concerned, their processing was hindered by the performance-approach goal manipulation. Fourthly, the presence of a control group in all of our studies adds valuable information, as it enables us to draw conclusions concerning the deleterious impact of performance-approach goals on performance. Indeed, one important aim of the present studies was to prevent the use of cheating or surface processing that might act as potential facilitators of performance. Once again, the modular arithmetic task turned out to be particularly suitable, as previous research (Beilock & DeCaro, 2007) has identified the use of shortcut solving strategies that hinder accuracy. In the present research, allowing that each problem only appeared once, and that the experimental setting left no time to prepare for the test, cheating was highly unlikely to occur.

This work contributes to research on motivation, to the extent that it helps to clarify the contradiction between performance-approach goals' positive impact on achievement and some "disruptive motivational concerns" (Elliot & Moller, 2003, p. 349) associated with its endorsement; indeed, it highlights the specific situations under which these goals exert a negative influence on performance. To our knowledge, the findings presented in this research constitute the first experimental evidence of the distractive consequences of performance-approach goals. This research thus depicts performance-approach goals as a potential interfering factor for task-focus, a finding that revives the debate closed by Senko et al. (2011, p. 33) who concluded to a "dearth of evidence for the task distraction hypothesis". Noticeably, the present finding emerged from a stringent laboratory test, in which we have tried to address some shortcomings that we believe could have interfered, in previous research, with the test of this specific hypothesis. Hence, we hope that the analysis that led to this test may encourage achievement goal research to reconsider, and test, the sheer effects of performance-approach goals on a wide range of cognitive and behavioral outcomes.

Moreover, our results also represent an important extension of the literature that studies how evaluative pressure impairs performance – and in particular that on the "choking under pressure" effect (Beilock et al., 2004), – by emphasizing how the manipulation of goals that motivate participants to outperform others has the potential to generate distractive outcome concerns simultaneous to task solving, thereby impairing cognitive performance. We believe that these promising results can encourage cross-fertilization between two very active areas of research– namely, achievement goals and evaluative pressure – that so far have developed independently from one another. For example, it could prove interesting to clarify whether anxiety – which is assumed to play a key role in the choking under pressure effect – is partly involved in the decrease in performance consecutive to performance-approach goal manipulation. While high-pressure situations as those manipulated by Beilock and colleagues put the emphasis on various stressful stakes (monetary incentives, peer pressure, and social evaluation), our performance-approach goal induction merely put the emphasis on the importance to get a high score and to outperform others, but still produced an impairment of cognitive performance.

One limitation of the present work is that it does not provide any assessment of performance-avoidance goals, which could arguably be partly responsible for the detrimental consequences of performance-approach goal manipulation. Indeed, it could be suggested that emphasizing the importance to succeed better than other participants on a new task led some individuals to focus their efforts on avoiding underachievement (performance-avoidance goals), rather than on reaching the highest score (performance-approach goals). Even if such an option cannot be definitely ruled out, it is worth underlining that the performance-approach goal manipulation used in Experiments 2 and 3 (i.e., explicit instructions) had previously been pretested, validated and found to have separate effects from a performance-avoidance goal manipulation (Darnon, Harackiewicz, et al., 2007, pilot study), and that the efficacy of the priming words (Experiment 1) had been assessed in the present research via a Pilot Study.

It is also worth pointing out that the present studies, because they were conducted in a laboratory setting, do not allow extending conclusions to more natural settings, that is, classroom environment. More specifically, precise situations where such a performance decrement might be prone to occur still remain to be studied. For example, spot tests might prove stimulating to examine, as students, in this specific situation, have to face the pressure of being evaluated without having had the possibility to strategically prepare for it. Hence, on the basis of the results reported above, the performance of students who primarily adopt performance-approach goals might suffer from distraction. These speculations allow addressing an important issue, that of the cognitive performance that follows striving for excellence, especially in light of the prominence of selection processes in academic contexts, and given that "in order to succeed in the university system, one has to get better grades than others, which implies the endorsement of performance-approach goals" (Darnon, Dompnier et al. 2009, p. 129). These dynamics might also be relevant for work and organizational settings, where selection processes may shape the form and effects of achievement goals (e.g. Janssen & van Yperen, 2004).

Footnotes

[1] In this manuscript, we report PRE (Proportional Reduction in Error; Judd & McClelland, 1989) instead of the more common eta squared. These two effect size indexes are identical in their calculation and interpretation. The issue with using eta squared is that in mathematical formalization Greek letters are used to refer to population values. Eta squared should thus be the true effect size in the population, which is by definition a value that cannot be known in experimental settings. What is commonly reported in articles are estimates of eta squared in a given sample (what Judd & McClelland, 1989, refer to as PRE).

[2] The modular arithmetic task has been widely used and validated by the research carried out by Beilock and colleagues (Beilock et al., 2004; 2007; Beilock & Carr, 2005); it is today well established that high-demand problems solicit a larger amount of working memory resources than low-demand problems. Thus, we selected Beilock and colleagues' high-demand modular arithmetic problems as a validated measure that suited the needs of the present research. The hypothesis and the analyses only focused on high-demand problems, because this was the measure chosen for the test of our hypothesis. However, since we used the materials kindly provided by Beilock and colleagues, low-demand (and intermediate-demand, for Experiment 1) problems were included. Interested readers can consult the full accuracy data analyses in the supplementary material available online.

[3] One could argue that these instructions appear contradictory and confusing for participants: at first, they read performance-approach goal instructions, and right after, they are asked to leave aside the thoughts related to this goal during task solving. However, these last instructions, far from being incongruous, are rather appropriate because they did not ask participants to *ignore* the previously assigned goal, but rather to *leave it aside,* the rationale being that "*It is now time to start and focus on the task*."

Supplementary material

Experiment 1 Accuracy Data Analysis

We submitted mean accuracy scores to a 2 (condition: control, performance-approach goal induction) X 2 (phase: 1, 2) X 3 (problem demand: low-demand, intermediate-demand, high-demand) mixed-model ANOVA with repeated measures on the second and third factors (see Table S1). This analysis revealed a significant main effect of problems' demand, $F(2, 42) = 29.21$, $p < .001$, showing that accuracy was significantly higher for low- than for high-demand problems. The condition X phase X problem demand interaction appeared to be non-significant, $F(2, 42) = 1.29$, $p = .28$, $PRE = .06$. No other effect reached significance. The same analysis that takes into account only low- and high-demand problems, to allow comparison with the following experiments, i.e., a 2 (condition: control, performance-approach goal induction) X 2 (phase: pre-manipulation, post-manipulation) X 2 (problem demand: low-demand, high-demand) mixed-model ANOVA with repeated measures on the second and third factors also revealed a significant main effect of problems' demand, $F(1, 42) = 59.35$, $p < .001$. The condition X phase X problem demand interaction appeared to be non-significant, $F(1, 42) = 2.48$, $p = .12$, $PRE = .06$. No other effect reached significance.

Table S1.

Experiment 1: Mean Accuracy (in Percentage) as a Function of Experimental Conditions, Phase, and Problem (Standard Deviations in Parentheses).

	Low-demand problems		Intermediate-demand problems		High-demand problems	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Control	97.39 (6.36)	97.92 (4.76)	93.23 (9.01)	93.23 (9.74)	79.17 (16.76)	81.25 (13.79)
Performance-approach Goal	95.62 (6.11)	95.62 (8.38)	95.00 (8.51)	95.00 (7.48)	86.25 (12.10)	78.12 (19.82)

Experiment 2 Accuracy Data Analysis

We submitted mean accuracy scores to a 2 (instructions: control, performance-approach goal induction) X 2 (design: horizontal, vertical) X 2 (problem demand: low-demand, high-demand) X 2 (phase: 1, 2) mixed-model ANOVA with repeated measures on the third and fourth factors (see Table S2). This analysis revealed a significant main effect of phase, $F(1, 110) = 20.80$, $p < .001$, as well as a significant main effect of problem demand, $F(1, 110) = 230.95$, $p < .001$. The phase X difficulty interaction also appeared to be significant, $F(1, 110) = 20.12$, $p < .001$, as well as the phase X problem demand X instructions interaction, $F(1, 110) = 5.65$, $p < .05$. The four-way interaction appeared to be marginally significant, $F(1, 110) = 3.84$, $p = .06$, *PRE* = .04. No other effect reached significance.

Table S2.

Experiment 2: Mean Accuracy (in Percentage) as a Function of Instruction, Problem design, Phase, and Problem (Standard Deviations in Parentheses).

	Low-demand problems		High-demand problems	
	Phase 1	Phase 2	Phase 1	Phase 2
Orientation				
		Control		
Horizontal	95.37 (9.62)	96.29 (5.34)	73.14 (15.21)	87.34 (10.68)
Vertical	98.48 (3.47)	97.47 (3.89)	75.25 (17.11)	82.07 (12.52)
		Performance-approach Goals		
Horizontal	94.55 (11.04)	96.22 (7.28)	77.24 (15.01)	78.84 (18.74)
Vertical	96.43 (6.18)	96.43 (5.29)	74.70 (16.27)	81.25 (12.71)

Experiment 3 Accuracy Data Analysis:

In order to take the phase (1, 2) into account in the linear regression analysis, we used the computed differences in performance (phase 2 – phase 1); additionally, in order to test whether the two computed differences in performance—for both low- and high-demand problems—differed as a function of experimental conditions, we computed a difference score by subtracting the difference in performance for high-demand problems from the difference in performance for low-demand problems (Judd & McClelland, 1989); but see Table S3 for accuracy means. We then conducted a linear regression analysis, where predictors were a set of orthogonal contrasts; results revealed that the first contrast – the one testing the planned comparison corresponding to the hypothesis: "1 -1 1 -1", respectively associated with control, performance-approach goal-only, performance-approach goal with neutral topic hyperaccessibility, and performance-approach goal with performance-goal hyperaccessibility conditions – appeared to be marginally significant, $B = -3.62$, $t(84) = -1.65$, $p = .10$, $PRE = .03$. Conversely, the second and third orthogonal tests (respectively, "1 0 -1 0" and "0 1 0 -1"), designed to assess the residual variance, were not significant (respectively, $B = 0.15$; $t < 1$, and $B = 3.75$, $t(84) = 1.25$, $p = .22$).

Table S3.

Experiment 3: Mean Accuracy (in Percentage) as a Function of Experimental Conditions, Phase, and Problem (Standard Deviations in Parentheses).

	Low-demand problems		High-demand problems	
	Phase 1	Phase 2	Phase 1	Phase 2
Control	95.83 (6.04)	98.81 (3.76)	76.19 (19.33)	85.12 (15.11)
Performance-approach Goal-only	96.74 (7.74)	98.37 (5.72)	82.06 (14.99)	78.80 (19.01)
Performance-approach Goal and Neutral hyperaccessibility	94.37 (8.58)	96.25 (7.14)	78.12 (17.15)	86.25 (18.54)
Performance-approach Goal and Goal hyperaccessibility	97.92 (4.76)	98.43 (5.60)	77.60 (17.70)	80.73 (19.14)

CHAPTER 2

Performance-Approach Goals Turn Cognitive Resources Away from Performing the Task

Performance-Approach Goals Turn Cognitive Resources Away from Performing the Task

Abstract

A longstanding line of research in academic settings has suggested that the endorsement of performance-approach goals – the desire to outperform others – can impair task-related processes (e.g. by favoring surface task processing, or preference for easy tasks), but no research to date has provided experimental evidence of the negative effect of performance-approach goals endorsement on task focus. In this research, we relied on Construal-Level Theory to manipulate the level of abstraction associated to the assigned performance-approach goals; results revealed that being focused on the high-level, abstract (rather than low-level, concrete) aspects of performance-approach goal pursuit had a detrimental effect on complex task performance. Crucially, the proportion of thoughts devoted to task solving – measured through a thought-listing questionnaire – mediated the relationship between the experimental manipulations and task performance. These findings suggest that performance-approach goal endorsement focus individuals on outcome-related (i.e., abstract) thoughts, to the detriment of task-related (i.e., concrete) processes.

Keywords: performance-approach goals, performance, construal level, task focus

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Performance-Approach Goals Turn Cognitive Resources Away from Performing the Task

"High school pressure is everything. And when you go to one of the top high schools in the Chicago suburbs, you'll do anything that you can to put yourself above the other 1200 students." These words – reported in the New York Times (Sharrett, 2012), in a press article focusing on the recent trend of taking drugs for academic advantage – belong to a 17-year-old high school student, and strikingly illustrate how the importance of grades and competition in schools can become haunting and thereby subordinate learning of course content to a means directed towards the higher-order goal of getting the best score and outperforming others.

In academic settings, students whose main concern is to obtain good grades and perform above their counterparts are described as pursuing performance-approach goals. This category of achievement goals – the purpose of achievement activity (Elliot & Sheldon, 1997) – remains an area of lively controversy, as research highlighted both positive and maladaptive consequences to its endorsement (for a review, Elliot & Moller, 2003). In particular, it remains unclear whether performance-approach goal adoption facilitates or inhibits individuals' ability to focus on the task materials. The primary aims of the current research are therefore twofold. First, we aim to show that the endorsement of performance-approach goals, by rising high expectations regarding final performance and ranking – i.e., high-level, superordinate considerations –, distracts part of the attention away from task-focused, i.e., low-level processes, and thus impairs cognitive performance. Second, we aim to obtain direct evidence showing that this detrimental effect is triggered by a decrease in the attention allocated to the task at hand; more specifically, we argue that the activation of performance-goal attainment concerns should ironically hamper its attainment, by diverting part of the individual's resources away from task-relevant materials.

Can Performance-Approach Goals be Detrimental to Task Focus?

In achievement goals research, the desire to outperform others and demonstrate one's abilities has been referred to as performance-approach goals (Elliot & Harackiewicz, 1996). These goals are promoted by selection processes that are prominents in academic contexts (Darnon, Dompnier, Delmas, Pulfrey, & Butera, 2009); however, there is still no consensus regarding whether performance-approach goals should be considered as a positive or rather a damaging motivation in academic settings (Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Midgley, Kaplan, & Middleton). In particular, while some studies have established students' endorsement of performance-approach goals as positively related to exam performance and academic success (for a recent review, see Senko, Hulleman, & Harackiewicz, 2011; see also, Murayama & Elliot, 2012), other studies have also found evidence suggesting that the pursuit of performance-approach goals, which uppermost motivates students to perform better than others, can lead them to give less importance to course content.

As a first set of evidence for the latter phenomenon, some longitudinal studies have documented a link between performance-approach goal pursuit and self-reported surface processing of course content, thereby demonstrating that this goal can promote strategic learning – such as rote memorization – to the detriment of deep and extensive learning strategies (Al-Emadi, 2001; Elliot, McGregor, & Gable, 1999; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Liem, Lau, & Nie, 2008). Second, some studies have also provided evidence that the adoption of performance-approach goals directs individuals towards the choice of easy tasks – i.e., tasks whose solving requires little effort – rather than difficult and challenging tasks (Ames & Archer, 1988; Elliott & Dweck, 1988).

These results support the idea that aiming to outclass others potentially emphasizes the importance of goal-attainment with the least possible effort and task focus, thereby suggesting that performance-approach goals can prove maladaptive regarding task processing and decrease the attention allocated to task materials. Nonetheless, no conclusion can yet be drawn regarding any detrimental consequences of performance-approach goals on task focusing, as no experimental research directly assessed whether its pursuit actually decreases the amount of resources engaged in task solving.

However, interestingly for our contention, some experimental studies have pointed out the detrimental potential of performance-approach goals on cognitive performance. Indeed, Crouzevialle and Butera (2013) relied on the literature that studies the distracting impact of evaluative pressure (Beilock, Kulp, Holt, & Carr, 2004) and threatening contexts (Beilock, Rydell, McConnell, 2007; Muller & Butera, 2007; Schmader & Johns, 2003) to claim that the endorsement of norm-driven performance-approach goals might compel individuals to divide their cognitive resources between goal-attainment concerns and task solving. Given the limited capacity of working memory (Cowan, 2001; Engle, 2001), this divided-attention situation should prove to be problematic during complex task solving.

To test this hypothesis, these authors asked participants to solve complex arithmetic problems either in a no-goal or a performance-approach goal condition. Consistently with the distraction hypothesis, participants who had been motivated to endorse performance-approach goals subsequently performed worse than did their no-goal counterparts. Crucially, this interference was demonstrated to be due to the activation of goal-related thoughts during task solving, which triggered a distractive inner speech that depleted working memory resources (Crouzevialle & Butera, 2013, Experiments 2 and 3). These results constitute a first step confirming the distractive potential of performance-approach goals during task resolution; however, direct evidence showing that being focused on performance-approach goal-attainment concerns takes part of the resources away from task-related processes is still lacking. How could such direct evidence be provided?

A Construal-Level Perspective on Performance-Approach Goals

Construal-Level Theory (Liberman & Trope, 2008; Liberman, Sagristano, & Trope, 2002; Trope & Liberman, 2010) posits that the level of mental construal people form of an action or object is closely associated with its psychological proximity. That is, low-level construals focus individuals on the "here and now", while high-level construals allow to project actions into the future (Liberman, Trope, McCrea, & Sherman, 2007). Accordingly, high-level construals put the emphasis on the general purpose of an action, directing individuals' attention on *why* they engage in this specific behavior, whereas low-level construals focus individuals on the concrete aspects of this action, i.e. on *how* performing it (Liberman et al., 2002). As an example, students who prepare for an exam can consider their work either with a high-level perspective, which will remind them of superordinate goals such as getting a certificate, or with a low-level perspective, which is more likely to put their attention on subordinate plans to adopt regarding the content they have to study. Interestingly for our concern, Vallacher and Wegner (1987) posited concrete levels of construal to be more adaptive than abstract level when confronting novel and difficult tasks; indeed, the former would allow focusing on action details, while the latter would inefficiently occupy attention during task solving.

Relating this framework to performance-approach goals, we propose that performance-approach goal endorsement – because of its emphasis on the importance to reach the highest score and to achieve above others – should by default activate high-level, superordinate considerations regarding *why* one engages in school and academic courses. Because they are not directly useful to cope with the task demands, we assume such abstract considerations to be irrelevant, disruptive and counter-productive for task solving (Vallacher & Wegner, 1987); consequently, they should interfere with task focus and harm performance, by reducing the amount of cognitive resources necessary to successfully solve the focal task. In other words, concerns with performance-approach goals should distract part of the attention away from the immediate demands of the task, and the particular behaviors and means necessary for achieving performance-approach goals (e.g., concrete operations, retrieval of information from long-term memory, etc.).

The above considerations result in two hypotheses. First, the detrimental consequences of performance-approach goals on performance (Crouzevialle & Butera, 2013) could be triggered by the activation of goal-attainment (i.e., high-level) concerns, to the extent that being motivated to outperform others might focus part of the individual's attention on the self-relevance of performance. Hence, if it is true that, by default, performance-approach goals elicit high-level, end-state considerations, then a condition that merely induces performance-approach goals, as well as a condition that induces performance-approach goals and additionally activates high-level goal construal considerations, should be more harmful to cognitive performance than a control, no-goal condition and a condition that induces performance-approach goals and additionally activates low-level goal construal considerations (H1). Indeed, leading participants to think about concrete (i.e., low-level) means directed towards goal attainment should favor task-related processes and reduce the interference generated by outcome focus.

Our second hypothesis directly stems from the previous one, and aims to find direct evidence that the decrease in performance triggered by our manipulations is due to task focus impairment. In particular, if it is true that high-level considerations associated to performance-approach goal attainment distract part of the individual's attention away from the task and from the various steps implied in its resolution, then participants should be less focused on the task to be solved – thereby accounting for performance decrement. We therefore used a thought listing technique in order to assess to what extent participants were focused on the task, and expected participants from the mere performance-approach goal condition and the condition that induces performance-approach goals and additionally activates a high-level goal representation to report less task-related thoughts than participants from the no-goal condition and from a condition that induces performance-approach goals and activates a low-level goal representation. Importantly, reported task-related thoughts are hypothesized to mediate the impact of the experimental manipulation on task performance (H2).

Method

Participants. One hundred and twenty-two participants volunteered in this study. The sample consisted of French-speaking Swiss undergraduate and graduate students enrolled in political and social sciences, arts and humanities, law, and business curricula. Seventeen participants were discarded from the analyses because the answers provided during the goal construal manipulation revealed that they did not take the instructions seriously (see the Procedure and Experimental manipulations section for more details). Additionally, six participants were dropped from the analyses because they spent a very short time reading the slide that contained performance-approach goal instructions (less than 5,000 ms). Lastly, due to various technical problems (one participant wrote the calculations on paper, three participants completed the wrong construal level manipulation, and data from two other participants were accidentally not registered), data from six additional participants were not taken into account in the analyses.

The final sample consisted of 93 participants, 58 female and 35 male students, with a mean age of 22.60 years (*SD* = 4.04), who were randomly assigned to one of the four experimental conditions.

Main Task. Participants had to solve modular arithmetic problems (Beilock et al., 2004). Participants were seated in front of a computer in an individual cubicle, and were informed that they would have to judge the validity of problems such as $17 \equiv 5 \pmod 6$. To that purpose, their job would be to first subtract the second number from the first (i.e., here, 17-5) and then to divide the obtained result by the last number. The statement is true if the final result is a whole number, and false if the final result is a decimal number. Participants were asked to mentally solve problems as quickly and accurately as possible, and to respond by pressing one of two keys on the keyboard. After a 500 ms fixation point, a modular arithmetic problem appeared and remained on the screen until the participant responded. The problem was then removed and a feedback was provided during 1,000 ms. The subsequent problems were individually displayed after a 1,000 ms inter-trial break.

Participants had to perform two blocks of 24 problems each. In order to vary problems' difficulty, each block consisted of 12 low-demand problems, which required a single-digit no-borrow subtraction, such as $7 \equiv 2 \pmod 5$, and 12 high-demand problems, such as $51 \equiv 19 \pmod 4$; because they require a double-digit borrow subtraction operation, high-demand problems solicit high working memory resources, by requiring to both calculate and maintain more intermediate products (DeStephano & LeFevre, 2004).

Procedure and Experimental Manipulations. Participants first familiarized themselves with the task through six problems (3 low- and 3 high-demand problems). Then, they solved the first block of problems (phase 1) that assessed baseline performance for each participant. This block was also presented as a training, in order to avoid activating any performance-related thought during its solving; participants were simply asked to solve the problems as quickly and accurately as possible.

Then, participants in the *control group* (*N* = 25) were informed that they were going to perform another set of problems, and that their performance would now be recorded. Participants in the three other conditions read extra instructions that aimed at inducing performance-approach goals ("*…you should try… to perform better than the majority of students…*"; validated by Darnon, Harackiewicz, Butera, Mugny, & Quiamzade, 2007, pilot study; for full instructions see the supplementary material available online).

Following these instructions, participants in the *performance-approach goal-only condition* (*N* = 23) started solving the second set of problems. For the two remaining conditions, participants additionally completed a construal-level priming manipulation, which aimed to activate either a low-level or a high-level construal of performance-approach goals. Participants assigned to the *low-level goal construal condition* (*N* = 25; performance-approach goals plus "how" condition) were informed that they would have to briefly think over *how* they would try to achieve the best performance when solving the problems in the next block. Below, they were presented with a diagram constituted of five vertically aligned boxes linked to each other by downward arrows (cf. Figure 1S, available online), a procedure validated by Freitas, Gollwitzer and Trope (2004). Participants had to gradually complete four empty boxes, from the top to the bottom. The question "How will you try to achieve the best performance?" was the starting point of the reflection[1]; after having inserted a response in the box immediately below, participants had to repeat this process by thinking over "how" they would achieve their previous response. This process was repeated four times, and was designed to orient participants towards concrete, low-level aspects of the previously induced performance-approach goals, by leading them to plan subordinate means oriented on the goal achievement.

Participants assigned to the *high-level goal construal condition* (N = 20; performance-approach goal plus "why" condition) were informed that they would have to briefly think over *why* they would try to achieve the best performance when solving the problems in the next block. This time, boxes of the diagram were linked to each other by upward arrows (cf. Figure 1S). The initial question "Why will you try to achieve the best performance?" was designed to trigger a reflection focused on the high-level, superordinate aspect of performance-approach goals. Thus, participants first inserted a response to the abovementioned question, and then had to think over "why" they would try to achieve their previous answer; this process was repeated four times[2]. Then, participants from these two conditions solved the second set of problems.

Finally, participants completed a thought-listing questionnaire, asking them to "write down everything that you remember thinking as you were performing the second part (that is, the recorded part) of the task". Participants were then debriefed and thanked.

Dependent Variable. We assessed performance by subtracting the percentage of accuracy in phase 1 (pre-manipulation) from the percentage of accuracy in phase 2 (post-manipulation), as Crouzevialle and Butera (2013) did. A positive difference in performance thus refers to an increase in performance from phase 1 to phase 2.

Mediator. Two judges blind to the experimental conditions coded the thoughts listed by the participants. Thoughts were coded as referring to the task when participants mentioned (a) characteristics of the math problems (e.g. "There were easy and more difficult problems"), (b) mental calculations (e.g. "I had to subtract and then to divide numbers"), or (c) considerations on solving strategies (e.g. "I tried to discover a faster way to find the correct answer"). Inter-rater reliability was assessed using Cohen's Kappa (K = .81). Judges resolved remaining disagreements through discussion. We then computed the proportion of references to the task, by dividing the raw number of thoughts associated to the task by the total number of thoughts, for each participant.

Results

Overview of the Linear Regression Analyses

We first analyzed the impact of our experimental manipulations on performance (*c* path), to test our first hypothesis (cf. Figure 1). In order to test the hypothetical model, we used a linear regression analysis; three orthogonal contrasts aimed to predict the difference in performance due to the experimental manipulation. The first contrast, which tests the planned comparison that corresponds to our hypothesis, was "1 -1 1 -1", respectively associated with the control, performance-approach goal-only, performance-approach goal plus "how" orientation, and performance-approach goal plus "why" orientation conditions. The remaining two orthogonal contrasts (respectively, "1 0 -1 0" and "0 1 0 -1") test the residual variance. According to Judd and McClelland (1989), if the model fits the data, the first contrast should reach significance, and the 2 orthogonal contrasts should not.

Second, to test our second hypothesis, we subsequently assessed the mediational role of the proportion of task-related thoughts on the effect of the experimental conditions on difference in performance (*a*, *b* and *c'* paths). The summary of the results is presented graphically in Figure 2.

Difference in performance

Our hypothesis is only concerned with high-demand problems, as it is today well established that high-demand problems solicit a larger amount of working memory resources than low-demand problems (Beilock et al., 2004; 2007; Beilock & Carr, 2005). Thus, we selected Beilock and colleagues' high-demand modular arithmetic problems as a validated measure that suited the needs of the present research. However, since we used the materials kindly provided by Beilock and colleagues, low-demand problems were included; thus, out of transparency, we conducted the same analysis also with low-demand problems, as a control. Preliminary analyses including gender as a factor revealed neither main nor interaction effects, and this variable was not retained for further analyses.

As far as high-demand problems are concerned, in line with hypothesis 1, the first contrast appeared to be significant, $B = 3.34$, $t(89) = 2.11$, $p < .04$, $PRE = .05$ (*c* path), and the two orthogonal contrasts were not (respectively, $B = 1.17$; $t < 1$, and $B = -2.01$, $t < 1$). As can be seen in Figure 1, means are in the expected direction: both performance-approach goal-only ($M = 1.81$, $SD = 17.22$) and performance-approach goal plus "why" orientation ($M = 5.83$, $SD = 14.07$) conditions led participants to a lower difference in performance as compared to both performance-approach goal plus "how" orientation ($M = 9.33$, $SD = 15.46$) and control ($M = 11.67$, $SD = 13.61$) conditions.

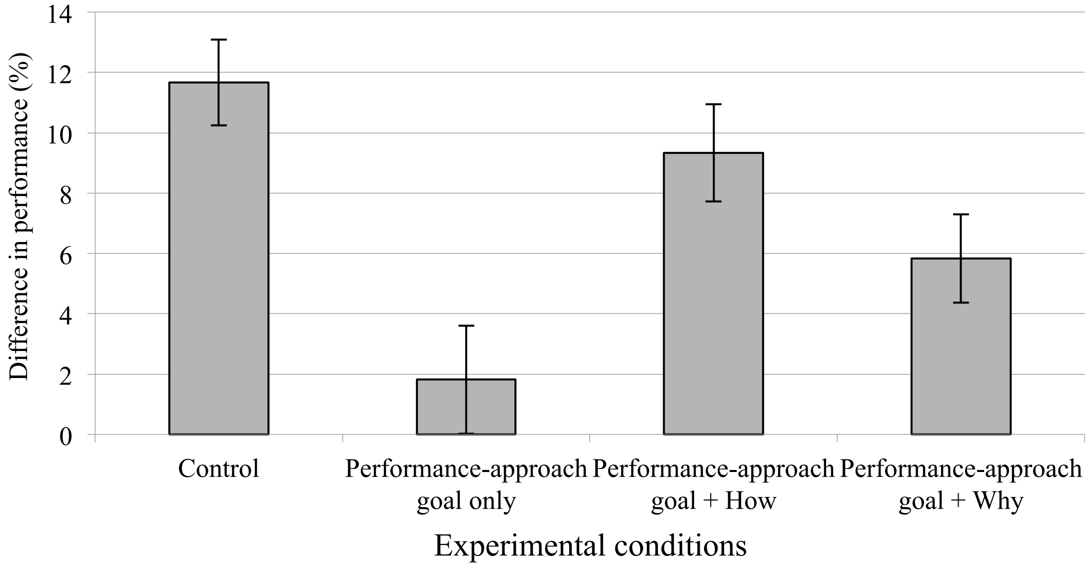

Figure 1. Mean difference in performance (%) for high-demand problems, as a function of experimental conditions.

Furthermore, in order to ensure that the accuracy results are not the product of a speed–accuracy trade-off, we conducted the same analysis with the centered phase 1 – phase 2 mean difference in response time for high-demand problems as a control. Because interactions between the contrasts and the centered mean difference of response time were not significant, all were trimmed from the final model. Results remain unchanged: The first contrast was significant, $B = 3.33$, $t(88) = 2.10$, $p < .04$, $PRE = .05$, and the two orthogonal contrasts were not (respectively, $B = 1.12$; $t < 1$, and $B = -1.99$, $t < 1$).

The same analyses conducted on low-demand problems did not yield any significant effects.

Mediational Role of Task-Related Thoughts

A Levene's test on the proportion of task-related thoughts proved to be significant, $F(3, 89) = 5.11$, $p < .005$. In order to correct for unequal variances, a square root transformation was applied, which successfully corrected heterogeneity of variance. The analyses were carried out with the transformed measure but, for the sake of readability, we present non-transformed means in Table 1.

To predict the proportion of thoughts associated to the task solving due to the experimental manipulation, we used the same three orthogonal contrasts in a linear regression analysis. Results revealed that the first contrast (i.e., the model) was significant, $B = 0.12$, $t(89) = 3.74$, $p < .001$, $PRE = .14$ (*a* path), whereas the two orthogonal contrasts were not (respectively, $B = 0.05$; $t(89) = 1.11$, $p = .27$, and $B = 0.02$, $t < 1$). Means – reported in Table 1 – are in the expected direction: participants from both performance-approach goal-only and performance-approach goal plus "why" orientation conditions mentioned thoughts related to task processing to a lesser extent than participants from both performance-approach goal plus "how" orientation and control conditions.

Table 1.

Mean Proportion of Thoughts Related to the Task Solving mentioned in the Thought Listing Questionnaire (Standard Deviations in Parentheses).

Conditions	Control	Performance-approach Goal-only	Performance-approach Goal + How	Performance-approach Goal + Why
	0.47 (0.36)	0.19 (0.23)	0.32 (0.26)	0.15 (0.19)

Then, a multiple regression analysis was conducted on difference in performance for high-demand problems, with the model contrast, the two orthogonal contrasts, and the proportion of thoughts related to the task solving as predictors. In line with hypothesis 2, results showed that the higher the proportion of thoughts related to the task solving, the higher the difference in performance, $B = 10.86$, $t(88) = 2.14$, $p < .04$, $PRE = .05$ (*b* path), while the model contrast became non-significantly related to the difference in performance, $B = 2.01$, $t(88) = 1.20$, $p = .23$ (*c'* path).

We then conducted a mediation analysis with 5,000 bootstrap resamples (Preacher & Hayes; 2008), which computes 95 % confidence intervals associated to indirect effects; the mediation pathway is considered significant if the confidence interval does not include zero. Results confirmed that the proportion of thoughts related to the task significantly mediated the relationship between the model contrast and difference in performance for high-demand problems (confidence interval from 0.24 to 2.97).

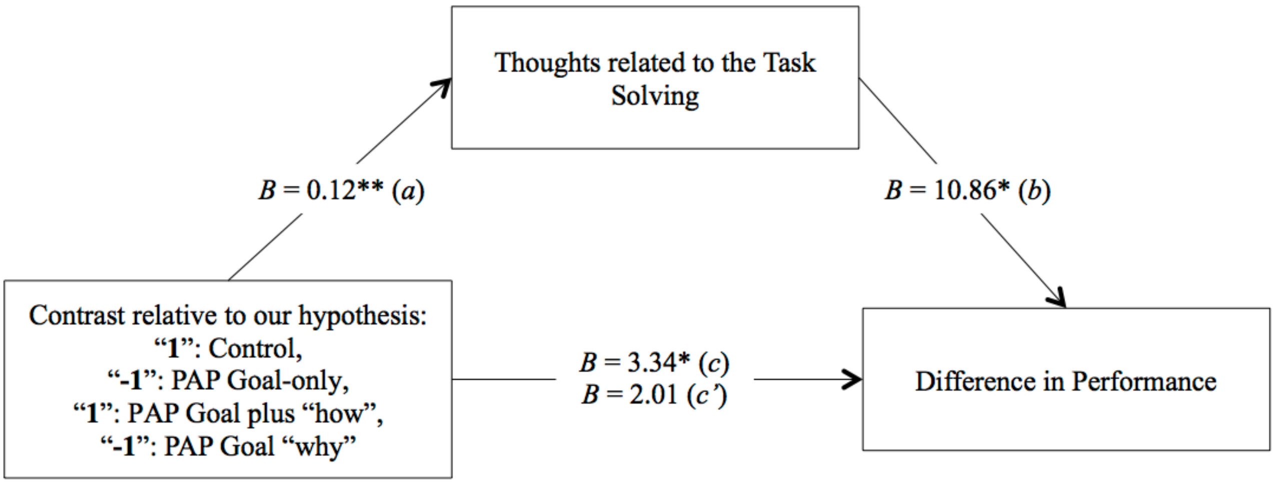

Figure 2. Mediation by task-related reported thoughts of the relationship between experimental conditions and difference in performance for high-demand problems.
* $p < .04$. ** $p < .001$.

Discussion

While the endorsement of performance-approach goals has consistently been associated to surface studying and choice of easy tasks (Senko et al., 2011), thereby depicting this category of achievement goals as potentially inimical to task focus, little research has explored whether performance-approach goal pursuit actually hampers the implementation of task-related processes during task solving. The purpose of the current study was twofold. First, relying on previous research that has highlighted the deleterious potential of performance-approach goals on performance (Crouzevialle & Butera, 2013), we hypothesized performance-approach goals to be detrimental to task focus, due to the activation of superordinate, high-level concerns (*why* to achieve success) at the expense of concrete, task-related processes (*how* to achieve success). Second, we sought to find evidence showing that the relation between a focus on the high-level aspects of performance-approach goals and decline in task performance would be mediated by a lower proportion of thoughts allocated to the task at hand.

Construal-Level Theory (Liberman & Trope, 2008; Trope & Liberman, 2010) allowed us to manipulate the level of construal associated to the assigned performance-approach goals. Results confirmed that performance for complex problem solving was impaired both in the mere performance-approach goal activation condition and in the condition that additionally activated a high-level representation of performance-approach goals, as compared to both the control condition and the condition designed to activate a low-level representation of performance-approach goals. This finding supports the view that performance-approach goals, by putting the emphasis on the self-relevance of performance, thereby engender high-level, outcome-related thoughts that focus part of the individual's attention on distractive (i.e., irrelevant for task resolution) considerations. As a corollary, and interestingly, this pattern of results suggests that the activation of a concrete mindset can be an efficient strategy to prevent the disruptive activation of performance-approach goal-attainment concerns.

The additional information provided by the mediation analysis constitutes an important step toward our understanding of the mechanisms at hand during performance-approach goal endorsement. Indeed, the mediation of the conditions – performance relationship by the proportion of thoughts related to the task solving offers an explanation of the negative impact of performance-approach goals on cognitive performance. Indeed, in line with our second hypothesis, the endorsement of performance-approach goals appears to impair cognitive performance because it diverts part of the cognitive resources away from the task processing; crucially, this distraction appears to be triggered by the level of abstraction associated to the pursued performance-approach goals. This result constitutes the first direct experimental test of the link between performance-approach goal pursuit and task focus, and brings support to the distraction hypothesis, as it shows that high-order concerns for performance compete with cognitive resources that otherwise would be allocated to efficient task solving.

The stringent experimental setting used in the present research was necessary to allow for causal reasoning on the predicted effects, but it also raises the question of ecological validity. Would such results still be obtained in a classroom environment, with a long-term perspective allowing pupils and students to plan goal pursuit throughout the whole academic year? In other words, would the activation of abstract, high-level considerations regarding performance-approach goal-attainment still be exclusively interfering and detrimental to achievement with a longer time frame? On the one hand, we could argue that the potentially threatening nature of this normative goal would still consume part of the working memory resources and thus prevent pupils from engaging in a deep and well-organized processing of course content, thereby damaging learning and jeopardizing the chance to perform optimally during exams. However, on the other hand, we could also reason that keeping the final goal active in memory is an important feature of goal pursuit that guide one's planning and behavior toward goal achievement. Indeed, following Klinger's (1977) argument, becoming commited to a goal will lead an individual to become "more likely to notice things relevant to it" (p. 46), due to an extrasensitivity to cues and possibilities that are considered as relevant to attain the goal. Following this reasoning, the frequent activation of superordinate reflections associated to the endorsed performance-approach goals might facilitate an effective and appropriate long-term preparation oriented towards goal achievement. Future work should examine this issue and test whether the consequences of high-order goal activation differ between short- and long-term settings.

Moreover, because the activation of high-level construals have been demonstrated to engender greater self-control (Fujita, Trope, Liberman, & Levin-Sagi, 2006), one could argue that being focused on the high-order aspects of performance-approach goals in long-term settings could also protect individuals from being easily distracted by temptations (e.g., attending a party while one still has a whole chapter to review for tomorrow), or by short-term, trivial goals that could interfere (e.g., planning an upcoming week-end). In other words, maintaining the high-level purpose highly activated in mind could help individuals to prioritize its attainment when facing secondary temptations. This possibility would have implications for clarifying the interplay between performance-approach goals and academic success – a question that is still widely debated within the achievement goal literature (Senko et al., 2011).

Taken as a whole, our results provide for the first time experimental evidence that the endorsement of norm-driven performance-approach goals disrupts and impairs individuals' complex task solving, by focusing part of their working memory resources on high-level thoughts that are too distant from task-related processes. Given the prevalence, in educational environments, of selection processes that are based on normative comparison, we believe these findings may also have important practical implications, as they might stimulate further research examining the deleterious consequences of performance-approach goal pursuit, along with strategies designed to alleviate them.

Footnotes

[1] One could argue that these instructions do not fit with the definition of performance-approach goals, which refers to the motivation to outperform others, and not merely to achieve the best performance. However, the diagram instructions were presented immediately after the performance-approach goal manipulation; thus, it was clear that this instruction referred to the previously activated goal.

[2] Seventeen participants were discarded from the initial sample because, when asked to answer why they would try to attain the assigned performance-approach goal, a series of participants mentioned that it was part of the instructions (e.g., “I will try to achieve the best performance because it is asked in the instructions”; “Because I want to help the experimenters for their research”; “Because I know it is very difficult to recruit participants”). We argue that such answers, instead of generating a reflection on the importance to attain performance-approach goals and the self-relevance of performance, rather move attention away from the assigned goals, and correspond to a refusal to take the experiment seriously.

Supplementary material

Performance-approach goals instructions:

During the recorded part of the task, the experimenters will assess your performance, on the basis of your accuracy score and your rapidity. At the end of the experiment, we will give you a document including the result of this evaluation, as well as your ranking compared with the other participants. You should try to achieve the best possible evaluation. It is important for you to be proficient, to perform well and to obtain a high score, in order to demonstrate your competence.

You should know that a lot of students will do this task, and we will rank individual scores in comparison with others. You are asked to keep in mind that you should try to distinguish yourself positively, that is, to perform better than the majority of students. In other words, what we ask you here is to show your competencies, your abilities.

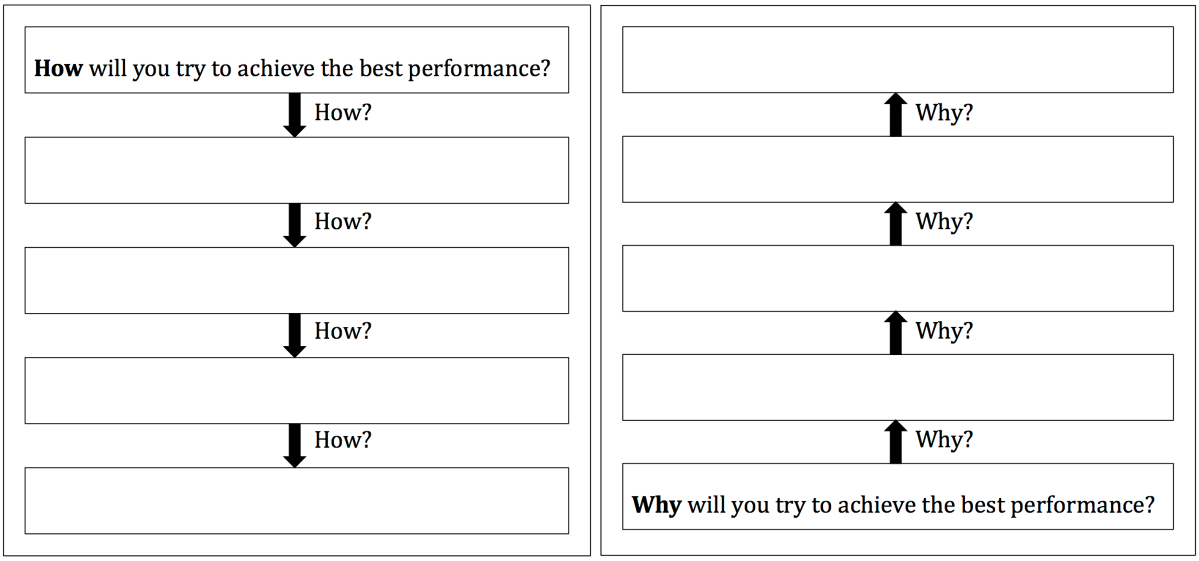

Figure 1S. Diagram designed to activate an increasingly concrete (left) or an increasingly abstract (right) construal of performance-approach goals.

CHAPTER 3

Striving for Excellence Sometimes Hinders High Achievers: Performance-Approach Goals Deplete Arithmetical Performance in Students with High Working Memory Capacity

Striving for Excellence Sometimes Hinders High Achievers: Performance-Approach Goals Deplete Arithmetical Performance in Students with High Working Memory Capacity.

Abstract

In the present research, we tested whether the goal to attain normative superiority over other students—the pursuit of performance-approach goals—is particularly distractive for high-WMC students (that is, those who are used to be high achievers). Indeed, Working Memory Capacity (WMC, i.e., the ability to both temporarily maintain and process information) is positively related to high-order cognitive performance and academic success, resulting in benefits for high-WMC as compared to low-WMC students. Consequently, for the former, the pursuit of performance-approach goals should represent an opportunity to reaffirm their positive status—a stake that may trigger disruptive outcome concerns that endanger the smooth continuity of task processing. Results revealed that with performance-approach goals—as compared to non-normative achievement goals—the higher the students' WMC, the lower their performance at a complex arithmetic task (Experiment 1). Crucially, this pattern was found to be driven by uncertainty regarding the chances to outclass others and excel at the task (Experiment 2); an accessibility measure also confirmed that this uncertainty led higher-WMC individuals to activate status concerns. We discuss why high-stake situations can paradoxically lead high-achievers to sub-optimally perform when high-order cognitive performance is at play.

Keywords: performance-approach goals, Working Memory Capacity, cognitive performance, status

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Striving for Excellence Sometimes Hinders High Achievers: Performance-Approach Goals Deplete Arithmetical Performance in Students with High Working Memory Capacity

Striving for success and the wish to rise above others is part of most students' lives, since academic achievement carries with it crucial consequences such as college acceptance, graduation, parents' pride, and access to the highest-profile jobs. However, whether this motivation—which is referred to as performance-approach goals—actually facilitates or rather endangers cognitive performance and achievement is an issue that is still widely discussed in the achievement goal literature. Indeed, although a wealth of research in the area of achievement goals has shown that performance-approach goals positively predict academic achievement (e.g., Senko, Hulleman, & Harackiewicz, 2011), recent research has demonstrated that performance-approach goals have the potential to activate outcome-related concerns that interfere with task focus, and impair cognitive performance (Crouzevialle & Butera, 2013).

This mixed picture creates a puzzling riddle. On the one hand, since performance-approach goals are positively associated with achievement, high achievers should feel comfortable with these goals and therefore should not be distracted by them. On the other hand, however, high-achievers—that is, the students who are the most used to succeed—might be particularly concerned by their outcomes and their standing, and paradoxically be more prone to experience distraction and see their performance decrease under performance-approach goals pursuit. The present research addresses the mechanisms involved in this riddle, and investigates whether the outcome-related concerns generated by performance-approach goals might be amplified for high Working Memory Capacity (WMC) students—that is, those individuals who are the most cognitively efficient in complex tasks—leading them to paradoxically experience more distraction than their low-WMC counterparts.

The Paradox of Performance-Approach Goals and Performance

In most academic settings, the salience of stakes as well as the importance to succeed constitute an indisputable reality for students, as grades, ranking and assessment processes constitute a central feature of academic functioning—carrying with it information regarding competence as well as consequences for self-esteem (Butler, 1987; 1989; Pulfrey, Buchs, & Butera, 2011). In particular, the selection processes that are applied in the University educational system put an emphasis on the importance to get good grades and to perform among the best students, so as to achieve at the highest level and later secure a high-profile job (Deutsch, 1979; see also Pope, 2001). This culture of high achievement has been demonstrated to promote the endorsement of performance-approach goals, defined as the strive for excellence through outperforming others in order to demonstrate competence

(Elliot, 1999; Elliot & Harackiewicz, 1996), and whose pursuit is recognized by students as adaptive and useful to succeed in the academic system (Darnon, Dompnier, Delmas, Pulfrey, & Butera, 2009).

The paradox of performance-approach goals lies in two sets of results. On the one hand, performance-approach goal adoption has been consistently found to predict academic performance (e.g., Barron & Harackiewicz, 2003; Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Murayama & Elliot, 2012), as well as many positive outcomes such as self-efficacy, challenge construal, effort and competence valuation (cf. Elliot & Moller, 2003, for a review). On the other hand, there is growing evidence showing that performance-approach goals tend to focus students on the importance of getting good grades and demonstrating competence, sometimes to the detriment of learning and task focus (Jagacinski & Nicholls, 1987); moreover, the use of unethical methods such as cheating (Pulfrey & Butera, 2013; Van Yperen, Hamstra, & Van der Klauw, 2011), and of strategic behaviors such as superficial learning and rote memorization (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000) constitute evidence that striving for success can jeopardize the educational function of the academic system, that is, learning and gaining knowledge. In support to this line of research, Elliot and Moller (2003)—when confronting the normative structures of educational systems with their learning function—underline that "when normative evaluation is the primary emphasis in a learning environment, it will evoke a host of motivational concerns (e.g., self-presentation, self-validation, self-protection)" (p. 347) prone to disrupt students' desire to focus on the task and develop abilities. Hence, strongly competitive learning environments may somehow divert students from the desire to gain knowledge by instead activating esteem-based, self-appearance concerns.

In line with this reasoning, Crouzevialle and Butera (2013) provided experimental evidence that performance-approach goals have indeed the potential to paradoxically reduce cognitive performance. In particular, they found that the desire to attain normative superiority over the other students could temporarily deplete working memory, by activating outcome-related concerns that interfere with task focus and impair complex task solving. While such a divided-attention situation generated by performance-approach goals is assumed to be applicable to the general student population, the present research proposes to test whether pressure to reach outstanding performance and achieve above peers could be amplified for a specific population of students—namely those who are the most used to reach high grades and outperform others. Specifically, building on work that has consistently depicted high Working Memory Capacity (WMC) students as those who are the most cognitively efficient in complex tasks (see Ashcraft & Krause, 2007; Engle, 2002; Daneman & Carpenter, 1980), we propose to test whether the advantage of high WMC students could paradoxically turn out to be harmful when performance-approach goals are salient.

High-Working Memory Capacity Students and Performance-Approach Goals

Working Memory refers to the ability to both temporarily maintain and process information necessary in the completion of various cognitive tasks. This cognitive ability is limited, and research has revealed inter-individual differences in Working Memory Capacity (WMC) that denote "differences in the ability to allocate attention resources" (Redick, Heitz, & Engle, 2007, p.126) and consistently demonstrated that WMC is a strong and powerful predictor of performance in a wide range of complex cognitive activities. To name but a few, WMC is positively related to learning, language comprehension, language production, and fluid reasoning (Daneman & Carpenter, 1980; Engle, 2002; Hambrick & Engle, 2003; Kane, Conway, Hambrick, & Engle, 2007), and has also been identified as a positive predictor of performance on mathematical problem solving (Ashcraft & Krause, 2007; Raghubar, Barnes, & Hecht, 2010). It therefore comes as no surprise that inter-individual differences in WMC, as tested through complex span tasks (see Conway, Kane, Bunting, Hambrick, Wilhelm, & Engle, 2005), also positively predict academic success in educational settings (Alloway & Alloway, 2009; Cain, Oakhill, & Bryant, 2004), thereby implying that higher-WMC students are most likely to be successful pupils and high-achievers in the classroom.

However, could this benefit turn out to be a burden in specific situations where evaluative stakes are particularly salient? This question is prompted by the literature showing that performance-approach goals elicit self-presentation (Elliot & Moller, 2003) as well as normative goal-attainment concerns (Crouzevialle & Butera, 2013) that derive from the "instrumental importance of the outcome" (McGregor & Elliot, 2002, p. 349) inextricably tied with performance-approach goal pursuit—concerns that may be higher in students used to succeed. Thus, our first general hypothesis is that the higher the WMC of students committed to the goal of outperforming others, the higher the distraction, which would result in impaired performance.

Why? Bearing in mind that WMC is frequently associated to academic achievement (Alloway & Alloway, 2009), high-WMC individuals are used to receiving frequent positive feedbacks regarding competence in academic contexts, and—since individuals "are strategic and will value those domains that are most likely to produce positive outcomes to the self" (Osborne & Jones, 2011, p. 132)—they should therefore have developed a strong concern with succeeding in academic settings. Following this reasoning, one can argue that achievement stakes will be perceived as higher for those students who are the most concerned with succeeding, since failure or underperformance would imply negative consequences for their self-esteem (Steele, 1997), while success would rather increase self-esteem and generate positive self-related emotions such as pride (Osborne & Jones, 2011). Consequently, we can formulate a second general hypothesis, whereby the pursuit of performance-approach goals, i.e, normative goals that put the emphasis on evaluative processes such as grades and ranking, should lead high-WMC individuals to activate more concerns about outperforming others than their low-WMC counterparts, especially when this evaluative situation does not allow an opportunity to reaffirm and preserve their positive status.

Interestingly for this contention, research carried out among students attending high-performing high schools indeed confirms that they are fully aware of the pressure to compete and maintain high achievement for college admission (Conner, Pope & Galloway, 2009; Galloway, Conner & Pope, 2013; Pope, 2001), and express concerns related to parents' standards, which often implies that "anything but the highest grade is a failure" (Galloway et al., 2013, p. 505). Performance-approach goal pursuit might thus carry higher stakes—and thereby trigger more interfering thoughts—for high-performing students.

It should be noted that such an hypothesis, stating that high-WMC individuals might be more vulnerable to interference and resource impairment than their low-WMC counterparts, might seem counter-intuitive with regard to the Working Memory literature, which rather suggests that high-WMC individuals, because of their extra cognitive resources, should be immune to the deleterious consequences of distraction. However, and interestingly for our contention, the non-vulnerability of high-WMC students has already been challenged by recent empirical findings, namely those documenting the Choking Under Pressure phenomenon—the performance decrements observed under evaluative pressure (Baumeister, 1984). Indeed, experimental research that has investigated the impact of evaluative pressure on cognitive performance has consistently demonstrated that highly evaluative situations specifically impair performance for high-WMC individuals, who lose the advantage stemming from their higher capacity and perform at the same level as their low-WMC counterparts (Beilock & Carr, 2005; Beilock & DeCaro, 2007; Gimmig, Huguet, Caverni, & Cury, 2006). These results therefore suggest that it is plausible to think that performance of high-WMC individuals may particularly impaired by a context emphasizing evaluative pressure.

Hypotheses and Overview

We conducted two experimental studies that aimed to assess whether performance-approach goal endorsement differentially impacts cognitive performance as a function of individuals' WMC. More specifically, we assume that the more individuals are prone to succeed at high-order cognitive tasks and academic work (i.e., the higher the WMC), the more likely they should be to activate concerns about the attainment of performance-approach goals (i.e., to outperform others). Indeed, as noted above, the higher the WMC, the more individuals experience success and high-ranking, and may therefore perceive evaluative situations as high-stakes opportunities to reaffirm their competences as compared to others—thereby increasing the importance to succeed. Such concerns about outperforming others should consume working memory resources and therefore interfere with task solving.

In sum, we expect that under performance-approach goal instructions, more than under non-normative goal instructions, the higher the WMC, the lower the cognitive performance (Hypothesis 1). In the above analysis, we posited that the activation of performance-approach goals should engender more distractive goal-attainment concerns as WMC increases; if this analysis is correct, then we should observe two effects. First, the decrease in performance generated by performance-approach goal activation as a function of WMC should be stronger in the case of an average—i.e., disappointing for high-achievers—feedback than if individuals receive reassuring feedback regarding their chance to succeed better than others (Hypothesis 2). Second, pursuing performance-approach goals without being reassured about the possibility to attain them might generate an increased accessibility of thoughts associated to status as WMC increases (Hypothesis 3).

Experiment 1 was designed to test the first hypothesis and contrasted performance-approach goal and non-normative (i.e., mastery-approach) goal conditions. Experiment 2 tested Hypotheses 2 and 3 by manipulating uncertainty about the chance to attain the assigned performance-approach goals; additionally to performance, we also measured the accessibility of status concerns.

Experiment 1

Method

Participants. One hundred and ten students enrolled in engineering, political and social sciences, arts and humanities, law, and business curricula in two French-speaking Swiss Universities volunteered in this experiment. As far as observations which were excluded were concerned, fourteen participants were removed from the analyses with the following criteria: four because they did more than fourteen math errors (i.e., less than 80% of accuracy) at the math calculation part of the OSPAN task, suggesting that the task had not been performed as was required (see Beilock & Carr, 2005; see also the 2.1.2.1. section for more details), four because they spent less than 5,000 ms reading the slide that contained the goal manipulation (mean reading time for the whole sample of participants was M = 22,17 ms, SD = 8,10), two because of very short response times (less than 2,500 ms) during the modular arithmetic problems solving, whatever the problem difficulty, suggesting a lack of involvement in math calculation (note that mean response time for the whole sample was M = 8.12 ms, SD = 2.65 for high-demanding problems), and four because their accuracy score at the baseline block was below (or equal to) 50% (see Beilock & DeCaro, 2007). The final sample consisted of 96 participants, 72 female and 24 male students, with a mean age of 22.02 years (SD = 2.64), who were randomly assigned to one of the two experimental conditions (49 and 47 participants in mastery-approach goal and performance-approach goal conditions, respectively).

Tasks and procedure. Upon arrival at the lab, each participant was seated in front of a computer in an individual cubicle.

Working memory. Participants were first introduced to a French version of the automated Operation Span task (OSPAN; Unsworth, Heitz, Schrock, & Engle, 2005). This task aims to measure individual's WMC, and requires participants to simultaneously solve easy mathematic calculations (the processing component) and retain sets of letters (the storage component). More specifically, participants are presented with series of 3 to 7 arithmetic equation-letter combinations; three series of each length are randomly presented. For each combination, they first have to check the validity of equations such as (6 * 1) + 2 = 8; immediately after their response, a single letter (e.g., F) is displayed on the screen for 1,000 ms. At the end of each series, participants are asked to recall the set of letters in the same order as presented. OSPAN scores can range from 0 to 75, and are obtained by adding the number of letters included in all the perfectly recalled sets (M = 42.92, SD = 17.26).

Additionally, and in order to prevent any trade-off between mathematic calculations and letters storage, the OSPAN classic procedure (Unsworth et al., 2005) emphasizes to participants that their accuracy for the equation part has to remain superior or equal to 85%. Hence, during each recall part, participants current percentage of accurately solved mathematic calculations was displayed in red font color in the upper right corner of the screen. A feedback was also displayed after each recall, informing participants regarding how many letters they had accurately recalled.

Baseline performance. Upon completion of the OSPAN task, participants were informed that they would move to the second (and unrelated) part of the experiment, which required them to solve modular arithmetic problems (Beilock & Carr, 2005). More specifically, written instructions informed them that they would have to judge the validity of statements such as 17 $\equiv$ 5 (mod 6). In order to do so, participants were required to first subtract the second number from the first (i.e., here, 17 – 5), and then divide the intermediary result by the last (mod) number. If the final result is a whole number, the statement is true; if it is a decimal number, the statement is false. Participants were asked to mentally solve modular arithmetic problems as quickly and accurately as possible, and to give their answer (true or false) by pressing one of two keys on the keyboard. Each modular arithmetic problem appeared on the screen after a 500 ms fixation point, and remained until the participant responded. A feedback (the word "correct" or "incorrect") was then displayed for 1,000 ms, followed by a 1,000 ms inter-trial break; the subsequent problems were then individually displayed. This procedure was the same for all modular arithmetic problems in the experiment.

After a short training, they had to solve a first block of 24 arithmetic problems. In order to vary the problems' difficulty, 12 problems only required a single-digit no-borrow subtraction (i.e., low-demand problems, such as 7 $\equiv$ 2 (mod 5)), while the remaining problems required a double-digit borrow subtraction operation, (i.e., high-demand problems, such as 51 $\equiv$ 19 (mod 4)), thereby soliciting higher working memory resources. Each problem was presented only once; presentation order within each block was randomized. This first block of problems (Phase 1) served as a baseline measure of modular arithmetic performance for each participant. In order to avoid activating any performance concerns during this first block, it was presented as a training block, for which participants were simply asked to solve the problems as quickly and accurately as possible.

Experimental manipulations. Participants were then informed that they would now have to solve a second block of arithmetic problems for which their performance would this time be recorded. Those in the "performance-approach goal" condition next read explicit instructions that aimed at activating performance-approach goals (validated by Darnon, Harackiewicz, Butera, Mugny and Quiamzade, 2007, pilot study):

During the recorded part of the task, the experimenters will assess your performance. It is important for you to be proficient, to perform well and to obtain a high score, in order to demonstrate your competence. You should know that a lot of students will do this task. You are asked to keep in mind that you should try to distinguish yourself positively, that is, to perform better than the majority of students. In other words, what we ask you here is to show your competencies, your abilities.

Participants in the "mastery-approach goal" condition read instructions designed to activate mastery-approach goals. In particular, because we wanted to create a non-normative achievement goal condition, these instructions aimed to arouse task interest and utility for everyday life, and deliberately put aside any reference to score and task performance:

In previous research, we have observed that practice of the arithmetic task you are solving right now benefits to cognitive functioning and leads to a progressive improvement of mental processes. Hence, this task solving can prove to be beneficial on the long-term. It is however necessary that you focus your attention on calculations mastery, so as to quickly and accurately solve each problem, in order to experience these benefits. Try to master this task as much as you can; keep in mind its practice can be beneficial to you.

Post-manipulation performance. After they had read these instructions, all participants started solving the second set of problems. Similarly to the first block, they had to solve 12 low-demand and 12 high-demand problems that were randomly presented. Finally, participants were debriefed and thanked.

Results

We assessed the influence of our manipulations on problem performance by computing a difference score, as Crouzevialle and Butera (2013) did; we thus subtracted the percentage of accuracy in Phase 1 (baseline) from the percentage of accuracy in Phase 2 (post-manipulation). Hence, the higher the difference in performance, the higher the participant's increase in performance from Phase 1 to Phase 2.

Because our hypothesis only deals with problems that require a large amount of working memory resources, we selected high-demand problems to run our main analysis. Indeed, this task has been widely used by Beilock and colleagues (e.g. Beilock, Kulp, Holt, & Carr, 2004), and this research has clearly shown that high-demand problems solicit a larger amount of working memory resources than low-demand problems. However, since we used the materials kindly provided by

Beilock and colleagues, in which low-demand problems were included, we also run the same analysis with low-demand problems, as a control.

In order to test the influence of goal manipulation on performance as a function of WMC, we regressed the difference in performance score on WMC (mean-centered), experimental conditions (with the performance-approach goal condition coded -0.5 and the mastery-approach goal condition coded 0.5), and the interaction between WMC and experimental conditions; we additionally entered the mean-centered difference in response time (phase 2 – phase 1), as a control, as well as the interactions between this covariate and each predictor, as recommended by Yzerbyt, Muller, and Judd (2004); however, because these interactions are not theoretically relevant in the present research, they will not be discussed further. The predicted interaction between WMC and the contrast proved to be significant, $B = 0.37$, $t(88) = 2.30$, $p < .03$, $PRE = .06$. As can be seen in Figure 1, under performance-approach goal instructions, difference in performance decreased as participants' WMC increased, a trend that did not emerge in the mastery-approach goal condition[1]. We also observed a significant main effect of difference in response time (phase 2 – phase 1) on difference in performance, $B = -0.002$, $t(88) = -2.77$, $p < .01$, revealing that faster response times from phase 1 to phase 2 were associated with greater performance improvement. No other effect was significant. The regression analysis conducted on low-demand problems led to non-significant effects (all *t*s < 1).

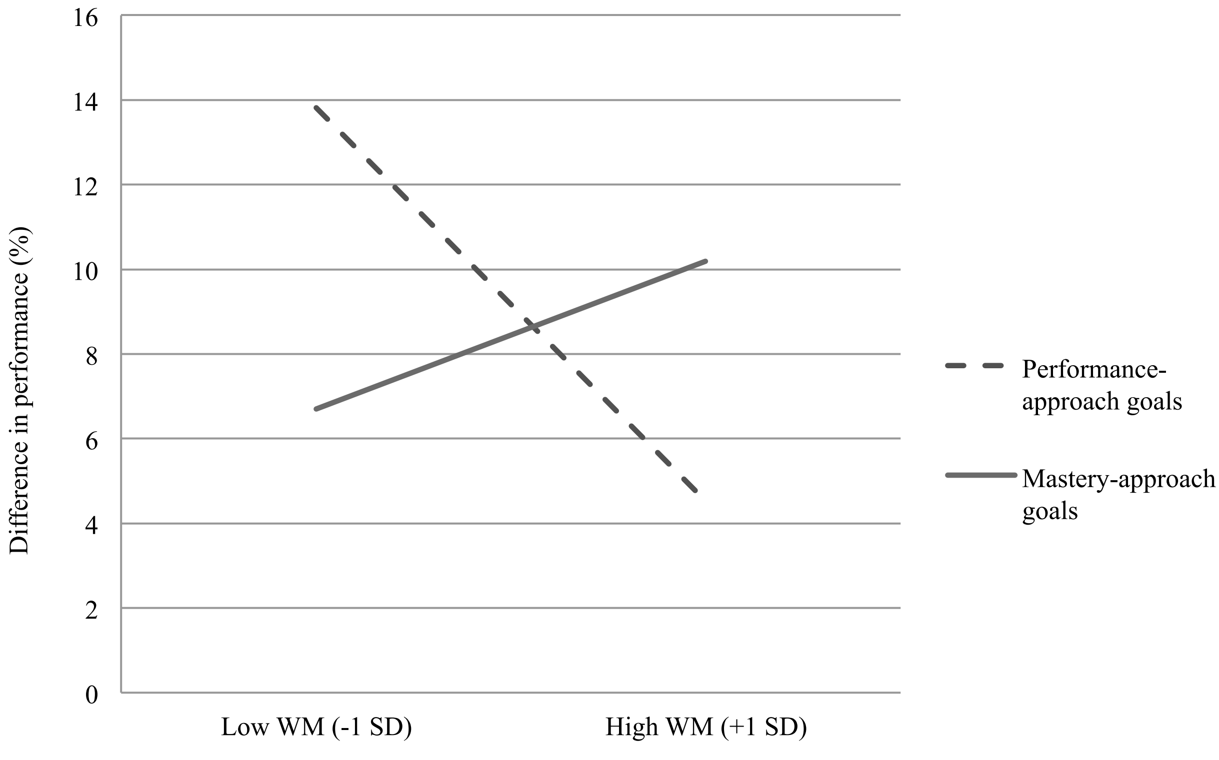


Figure 1.

Mean difference in performance (%) for high-demand problems, as a function of experimental conditions and WMC.

Discussion

Experiment 1 sought to find evidence that motivating individuals to pursue a normative achievement goal in a laboratory setting should prove to be more interfering and detrimental to cognitive performance for high-WMC individuals than for low-WMC individuals. In particular, Hypothesis 1 predicted that the higher the WMC, the more the activation of performance-approach goals—but not the activation of non-normative goals— should disrupt mental calculations required during high-demand problem solving (that is, problems whose solving most heavily rely on working memory resources), thereby impairing performance. Experiment 1 findings constitute the first evidence confirming this hypothesis: As expected, under performance-approach goal instructions, the difference in performance between pre- and post-manipulation blocks decreased with the increase of participants' WMC; this effect did not appear with non-normative goal instructions[2]. Thus, Experiment 1 suggests that performance-approach goal pursuit is particularly distractive for individuals with higher WMC.

Experiment 2

Experiment 2 sought to understand the mechanism activating the concerns supposed to underlie the observed detrimental effects of striving for normative performance in individuals with higher WMC. Hence, additionally to a condition that merely manipulated performance-approach goals, we aimed to manipulate uncertainty about the chance to attain the assigned performance-approach goals, by also providing a bogus feedback with information about both score and ranking just before the completion of the evaluated modular arithmetic block. This bogus feedback was either very positive (high score and ranking) or average (medium score and ranking), and was designed to generate confidence vs. uncertainty regarding the chance to subsequently get a high score and outperform others; if, as we assume, high-WMC individuals activate more concerns about performance-approach goal attainment than low-WMC individuals, then being reassured about their chance to rise above others should reduce this activation, while receiving a disappointing score should maintain distractive outcome concerns at a high level. Thus, in order to observe the distractive effect of these concerns, we again measured the difference in performance at the same modular arithmetic task; additionally, in order to gain further information regarding the nature of these concerns, we measured the activation of status-related thoughts through a lexical decision task.

Method

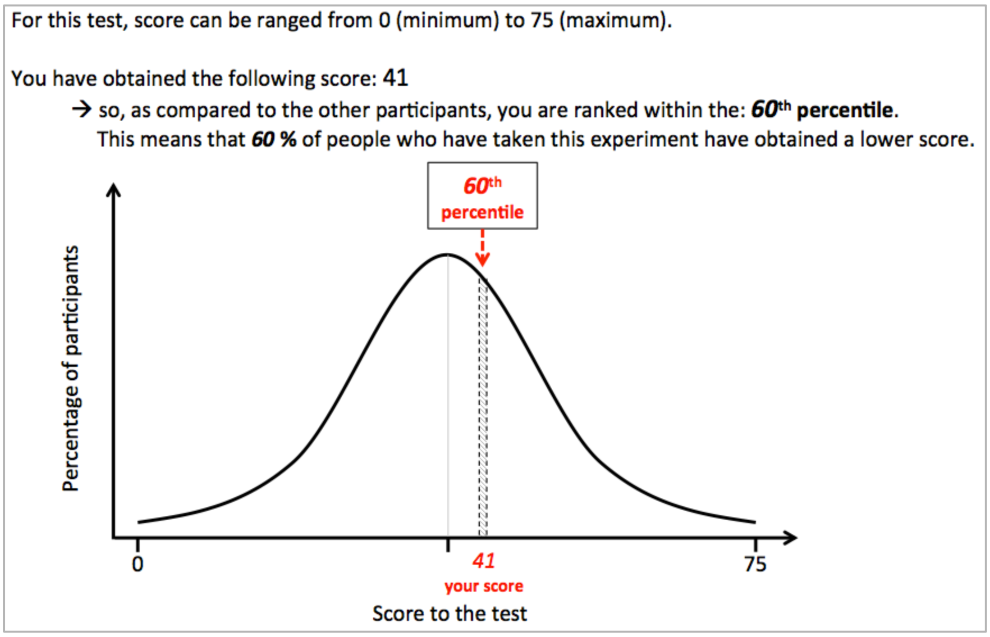
Participants. One hundred and nineteen students volunteered in this experiment. The sample consisted of French-speaking Swiss undergraduate and graduate students enrolled in political and social sciences, arts and humanities, engineering, and business curricula. Eighteen participants were discarded from the analyses: six because they did more than fourteen math errors (i.e., less than 80% of accuracy; see Beilock & Carr, 2005) at the math calculation part of the OSPAN task, four because they spent less than 5,000 ms reading the slide that contained the performance-approach goal manipulation (mean reading time for the whole sample of participants was of *M* = 23.15 ms, *SD* = 10.00), six because of very short response times (less than 2,500 ms) during the modular arithmetic problems solving, whatever the problem difficulty, suggesting a lack of involvement in math calculation (note that mean response time for the whole sample was *M* = 8.70 ms, *SD* = 3.45 for high-demanding problems), and three because their accuracy score at the baseline block was below (or equal to) 50% (see Beilock & DeCaro, 2007). The final sample consisted of 101 participants, 65 male and 39 female students, with a mean age of 22.64 (*SD* = 5.15) who were randomly assigned to one of the three experimental conditions (32, 33, and 36 participants in performance-approach goal alone, performance-approach goal with average feedback, and performance-approach goal with positive feedback conditions, respectively).

Tasks and procedure. Upon arrival to the lab, participants were informed that they were about to complete different tasks that were part of the same experiment – a cover story that was important for the credibility of our manipulations, see below.

Baseline performance. Participants were then asked to seat in front of a computer in an individual cubicle, and were introduced to modular arithmetic problem solving through written instructions; the task was the same as that used in Experiment 1. After a short training, they had to solve a first block of 24 arithmetic problems, among which half were low-demand problems, and half were high-demand problems that solicited higher working memory resources. As in Experiment 1, this first block of problems (Phase 1) served as a baseline measure of modular arithmetic performance for each participant, and was presented as a training block, in order to avoid activating any performance concerns. Hence, participants were simply asked to solve the problems as quickly and accurately as possible.

Working memory. After the first block of arithmetic problems solving, participants were instructed to complete the same OSPAN task as in Experiment 1, which aimed to measure individual's WMC; OSPAN scores ranged from 0 to 75, and were obtained by adding the number of letters included in all the perfectly recalled sets (*M* = 45.75, *SD* = 16.14). As in Experiment 1, we used the automated OSPAN task version, which provides participants—during each recall part—with their current percentage of accurately solved mathematical calculations, displayed together with a feedback regarding how many letters they have accurately recalled.

Experimental manipulations. The first manipulation occurred upon completion of the OSPAN task, as participants in the "*performance-approach goal with average feedback*" and "*performance-approach goal with positive feedback*" conditions received a bogus feedback informing them about their OSPAN score as well as the rank they had reached compared to the other participants – a feedback that was said to be delivered "for informational purposes". Participants were told that this final score was calculated as a function of accuracy (each problem being differently weighted depending on its difficulty) and response rapidity; this complex calculation was designed to make the bogus feedback credibility difficult to challenge. In both conditions, both the bogus score and rank given to the participant were illustrated in the form of a normally distributed diagram on which the participant's position was clearly located (cf. Figures 2.a and 2.b). Participants in the "*performance-approach goal with average feedback*" condition were told that they had obtained a score of 41 out of 75, leading them to be ranked at the 60th percentile of the whole sample. Participants in the "*performance-approach goal with positive feedback*" condition were told that they had obtained a score of 73 out of 75, leading them to be ranked at the 95th percentile of the whole sample. In order to check whether the feedback had correctly been understood, participants were then asked to recall it; none of them failed to do so. Participants in the "*performance-approach goal alone*" condition received no bogus feedback.



2.a.

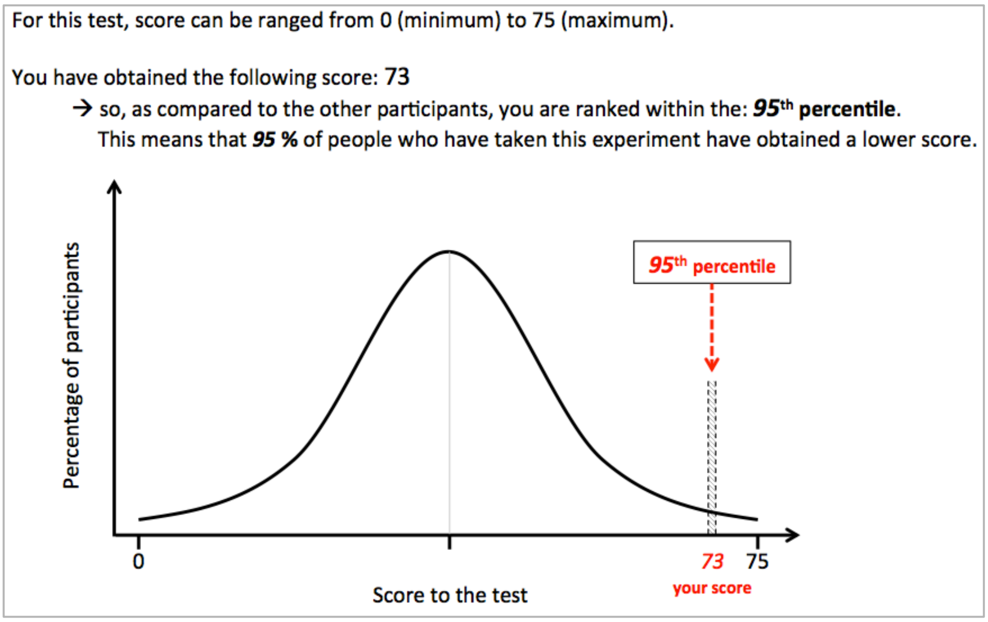
2.b. 

Figure 2.

Bogus score, ranking, and normally distributed diagrams that were presented to participants in the "performance-approach goal with average feedback" (Figure 2.a) and in the "performance-approach goal with positive feedback" (Figure 2.b).

Post-manipulation performance. Then, participants in all three conditions were informed that they would now have to solve a second block of arithmetic problems for which their performance would this time be recorded. In order to make the information carried by the previously manipulated bogus feedback relevant for this next phase, we explicitly mentioned that both tasks (the OSPAN and the modular arithmetic task) were part of the same experiment and relied on similar abilities, that is, "working memory and mental calculation". This explains why the OSPAN task had to be inserted between the baseline and the post-manipulation measure of the modular arithmetic task. Participants of the three conditions then read explicit instructions that aimed at activating performance-approach goals, which were similar to those used in Experiment 1. Participants next started solving the second set of problems. Similarly to the first block, they had to solve 12 low-demand and 12 high-demand problems that were randomly presented.

Accessibility of status. Upon completion of the second set, participants were introduced to the lexical decision task (Koole, Smeets, van Knippenberg, & Dijksterhuis, 1999), which was presented as a verbal task designed to assess word recognition. This task involved words and non-words that were individually displayed on the center of the screen; participants were simply asked to indicate – as quickly and accurately as possible – whether the items that appeared on the screen were words or non-words, by pressing two different keys on the keyboard. This task actually aimed at measuring the accessibility of words related to status compared with filler (neutral) words. Hence, forty items were randomly presented, among which 20 were non-words and 20 were existing French words. More specifically, 10 words were related to the concept of status (e.g., hierarchy, privilege, influence) and 10 were filler words (e.g., itinerary, lunch, nature). It is important to note that words related to status had been pilot-tested: a sample of 13 students from the same population had been asked to generate words that were related to the concept of status. Words that had been generated the most often were retained for the lexical decision task; the full list of words is available form the authors. Words were matched for frequency; non-words and words were also matched for length. Upon completion of the lexical decision task, participants were fully debriefed and thanked.

Results and Discussion

Difference in performance.

We again computed a difference score between the pre- and post-manipulation phases (in percentages); a positive score thus refers to an increase in performance from phase 1 to phase 2. Then, in order to test our model, we used a linear regression analysis. Because our hypothesis only deals with problems that require a large amount of working memory resources, we again selected high-demand problems to run our main analysis; however, because low-demand problems were also included in the material, we also run the same analysis with low-demand problems, as a control.

We conducted a preliminary analysis that included gender as a factor; because neither main nor interaction effects proved to be significant; this variable was not examined further. Then, in order to test our hypothesis, we created a set of two orthogonal contrasts: the first contrast testing the planned comparison was “-1 -1 2”, respectively associated with the “performance-approach goal”, “performance-approach goal with average feedback” and “performance-approach goal with positive feedback” conditions; the second orthogonal contrast was “1 -1 0” and meant to assess the residual variance (Judd & McClelland, 1989). We then regressed the difference in performance scores for high-demand problems on WMC (mean-centered), the two orthogonal contrasts, and the two interactions between each contrast and WMC; the mean-centered difference in response time for high-demand problems (Phase 2 - Phase 1) was again entered as a control, as well as the interactions between this covariate and each predictor; however, because these interactions are not theoretically relevant in the present research, they will not be discussed further.

The interaction between WMC and the first contrast (i.e., the model) proved to be non-significant ($t < 1$), showing that our model did not fit the data well. However, WMC significantly interacted with our second contrast, $B = 0.23$, $t(88) = 2.07$, $p < .05$, $PRE = .05$; no other effect was significant. A full representation of the data is presented in Figure 3.

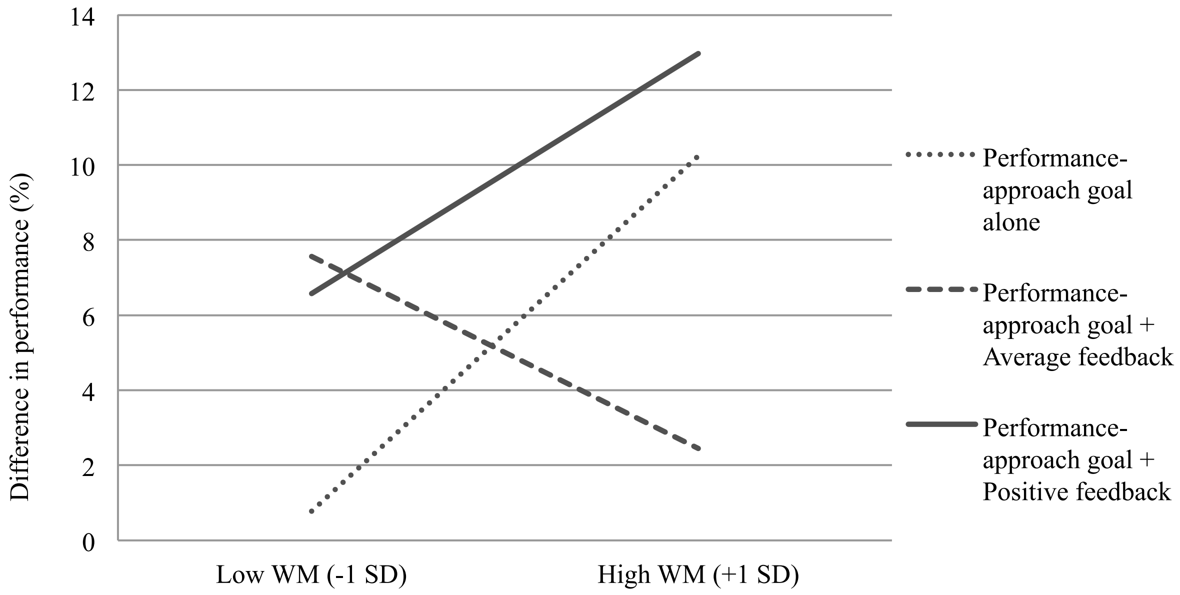


Figure 3.

Mean difference in performance (%) for high-demand problems, as a function of experimental conditions and WMC.

This unexpected result informs us that the overall pattern does not fit with our expectations. Indeed, the significant interaction between WMC and the orthogonal contrast indicates that the "performance-approach goal alone" condition and the "performance-approach goal with average feedback" condition performed differently as a function of participants' cognitive capacity, and more specifically revealed a positive slope in the "performance-approach goals alone" condition – the higher the participants' WMC, the greater their difference in performance – a result at odds with our previous finding from Experiment 1. Figure 3, however, also reveals that the pattern obtained for both the "performance-approach goal with average feedback" and "performance-approach goal with positive feedback" conditions perfectly goes in the expected direction: in line with Hypothesis 2, the lower performance generated by performance-approach goal activation as a function of WMC was observed in the case of an average—i.e., disappointing for high-achievers—feedback, but not when participants received reassuring feedback regarding their chance to succeed better than others. Could it be that the absence of replication from Experiment 1 to Experiment 2 regarding the effect of the "performance-approach goal alone" condition is attributable to some subtle modification in the setting procedure?

The main hypothesis of this research posits that high-WMC individuals, that is, individuals who are most susceptible to have accumulated achievements and high rankings in their academic life, should experience more concerns about outperforming others when assigned to pursue performance-approach goals in a laboratory setting, as compared to their low-WMC counterparts. In particular, they should view goal attainment as an opportunity to reassert their favorable position as compared to others, a representation that carries with it higher-stakes perception as well as important consequences for self-esteem. In Experiment 2, we chose to test this hypothesis by manipulating a bogus feedback designed to generate confidence versus uncertainty regarding the chance to outperform other participants. The “performance-approach goal alone” condition was intended as a control condition in which the uncertainty regarding the chance to outperform other participants (no feedback on performance) should have reproduced the negative relationship between WMC and difference in performance observed in Experiment 1. However, in the present procedure, was the mere “performance-approach goal” condition completely devoid of feedback regarding prior performance?

In Experiment 2, the OSPAN task—and not the first block of modular arithmetic problems as in Experiment 1—immediately preceded performance-approach goal instructions. Crucially, the OSPAN classic procedure entails that, during completion, a feedback regarding how many letters had accurately been recalled was displayed after each recall, thereby allowing participants to get an idea of whether they excelled in the task or not. Furthermore, the instructions made it very clear that the OSPAN task (which was over) and the modular arithmetic task (that they would have to complete straight after) relied on similar abilities, that is, “working memory and mental calculation”. It is therefore possible that, in the absence of any bogus feedback, this sequence gave participants the impression that (a) the task that they just completed had measured a given ability, and that (b) their performance at this task would be strongly correlated to their success at the modular arithmetic one, since both tasks relied on the same ability. This reasoning would thus imply that participants' perceived attainability of performance-approach goals has been influenced by their OSPAN performance – a reasoning that, importantly, cannot be applied to Experiment 1, since the first block of modular arithmetic problems was inserted after the OSPAN task, and the two tasks were presented as disconnected. We could then assume that participants in the “performance-approach goal alone” condition took on the task with a high confidence regarding their chance to attain performance-approach goals—just like the participants of the “performance-approach goal with positive feedback” and unlike the participants of the “performance-approach goal with average feedback” condition—an assumption that would account for the positive relationship between WMC and performance.

To test this interpretation, we ran a second linear regression analysis, for which we created a new set of contrasts, the first contrast opposing the “performance-approach goal with average feedback” to both the “performance-approach goal alone” and the “performance-approach goal with positive feedback” conditions (respectively coded as “-2 1 1”), and the second contrast (“0 1 -1”) testing the residual variance. Difference in performance for high-demand problems was then regressed on WMC, the two contrasts, as well as the two interactions between contrasts and WMC. The mean-centered difference in response time for high-demand problems (Phase 2 - Phase 1) was also entered as a control, as well as the interactions between this covariate and each predictor;

however, because these interactions are not theoretically relevant in the present research, they will not be discussed further.

Results revealed a significant interaction between WMC and the first contrast, $B = 0.14$, $t(89) = 2.10$, $p < .04$, $PRE = .05$; this finding provides evidence that the relationship between WMC and difference in performance is negative in the "performance-approach goal with average feedback" condition, and positive both in the "performance-approach goal alone" and the "performance-approach goal with high feedback" conditions[3]. No other effect was significant. The regression analysis conducted on low-demand problems led to non-significant effects (all *t*s < 1).

In sum, when taking the above re-interpretation into account, the second regression analysis that contrasted both the "performance-approach goals alone" and the "performance-approach goal with positive feedback" conditions with the "performance-approach goal with average feedback" condition brings support to Hypothesis 2, as it reveals a negative WMC – performance relationship only in the "performance-approach goal with average feedback" condition. Conversely, the opposite pattern appeared in both the "performance-approach goals alone" and the "performance-approach goal with positive feedback" conditions, those that provided, in different ways, reassuring information regarding the participants' chance to outperform others: in these cases, the higher the participants' WMC, the higher their difference in performance from pre- to post-test.

Lexical Decision Task.

Nine participants were excluded from the lexical decision task analysis: one participant had to be removed due to some computer's technical problems, and eight other participants were discarded from the analysis because they were not fluent French speakers and mentioned difficulties to efficiently differentiate words from non-words. Response times were log-transformed to achieve homogeneity of error variance; we however present non-transformed means, for the sake of clarity. Errors were excluded from the analysis (3.4% of the responses, 1.2% for words) as well as response latencies that were three standard deviations greater or smaller than each participant's mean response time for words.

In order to test whether status accessibility was different across experimental conditions depending on participants' WMC, we first computed a difference score for each participant, by subtracting the mean response time for status words from the mean response time for neutral words (non-words were not taken into account): the higher the score, the more accessible the status words. As for our performance dependent variable, we then computed a set of orthogonal contrasts. We have previously discussed the fact that the "performance-approach goal alone" condition actually contained feedback information regarding prior performance. Thus, we decided to run a linear regression analysis that aimed to test whether the activation of status increased as WMC increased, specifically in the "performance-approach goal with average feedback" more than in "performance-approach goal alone" and the "performance-approach goal with positive feedback" conditions.

Hence, we regressed the difference in response latencies on WMC (mean-centered), the same two orthogonal contrasts as in the second analysis presented for the difference in performance (respectively contrast 1: "-2 1 1" and contrast 2: "0 1 -1"), and their interactions. A main effect of WMC was found, $B = 0.001$, $t(86) = 1.99$, $p < .05$, $PRE = .04$, showing a higher activation of status concerns for individuals with high WMC. Also, interestingly, the predicted interaction between WMC and contrast 1 appeared to be significant, $B = -0.002$, $t(86) = -2.46$, $p < .02$, $PRE = .08$: In the "performance-approach goal with average feedback" condition, the higher the WMC, the higher the activation of status concerns, more so than in the "performance-approach goal alone" and "performance-approach goal with positive feedback" conditions (see Figure 4). This result highlights, in line with Hypothesis 3, that the accessibility of status concerns increases with WMC specifically for participants who have not been reassured about their performance, which nicely completes the result obtained with our main dependent variable, i.e., the difference in performance.

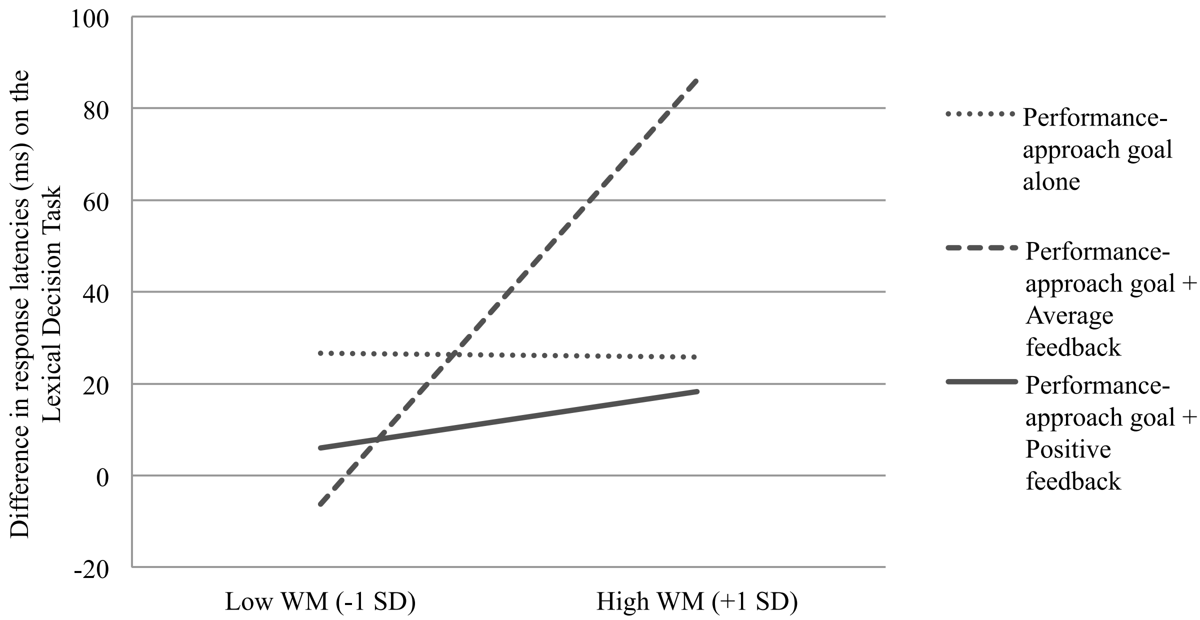


Figure 4.

Mean difference in response latencies (Neutral words – Status-related words) on the Lexical Decision Task as a function of experimental conditions and WMC.

3.2.2. Mediational role of status accessibility

In order to further assess the decisive role played by status activation in participants' decreasing difference in performance as a function of their WMC and the reception of an average normative feedback, we conducted a mediation analysis. In particular, we tested the mediational role of status accessibility (as measured through the lexical decision task) in the interaction effect between the experimental conditions and WMC on difference in performance. The summary of the results is presented graphically in Figure 5.

The conditions necessary for conducting the mediational analysis were met. In particular, as reported in the previous sections, the interaction testing Hypotheses 2 and 3—that is, the interaction between the first contrast ("1 -2 1", respectively associated with the performance-approach goals alone, performance-approach goal with average feedback, and performance-approach goal with positive feedback) and participants' WMC—significantly predicts our main dependent variable—that is, difference in performance (*c* path). Additionally, this same interaction between the first contrast and participants' WMC also proved to be a significant predictor of the mediator variable—that is, the accessibility of status as measured with the lexical decision task (*a* path).

We then conducted a multiple regression analysis on difference in performance for high-demand problems, with participants' WMC (mean-centered), the model contrast, the orthogonal contrast, their interactions, and the difference in response latencies at the lexical decision task as predictors; again, the mean-centered difference in response time for high-demand problems was entered as a control, as well as the interactions between this covariate and each predictor. Supporting the mediational role of status accessibility, results showed that the higher the difference in response latencies at the lexical decision task, the lower the difference in performance, $B = -39.87$, $t(80) = 1.99$, $p < .05$, $PRE = .05$ (*b* path)—meaning that the higher the accessibility of status, the lower the difference in performance—, while the interaction between the model contrast and participants' WMC became non-significantly related to the difference in performance, $B = 0.10$, $t(80) = 1.47$, $p = .14$ (*c'* path).

Finally, we followed the guidelines provided by Preacher and Hayes (2008) and conducted a mediation analysis with 5,000 bootstrap resamples. This approach computes 95 % confidence intervals associated to indirect effects; the mediation pathway is considered significant if the confidence interval does not include zero. Results confirmed that the accessibility of status-related thoughts as measured through the lexical decision task significantly mediated the relationship between the model contrast by participants' WMC interaction and difference in performance for high-demand problems (confidence interval from 0.01 to 0.12).

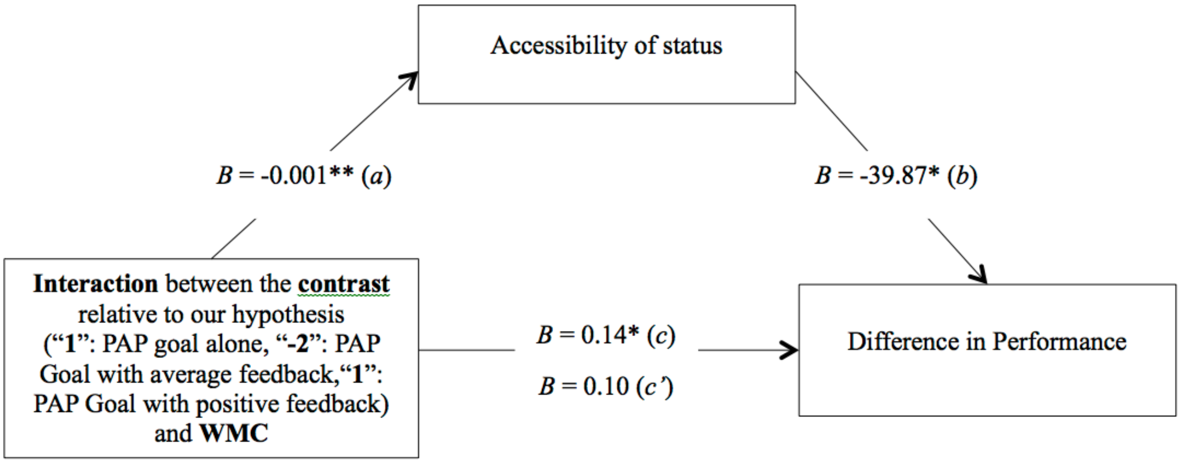


Figure 5.

Mediation by accessibility of status (as measured through the lexical decision task) of the relationship between the experimental conditions by WMC interaction and difference in performance for high-demand problems.

$* p < .05$. $** p < .02$.

General Discussion

The present research was conducted in order to examine whether the pursuit of performance-approach goals might paradoxically endanger high-WMC individuals' performance on cognitive tasks, to the extent that goal attainment may sometimes be uncertain. In particular, building on recent research showing that performance-approach goals can temporarily deplete working memory by activating outcome-related concerns that interfere with task focus (Crouzevialle & Butera, 2013), we proposed that high-WMC individuals—that is, individuals who are the most used to succeed academically (Alloway & Alloway, 2009; Cain et al., 2004)—might experience an heightened distraction related to performance-approach goals. This distraction may derive from high-WMC individuals' perception of evaluative situations as high-stake opportunities to reaffirm and preserve their positive status. Hence, high-WMC students, i.e. those who are the most acquainted with positive feedback and a reputation of being good students, should be vulnerable to evaluative pressure. Such an assumption might be regarded as counter-intuitive in light of research that has consistently identified WMC as a positive and robust predictor of achievement and performance in various domains including fluid intelligence (Unsworth & Engle, 2005) and mathematical problem solving (Ashcraft & Krause, 2007). Notwithstanding these rather consistent findings, the literature on the "choking under pressure" phenomenon has shown that individuals high in WMC may reduce their cognitive performance more than low WMC individuals when put under strong evaluative pressure (e.g. Beilock & Carr, 2005). We proposed that the higher the WMC, the more the students may be vulnerable to the concerns with the importance of outperforming others—i.e. performance approach goals—as attainment of these normative goals would imply the preservation of their high normative status. Since performance-approach goals have been shown to tax working memory in cognitive tasks (Crouzevialle & Butera, 2013), we predicted that higher WMC should result in lower cognitive performance specifically under performance-approach goals, as compared to non-normative goals.

Firstly, and in line with this hypothesis, results from Experiment 1 confirm our hypothesis that performance-approach goal—as compared to a non-normative achievement goal—entails higher distraction in a modular arithmetic task as the students' WMC increases. Thus, it appears that—paradoxically—it is precisely the striving for excellence that distracts higher-WMC students from the task. Secondly, Experiment 2 provides additional support to the hypothesis that higher-WMC students are particularly distracted by concerns with the attainment of a normatively superior position, through the manipulation of a bogus feedback. Indeed, the negative WMC – performance relationship was stronger after the presentation of an average, disappointing feedback, then after reassuring information about performance. It is then the need to outperform others without the assurance to be able to attain this goal that deprives higher-WMC students from a crucial part of their cognitive resources that cannot serve task focus, leading to performance impairment.

Our third finding of interest in this research confirms the existence of these concerns with status: As shown by the result obtained with the lexical decision task in Experiment 2, the higher the WMC, the higher the accessibility of status concerns, particularly when participants pursued performance-approach goals after the presentation of an average feedback. This finding brings evidence for the first time that high-WMC individuals can activate status concerns when put into conditions of uncertainty regarding their chance to outclass others and excel at the task. Moreover, the mediation analysis added crucial information by highlighting the explanatory role played by the accessibility of status concerns on the interactive effect of experimental manipulations and WMC on cognitive performance. This result supports our claim that evaluative situations where success is not guaranteed lead high-WMC individuals to activate specific status concerns, whose irrelevance regarding task focus compromises cognitive performance—thereby revealing by which mechanisms high competence can turn out to be a burden when important stakes such as demonstrating higher competence and high status maintenance are also at play.

It is worth noting that the presentation of results in Experiment 2 is rather unconventional. When we designed Experiment 2, we assumed that the "Performance-approach goals alone" condition, without a specific instruction with a performance feedback, should leave participants in doubt as to the chances to attain the goal, and create a negative link between WMC and cognitive performance like in the "Performance-approach goals" condition of Experiment 1, and the "Performance-approach goal with average feedback" condition of Experiment 2. Following the observation that in the "Performance-approach goals alone" condition the link between WMC and cognitive performance was positive, we reconsidered the procedure of Experiment 2. We have already discussed the reason that might account for this apparently contradictory result: because participants completed the OSPAN task just before reading the performance-approach goal manipulation, and due to the fact that feedbacks regarding performance were frequently displayed during the OSPAN task, participants took on the following task (which was presented as relying on similar abilities) with some confidence regarding their chance to attain performance-approach goals. Thus, even if the feedback provided during the OSPAN task did not inform participants about their ranking compared to others, it potentially influenced their feelings of self-efficacy and reduced the uncertainty that we suppose to be at play in the normative goal condition of Experiment 1. And indeed, the regression that tested this interpretation revealed a significant interaction effect. We decided to present the results in a narrative fashion, displaying both the failed and the successful analysis, because we believe that our initial misinterpretation of the properties of our experimental procedure is not a limitation but rather an element that supports our theoretical analysis: if we consider that in Experiment 2 the "Performance-approach goals alone" condition implies, like the "Performance-approach goal with positive feedback" condition, some reassurance concerning the possible attainment of performance-approach goals, then the results are in accordance with our Hypothesis 2 that uncertainty regarding chances to rise above others and preserve a positive status constitutes an increasingly distracting element as individuals' WMC increases.

The present research represents an important contribution to the achievement goal literature, since our findings allow shedding some light on the processes responsible for the link between performance-approach goals and achievement. Indeed, this literature has long shown that higher performance-approach goals lead to higher achievement, and that high achievers endorse performance-approach goals to a higher extent (for reviews, see Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Midgley, Kaplan, & Middleton, 2001; Senko et al., 2011). The existing results may therefore suggest that high achievers are comfortable with the strive for excellence represented by performance-approach goals, but the present results specify that this is the case to the extent that high-WMC students—shown to typically being high achievers (Alloway & Alloway, 2009)—are confident that they will attain their goals. Indeed, both experiments in the present study revealed that when performance-approach goals are salient and goal attainment is uncertain, WMC is paradoxically negatively related to cognitive performance, unlike situations in which normative goals are not salient (Experiment 1) or the attainment of performance-approach goals seems probable (Experiment 2).

Additionally, this research can also be related to the choking under pressure literature, as it demonstrated that the goal to outclass others carries more distractive consequences for high- than for low-WMC individuals—a result that somehow mirrors findings reported in this area (Beilock & Carr, 2005; Beilock & DeCaro, 2007; Gimmig, Huguet, Caverni, & Cury, 2006). Although our performance-approach goal manipulation, which is designed to motivate participants to get a high score and rise above others, diverges from the high-pressure scenario used in Beilock et al.'s studies—which mentions monetary rewards, peer pressure and social evaluation—this work could however provide inspiring new perspectives regarding the mechanisms at play under situations where one is motivated to perform at one's best. We thus believe that these promising findings may pave the way for future fruitful research, as they highlight the importance of further exploring the critical impact of outcome concerns and status activation when studying the moderating role of WMC differences in the deleterious effect of evaluative contexts on performance.

Footnotes

[1] Although the test of our hypothesis only requires the WMC * condition interaction to be significant, we additionally report the simple effects, for the sake of transparency. Simple effects analysis showed that among participants in the performance-approach goal condition, the higher the WMC, the lower the difference in performance, $B = -0.25$, $t(91) = -2.31$, $p < .05$; the relation between WMC and difference in performance in the mastery-approach goal condition is positive and non significant, $B = 0.10$, $t < 1$. Additionally, difference in performance does not differ across experimental conditions, be it among low-WMC participants ($B = 7.12$, $t(92) = 1.77$, $p = .08$) or among high-WMC participants ($B = 5.66$, $t(92) = 1.42$, $p = .16$).

[2] It can be noted that difference in performance of low-WM participants tends to be higher in the performance-approach goal condition as compared with the mastery-approach goal condition. A possible interpretation is that mastery-approach instructions might have slightly reduced all participants' efficiency, by focusing part of their attention on reflections regarding, for example, how to solve the task in the most effective way, or how they could gain knowledge from its practice. While such reflections and explorative behaviors could possibly be of benefit to long-term knowledge acquisition and growth, they may also have temporarily impaired task processing. We believe that this explanation is plausible in light of the growing literature on achievement goals that highlights the pursuit of mastery-approach goals as sometimes triggering study strategies that are primarily driven by one's interest without taking into account assignments or teachers' expectations—a study method that can jeopardize optimal academic achievement (e.g., Senko & Miles, 2008).

[3] As in Experiment 1, we report the simple effects, for the sake of transparency. Simple effects showed that in both the performance-approach goal alone condition, $B = 0.27$, $t(95) = 1.87$, $p = .06$, and in the the performance-approach goal with positive feedback condition, $B = 0.20$, $t(95) = 1.19$, $p = .23$, the relationship between participants' WMC and difference in performance is positive, although non-significant, while in the performance-approach goal with average feedback condition, this relationship is negative, although non-significant, $B = -0.15$, $t < 1$, $p = .33$. Additionally, we tested whether difference in performance differs across conditions for low-WMC and high-WMC participants, respectively. As far as low-WMC participants are concerned, simple effect analyses yielded no significant difference between the performance-approach goals alone and the performance-approach goals with average feedback conditions, $B = 5.81$, $t(95) = 1.18$, $p = .24$; moreover, no significant difference appeared between the performance-approach goals alone and the performance-approach goals with positive feedback conditions, $B = 4.93$, $t < 1$, $p = .35$; finally, no significant difference appeared between the performance-approach goals with average feedback and the

performance-approach goals with positive feedback conditions, *B* = 0.88, $t < 1$, $p = .87$. As far as high-WMC participants are concerned, the analyses revealed that the difference in performance significantly differed between the performance-approach goals with average feedback and the performance-approach goal with positive feedback conditions, *B* = 10.67, $t = 2.10$, $p < .05$. No significant difference appeared between the performance-approach goals alone and the performance-approach goals with average feedback conditions, *B* = 8.04, $t(95) = 1.55$, $p = .12$, or between the performance-approach goals alone and the performance-approach goals with positive feedback conditions, *B* = 2.63, $t < 1$, $p = .60$.

CHAPTER 4

Performance-approach goals influence strategic studying in the classroom: Examining the role of test anticipation on test performance

Performance-approach goals influence strategic studying in the classroom: Examining the role of test anticipation on test performance

Abstract

Whilst performance-approach goals (i.e., the desire to outperform others and demonstrate competence) are often described as positive predictors of test performance, their maladaptive impact on task focus have also been highlighted. This research investigates whether the test performance of students who strongly adopt performance-approach goals may be explained by their studying strategically—rather than regularly—e.g., when a graded test is upcoming. We set up a longitudinal design taking place in high-school classrooms; first we measured performance-approach goals, and later asked students to take a test that had either been announced a few days before (enabling strategic preparation) or not. Interestingly, the expected interaction between performance-approach goal endorsement and test anticipation proved to be moderated by students' initial level, and only appeared among low-achievers—for whom the pursuit of performance-approach goals predicted greater performance, but only when the test had been scheduled. Conversely, for high-achievers, performance-approach goal adoption positively predicted test score in the unscheduled test condition. This finding suggests that normative strivings differentially impacts low- and high-achievers' study strategies.

Keywords: performance-approach goals, strategic studying, test anticipation, performance

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Performance-approach goals influence strategic studying in the classroom: Examining the role of test anticipation on test performance

"Strong students read before classes, review their course material/notes after every class, and study throughout the entire 15 weeks of the semester—not just before the exam." This statement—which can be read under the "study tools and tips" headline of the Florida State University website—reflects a common advice most students repeatedly hear at the beginning of the academic year. However, despite this official discourse depicting ideal students as working on a regular basis rather than as a function of tests' and exams' schedule, evaluations are susceptible to play a central role in academic study strategies. Indeed, students' competence and knowledge acquisition are predominantly valued through tests and exams that lead teachers or examiners to attribute some worth, most often through the use of grades, to their performance (Covington, 2000; Deutsch, 1979; Ryan & Weinstein, 2009). Since the resulting grades and outcomes carry with them important consequences for school curricula and career development, students might consequently choose to deliberately focus their efforts and studying time on pre-evaluation periods, and thus favor a strategic—rather than regular—studying so as to secure high test performance.

According to the achievement goal approach (Elliot, 2005), students whose main goals are to obtain high grades and favorable evaluations, and to outperform their classmates, are described to pursue performance-approach goals (Elliot & Harackiewicz, 1996)—a motivation that has to be distinguished from performance-avoidance goals that refer to the striving for avoiding doing worse and appearing less talented than others. The beneficial as well as detrimental aspects and consequences of performance-approach goal pursuit on academic outcomes have been extensively debated (for reviews, see Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Midgley, Kaplan, & Middleton, 2001); indeed, the aim to outperform and rise above others has been shown to predict maladaptive academic behaviors, such as surface studying, but also crucial outcomes such as academic achievement. The present research proposes to study this paradox by testing whether the endorsement of performance-approach goals, by putting the emphasis on grades and ranking, engender a strategic rather than regular course studying that boosts performance when tests have been scheduled ahead.

The Paradox of Performance-Approach Goals and Academic Outcomes

While achievement goal literature has consistently depicted performance-avoidance goals as linked with a broad range of maladaptive outcomes such as anxiety, self-handicapping, work disorganization, and low achievement (Elliot & Church, 1997; Elliot, McGregor, & Gable, 1999; Midgley & Urdan, 2001; Wolters, 2004), behaviors and academic outcomes stemming from performance-approach goals depict a less straightforward profile. Indeed, a paradox has emerged, namely between on the one hand the seemingly positive consequences of performance-approach goal endorsement on academic achievement and, on the other hand, its maladaptive profile regarding various other academic behaviors, such as study processing and willingness to cooperate with others.

The consequences of performance-approach goal adoption on achievement has mainly been explored in classroom settings through the use of longitudinal designs; in particular, this method implies that students' self-reported achievement goal endorsement, measured during the academic year via questionnaire, is later associated with their actual final exam performance. Results stemming from these research have consistently identified performance-approach goal adoption as positively related with academic success (Barron & Harackiewicz, 2003; Darnon, Butera, Mugny, Quiamzade, & Hulleman, 2009; Elliot & McGregor, 1999, 2001; Elliot, McGregor, & Gable, 1999; Harackiewicz, Barron, Tauer, & Elliot, 2002; see also Senko, Hulleman, & Harackiewicz, 2011, for a review); importantly, this link that has been replicated among college students (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000) as well as middle school students (Wolters, Yu, & Pintrich, 1996), in large introductory courses (Elliot & Church, 1997; Pekrun, Elliot, & Maier, 2009) but also advanced seminars (Barron & Harackiewick, 2003). In accordance with this positive pattern, some studies have also showed a positive link between performance-approach goal adoption and effort (Elliot et al., 1999; Lopez, 2000), challenge construal (McGregor & Elliot, 2002), as well as deep processing strategies (Howell & Watson, 2008; Liem, Lau, & Nie, 2008).

While such findings depict performance-approach goal adoption as beneficial to achievement in the classroom, other results however point out its maladaptive consequences on various academic outcomes. Indeed, performance-approach goals have been associated with low persistence after failure, preference for easy rather than challenging tasks (Grant & Dweck, 2003; Midgley, Kaplan, & Middleton, 2001), deleterious forms of conflict regulation (Darnon, Muller, Schrager, Pannuzzo, & Butera, 2006), lower cooperation intentions with classmates (Poortvliet, Janssen, Van Yperen, & Van de Vliert, 2007), as well as higher cheating intentions and behaviors (Pulfrey & Butera, 2013; Van Yperen, Hamstra, Van der Klauw, 2011). Additionally, performance-approach goals have often been related to the use of surface learning strategies (Elliot & McGregor, 2001; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000) such as rote memorization (Elliot, McGregor, & Gable, 1999), depicting performance-oriented students as prone to rely on short-cut strategies that may temporarily prove useful to obtain high grades at the exam but that however do not seem directed towards deep and long-term learning. Thus, it seems that the importance to secure a high score and to outperform others has the potential to jeopardize task focus and knowledge acquisition, revealing a maladaptive side of performance-approach goal adoption.

Can Strategic Studying Account for Good Grades of Performance-Approach Students?

How, then, can the robust positive impact of performance-approach goal endorsement on academic achievement be accounted for? Senko et al. (2011) reviewed the possibility that surface learning might prove adaptive, and allow reaching good grades while circumventing arduous work, but concluded that "no study supported the assumption that surface learning can explain the normative goal link with achievement" (p. 39). Interestingly, the "learning agenda" hypothesis recently put forward another noteworthy explanation, and proposed that performance-approach goal adoption, instead of promoting a fixed (i.e., deep vs. surface) type of task learning and studying, rather renders students more vigilant towards cues related to teachers' expectations and topics that they consider as the most important. Accordingly, Senko, Hama, and Belmonte (2013) found first evidence for this vigilant approach and showed it had the potential to help achievement, by promoting "strategic flexibility in how students approach their learning" (p. 8).

While Senko and colleagues chose to focus on the question of *what* students choose to study, we propose to investigate performance-oriented students' strategic studying by examining *when* they study. In particular, we claim that finding evidence demonstrating that performance-approach goals trigger a strategic, test-focused—rather than continuous and regular—study of course content would contribute to explaining the paradox of performance-approach goals, which predict the use of short-cut learning strategies and at the same time test performance.

Exams and assessments, which occupy a central position in students' lives, are in most cases scheduled ahead: most of the time, teachers set up a fixed date for the test and inform the class accordingly, a few days before. This procedure gives students the possibility to study their notes and lessons in order to be well prepared for the evaluation and maximize their chance of success. In this article, our aim was to find evidence that students committed to the pursuit of performance-approach goals do rely on a strategic and test-focused revision schedule, and consequently choose to tactically concentrate their resources and efforts on pre-evaluation period rather than to work regularly throughout the academic period. Following this reasoning, the time lag between test announcement and the test itself would constitute, for a performance-driven student, a key period allowing test preparation in order to succeed at the exam and attain normative competence.

Following this reasoning, we carried out a field experiment in a public high school; we first measured the students' performance-approach goals, and then manipulated evaluative test announcement (scheduled vs. pop quiz) following regular class lessons. In particular, we considered that high schools should be a particularly appropriate setting to test our hypothesis, given that tests are quite frequent and pop quizzes are common practice in this environment. Thus, we tested the hypothesis that—if students who strongly adopt performance-approach goals in academic settings choose to study strategically only before scheduled evaluations, rather than regularly—then performance-approach goal adoption should predict test performance under scheduled test condition, more so than under conditions that give no opportunity to strategically anticipate the evaluation (pop quiz).

Method

Participants. One hundred and ninety-six students attending the 10^{th} grade in a public high school based in France took part in this experiment. Twenty-three students were discarded from the analyses: twenty of them were absent the day of the final test, one student did not fully fill in the questionnaire measuring achievement goals, and two students respectively answered either 1 or 7 to every question in the questionnaire, suggesting a lack of involvement in the task. The final sample consisted of one hundred and seventy-three students (81 girls, 92 boys), with a mean age of 15.48 (*SD* = 0.62), attending six classes; three classes were randomly assigned to each of the two conditions (scheduled test, N = 83, and unscheduled test, N = 90). Before the experiment, we obtained the agreement of the regional inspector of public education, the school's headmaster and the teachers, as well as the authorization of the children's parents.

Procedure. The first stage of this experiment consisted of the students filling out a questionnaire that assessed performance-approach goals; we used Elliot and McGregor's scale (2001; validated in French by Darnon & Butera, 2005). This stage of the procedure was carried out by one of the authors at the beginning of a regular physics and chemistry class, one week prior to the beginning of the course session that was part of the experiment; with the collaboration of the class teachers, the questionnaire was presented to the pupils as a survey investigating high school students' motivation. Students were told that their answers to that questionnaire would be treated anonymously, and that it was crucial for the aim of the survey that they responded in the most honest and authentic manner. The scale had been adapted in order to fit the physics and chemistry class; participants were asked to report to what extent each statement was true for them, by using 1 (*strongly disagree*) to 7 (*strongly agree*) scales. Our measure included three items measuring performance-approach goals[1] (e.g., "In this class, it is important for me to outperform others", α = .82, M = 3.75, SD = 1.42).

As a second stage of the experiment, all students from the six classes attended a two-week lesson that was taught by their regular teacher during their regular physics and chemistry class. The three teachers who were involved in the experiment—but were blind to the specific hypotheses—had come to an agreement regarding the course content as well as the practical exercises that had to be addressed within the classroom; hence, crucially, the content of this two-week lesson was strictly similar throughout the six classes. This lesson dealt with distillation and extraction techniques, and was divided between classes and practical workshop sessions. Importantly, this part of the experiment was rigorously controlled and directed by the authors, so as to ensure that the content was similar for each class.

Our manipulation occurred before the next part of the experiment, that is, the final test taking place at the end of this two-week period; indeed, this final test was either announced by their teacher one week before, for three classes ("*scheduled test*" condition), or not, for the three remaining classes ("*unscheduled test*" condition), thereby enabling—or not—test preparation. The test was a multiple-choice questionnaire designed to assess students' understanding and integration of the lesson content; it consisted of 20 different questions. In order to make sure that the answering process was difficult enough, for each question, either none, one, or several of the four answer choices were correct and had to be accurately identified by the student; only then was the answer counted as correct. Finally, all the tests were corrected by the teachers, and graded on a scale from 0 to 20 (M = 12.73, SD = 3.41), which corresponds to the usual grading scale in France.

In addition to test scores, we collected the average grade obtained by each student in the physics and chemistry class both in the first and second quarter, as a baseline. Because they were strongly correlated with each other (r = .83, p < .001), we averaged them in an overall grade that we labeled "initial level", also rated between 0 and 20 (M = 10.43, SD = 3.53).

Results

Correlations among variables. Inter-correlations among variables reveal that performance-approach goals are positively correlated to the initial level (r = .34, p < .001), as well as to test score (r = .33, p < .001); additionally, test score is positively correlated to the initial level (r = .53, p < .001).

Test score. We hypothesized that performance-approach goal endorsement should predict final test score in the "scheduled test" condition more than in the "unscheduled test" condition, if it is true that normative goal pursuit leads students to study strategically, rather than regularly, only before scheduled evaluations. In order to test this hypothesis, we carried out a linear regression analysis, which included performance-approach goals (mean-centered), the experimental conditions (with the "unscheduled test" condition coded -0,5 and the "scheduled test" condition coded 0,5), as well as the interaction between performance-approach goals and the experimental condition. We additionally entered the initial level grade (mean-centered) as a covariate, as well as the interactions between the covariate and the two independent variables (Yzerbyt, Muller, & Judd, 2004).

In preliminary analyses, we additionally included gender as a factor, as well as the interactions between gender and each predictor. This analysis revealed a significant main effect of gender, B = -1.19, t(157) = -2.46, p < .02, showing that boys obtained a better performance at the test as compared with girls. However, since gender did not interact with any of the regression predictors, this variable was not retain for further analysis.

The final regression model thus contained seven terms: two main effect terms (performance-approach goals and experimental conditions), the covariate (initial level grade), three two-way interaction terms (the one between performance-approach goals and experimental conditions, as well as two interactions between the covariate and each independent variable), and a three-way interaction among performance-approach goals, the experimental conditions, and the initial level grade.

This linear regression analysis revealed that both performance-approach goals, $B = 0.42$, $t(165) = 2.65$, $p < .01$, and the initial level, $B = 0.45$, $t(165) = 6.95$, $p < .01$, positively predicted the final test score; we also observed a significant impact of the experimental manipulation on test performance, $B = 1.78$, $t(165) = 3.99$, $p < .01$, revealing that students from the scheduled test condition obtained a higher score than their counterparts from the unscheduled test condition. Crucially, the predicted interaction between experimental conditions and performance-approach goals appeared to be non-significant, $B = -0.3$, $t < 1$. However, and most interestingly, the three-way interaction between performance-approach goals, the experimental conditions, and the initial level grade proved to be significant, $B = -0.18$, $t(165) = -1.98$, $p < .05$, revealing a noteworthy pattern that is displayed in Figure 1.

This three-way interaction revealed that the impact of the final test announcement was quite different depending on performance-approach goal endorsement as well as initial level grade. Analyses of simple slopes further indicated that, for students with a low initial level in physics and chemistry, performance-approach goal adoption positively predicted test performance in the scheduled test condition, $B = 0.76$, $t(165) = 2.59$, $p < .02$, but not in the unscheduled test condition, $B = 0.17$, $t < 1$, a pattern that is in line with our hypothesis. However, for students with a high initial level, performance-approach goal adoption was neither related to test performance in the scheduled test condition, $B = 0.05$, $t < 1$, nor in the unscheduled test condition, $B = 0.70$, $t(165) = 1.95$, $p > .05$.

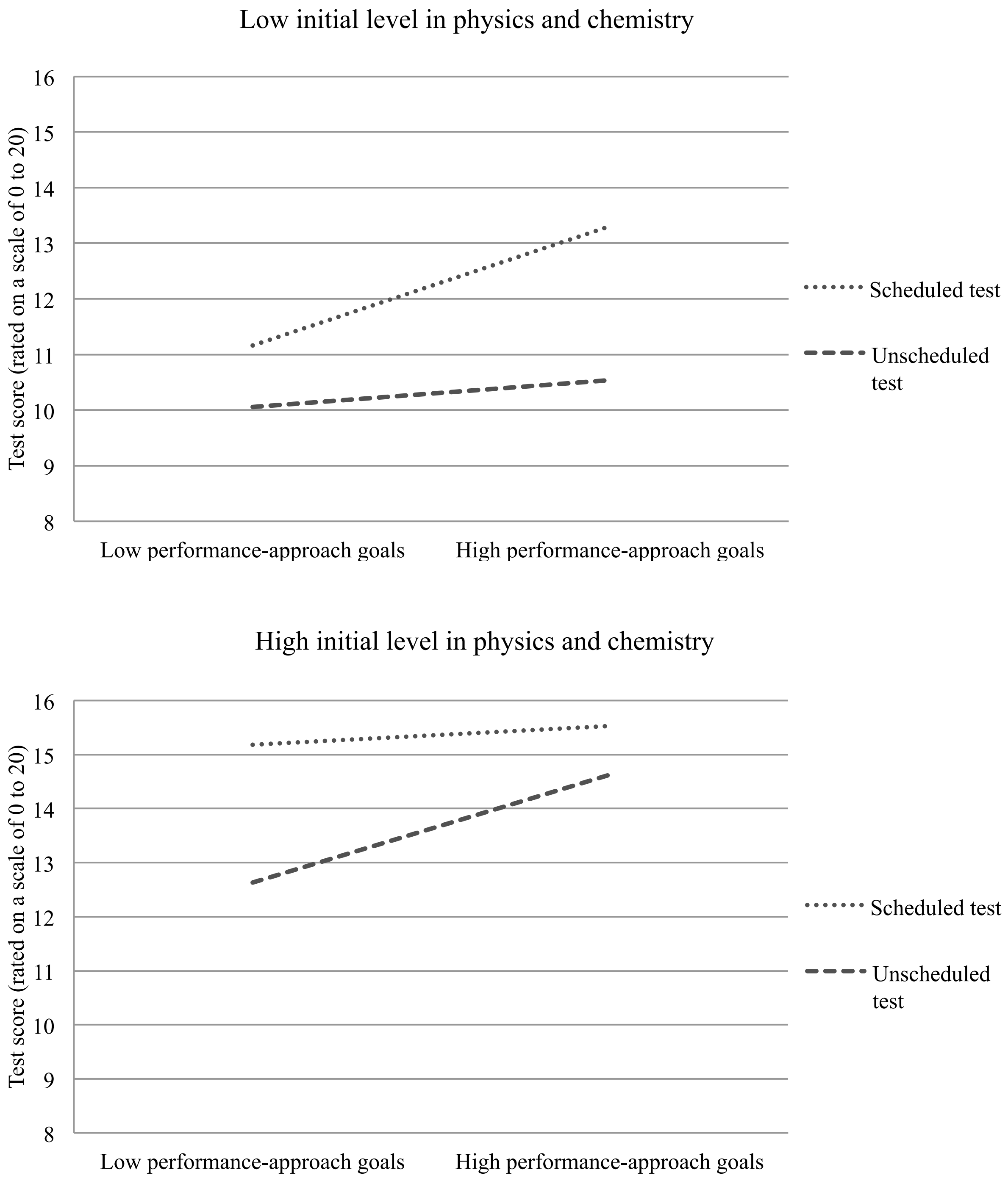

Figure 1.

Test scores on the final multiple-choice questionnaire, as a function of self-reported performance-approach goal endorsement and test announcement (scheduled, unscheduled), for students having a low (top chart) and high (bottom chart) initial level in physics and chemistry.

Discussion

Normative strivings have been found to positively predict students' academic achievement and exam performance (Elliot, 2005), but they have also been frequently associated with the use of strategic behaviors (e.g., cheating, surface processing of course content, heightened vigilance toward teachers' expectations), depicting performance-approach goals as fostering a desire to guarantee exam success while sparing a rigorous and effortful study of course content. This research sought to find evidence that students driven by normative strivings achieve high test performance through the use of superficial and purely tactical study of course content instead of deep, effortful and regular studying. In particular, we studied to what extent performance-driven students strategically focus their review of course material to periods preceding graded evaluations (usually scheduled ahead). To test this hypothesis, we set up a longitudinal design taking place in the natural setting of a physics and chemistry class, and manipulated students' anticipation of the final evaluation, that was either announced beforehand or not. Our hypothesis was that, if performance-approach goal endorsement indeed favors performance through enhancing strategic studying prior to the test, then the positive normative goal endorsement-performance relationship should be observed especially in the condition that allowed test anticipation.

Unexpectedly, results revealed that the predicted interaction between performance-approach goal endorsement and test announcement on test performance—which was non significant—was actually moderated by the students' initial level in chemistry and physics (as measured by their average grade in the first and second quarter). In particular, our data indicated that the pattern that was expected to emerge—i.e., the higher the students' performance-approach goal adoption, the higher their test score, especially when the test had been announced ahead—appeared only among low-achievers, that is, students with a low initial level in physic and chemistry. Interestingly, a different pattern emerged among students taking the test with a high initial level; indeed, their adoption of performance-approach goals did not affect test performance, either when the test had been scheduled or in the unscheduled test condition, thereby suggesting a generalized beneficial impact of being a good student.

Why is this? The present research does not allow a full understanding of the mechanisms underlying this moderating effect, but nonetheless paves the way to promising directions for future research. In particular, the diverging patterns observed for students with a low versus high initial level suggest that the pursuit of performance-approach goals may lead students to adopt different study behaviors depending on their level of competence. Because our research took place at a late stage of the academic year, namely in April, it is reasonable to assume that, at this point in time, each students' average level of competence inside the classroom—based on the grades and ranking they had so far obtained throughout the year in this discipline—was already well-established, respectively associating the lowest- and highest-performing students with different status, namely that of either low- or high-achievers, of either bad or good pupils. In particular, data related with students' initial level in this class before taking the test indicate that low-performing students had reached an average of 6.90 out of 20—meaning they were indeed failing to reach the pass mark—while high-performing students had so far obtained an average of 13.96 out of 20 (which, in France, corresponds to a modestly high average).

Our findings tend to indicate that the more low-achieving students pursue the goal to perform better than other classmates, the more they rely on test-focused study strategies, suggesting that when motivated by normative concerns, these students choose to work on their course content only when a graded test is upcoming, and strongly rely on pre-evaluation periods to intensively study the course material. This dynamic does not appear among their high-performing counterparts; indeed, data suggest that they adopt a regular and steady process of course content instead of implementing study strategies that are dictated by test schedule, and this whatever their normative goal endorsement.

This explanation, which remains speculative, will certainly need to be addressed in further research. We believe this is an important endeavor, as it allows shedding light on the motivational dynamics underlying students' study behaviors and eventually influencing crucial outcomes such as test performance and learning. Notably, the present research did not include a long-term learning measurement—an outcome that might however be prone to add crucial information regarding the either adaptive or deleterious long-term consequences of study strategies' behaviors. Notwithstanding this limitation, we believe the present work allows a first understanding of how traditional features of testing evaluations (here: test anticipation) are prone to influence performance-driven students' studying strategies; hence, we believe this line of research has the potential to bring crucial information regarding the debate of whether performance-approach goals are beneficial or detrimental to academic achievement and for whom.

Footnote

[1] Even if our hypothesis only dealt with performance-approach goal endorsement, we additionally included the items of the scale measuring mastery-approach goals, mastery-avoidance goals, and performance-avoidance goals, and conducted preliminary analyses, as a control, in order to assess whether either of them interacted with test announcement to predict test score. As none of these analyses appeared to be significant, data regarding these three achievement goals are not discussed further.

GENERAL DISCUSSION

Striving for excellence is part of most students' lives, as they hear quite frequently about the importance of getting high grades and positively distinguish themselves in the eyes of teachers and of the assessment body, so as to maximize their chances to get access to a high-profile career associated with prestigious and lucrative positions in society. Success at school and University is thus associated with high stakes that are often perceived by students as sources of pressure. In particular, the salience and importance of grades—which represent a central feature of scholastic life, since they determine individuals' achievement as well as their advancement from one year to the next—entails that students may devote a significant part of their attention to their performance as well as to their rank as compared with their classmates.

In this dissertation, our main aim was to explore whether being motivated to outperform others and appear talented (i.e., the pursuit of performance-approach goals) can generate concerns that have the potential to interfere with task processing and therefore to erode cognitive performance. In particular, we argued that the salience of high stakes embedded within the normative goal pursuit—be they relative to direct academic consequences such as graduation, but also to the need to maintain positive feelings of self-worth—, may trigger a frequent activation of performance-approach goals in mind, and compromise a full focus on the task. Importantly, our reasoning also implied that such salience of goal-attainment concerns might on the contrary be beneficial to academic achievement as traditionally measured in educational structures, i.e., in long-term classroom settings, by motivating performance-driven students to adopt strategic academic behaviors directed toward the guarantee of high grades more than the deep learning of the materials.

1. Highlights of the results

The aim of our first line of research was to seek evidence confirming the interfering potential of performance-approach goals, which we argue to be due to the activation of outcome concerns that should reduce the attentional resources available for the task at hand (Hypothesis 1). Results stemming from three laboratory experiments—reported in the first empirical chapter of this dissertation—confirm this hypothesis. Indeed, Experiment 1 brought preliminary evidence in favor of the distraction hypothesis, by demonstrating that performance-approach goal pursuit—here manipulated via an implicit priming—impaired performance at complex cognitive problem solving as compared with a control (i.e., no goal) condition. Further information regarding the *nature* as well as the *content* of this interference came with Experiments 2 and 3. In these experiments, we opted for a more commonly used goal manipulation, that is, explicit instructions putting the emphasis on the importance to perform better than other participants (normative component of performance-approach goals) as well as on the importance to be judged positively by experimenters (appearance component of performance-approach goals). These instructions actually aimed at motivating participants to endorse performance-approach goals while imitating the normative evaluative structure of most educational environments. Results of Experiment 2 confirmed that the pursuit of performance-approach goals activated distractive thoughts, taking the form of an inner language that drew on the limited verbal resources of working memory. Indeed, the deleterious impact of performance-approach goals observed in Experiment 1 was replicated only when the task to be performed heavily solicited these verbal resources. Importantly, this finding moved us forward in the understanding of the distraction hypothesis, by demonstrating that performance-approach goal pursuit co-opted working memory resources required for the task at hand. Then, as a next step, Experiment 3 sought to assess the content of these distractive thoughts; relying on Wegner's theory dealing with mental control and thought suppression (Wegner, 1994; Wegner & Erber, 1992), we obtained evidence confirming that performance-approach goals by default elicited goal-related hyper-accessibility—an hyper-accessibility that was indeed involved in the task performance impairment.

Hence, taken together, these three experiments pinpointed the intrusive potential of performance-approach goals, by highlighting how its pursuit is prone to consume working memory resources that are therefore no longer available for the task solving—a divided attention situation that is problematic if the task or activity to be completed is highly demanding. Furthermore, results stemming from the test of Hypothesis 2a and 2b, presented in the second empirical chapter of this dissertation, nicely built on—and extended—the above findings, and provided valuable information regarding the mechanisms underlying the interfering effect of performance-approach goals on cognitive performance. Indeed, Experiment 4 revealed that the pursuit of performance-approach goals directed participants' attention towards abstract, high-level considerations related to the pursued final outcome as well as its potential consequences and implications for the self, to the detriment of task-related processes directed towards the means required to efficiently attain the goal. The use of a thought listing questionnaire further allowed us to confirm that this abstract representation of the goal indeed lowered task focus (as measured by the proportion of thoughts devoted to the task during its solving)—which in turn caused the performance impairment, as testified by the significant mediation analysis. This result thus once again pointed at *distraction* as the mechanism responsible for performance decrement under performance-approach goal pursuit, thereby highlighting for the first time performance-approach goals as disruptive for the full cognitive engagement in the task solving.

As we mention the deleterious consequences of *goal hyper-accessibility* on task focus and cognitive performance, we wish here to make a comment regarding what the term "hyper-accessibility" precisely imply, and in particular to clarify the distinction between on the one hand a "useful" goal accessibility, and on the other hand a "useless" and detrimental one. Earlier in this manuscript, we have evoked Klinger's current concerns theory which proposes that goal commitment yields a high degree of accessibility and detection of goal-related stimuli—a mechanism that proves to be useful since it enhances chances to successfully attain the goal. We contend that such goal accessibility is thus functional. Moreover, and interestingly for this contention, experimental research demonstrated that the initiation of a previously formed implementation intention—leading the individual to explicitly plan a behavioral response when encountering a specific situational context—could be made outside of conscious awareness and would not solicit cognitive resources (Sheeran, Webb, & Gollwitzer, 2005). However, and as mentioned in the introduction of this dissertation, thoughts associated with the targeted end state can by contrast prove to be irrelevant and distractive—especially when the pursued goal is a higher-order goal—since it can trigger thoughts whose abstractness does not serve task-related processes. We chose to label this "useless" goal accessibility *hyper-accessibility*, arguing that the frequency of goal-related concerns is, in that case, largely irrelevant and thus taxes cognitive resources and attention in an inefficient way.

We now turn to the second line of research of this dissertation, namely to investigate whether the performance-approach goal-related interference highlighted in the first line of research could be even amplified for high-achieving individuals. In particular, basing our reasoning on results showing how high-working memory capacity individuals are more prone to underachieve under evaluative pressure than their low-working memory capacity counterparts—the "choking under pressure" phenomenon—, we argued that this vulnerability might be rooted in heightened feelings of pressure and perception of high-stakes for those individuals who are the most used to perform well. Addressing this question led us to design Experiments 5 and 6. Results of these two experiments, reported in the third empirical chapter of this dissertation, supported the aforementioned hypothesis. In particular, using the same modular arithmetic task solving as in our first line of research, we obtained evidence that the higher the participants' working memory capacity, the greater their performance impairment under performance-approach goal instructions—an effect that, importantly, did not appear with non-normative achievement goal instructions. Crucially, Experiment 6 revealed that this phenomenon was driven by uncertainty regarding the chances to attain performance-approach goals, that is, to successfully rise above other participants and excel at the task. This important finding highlighted for the first time the reason why normative strivings can paradoxically turn out to be threatening for individuals who are used to be high-achievers, and for whom failure to maintain their positive status might carry deleterious consequences as far as feelings of self-worth are concerned. Crucially, findings regarding accessibility of status-related thoughts gave additional weight to this interpretation, and showed that raising the possibility to not achieve at one's best entailed the activation of status-related concerns for high-working memory capacity participants. Taken together, these two experiments suggest that performance-approach goal pursuit, when coupled with uncertainty to attain the goal, carries a very specific distraction for high-achieving individuals—a distraction that precisely stems from their favorable status that they have to defend at each important evaluative occasion.

Notably, one might draw a parallel between this finding and literature documenting the deleterious effect of positive stereotype activation on performance. Indeed, Cheryan and Bodenhausen (2000) have shown that Asian participants who had been exposed to a positive stereotype regarding their social identity (i.e., "Asian people are good at math") were subsequently less likely to perform well at a math test than their counterparts for whom no positive stereotype had been activated. They assimilated this phenomenon to the Choking under Pressure one, arguing that positive expectancies of personal success ironically threatened performance. An important difference should however be highlighted. Indeed, in the Cheryan and Bodenhausen's experiment, the positive stereotype was made explicitly salient by the procedure, since participants from this condition were asked to complete the Collective Self-Esteem scale (Luthanen & Crocker, 1992; e.g., "Overall, my race is considered good by others") in order to make the public performance expectancies prominent. In both our experiments, such external, public expectations of performance were not rendered explicitly salient, as our manipulation was more subtle (participants were informed their personal score and rank would be provided at the end of the experiment and that they should try to obtain the most favorable ranking information). We thus believe that, in our experiments, the *public* aspect of the positive expectations may not be necessary to trigger interference, and that *private* expectations—and in particular the desire to maintain a positive self-image—could be sufficient to activate distraction. This point may however be interesting to address in future research.

With the third line of research, we turned toward natural classroom settings with the purpose to investigate whether and how students' endorsement of performance-approach goals might, in such long-term settings, entail the implementation and use of study strategies favoring test performance. Our underlying goal was to try to reconcile results stemming from our laboratory studies—highlighting the performance-approach goals' distractive consequences on working memory resources—with the overall profile emerging from longitudinal research, which consistently depicts an opposite pattern, namely performance-approach goals as a positive predictor of students' test scores. Here, we chose to assess students' use of study strategies by manipulating test announcement. Our results revealed an unexpected pattern, since the interaction between test announcement and performance-approach goal endorsement that we expected to predict test performance turned out to be moderated by students' initial level. In particular, our hypothesis was confirmed only among low-achieving students, for whom performance-approach goal adoption positively predicted test score when the test had been anticipated more so than when it had not (pop quiz); by contrast, high-achieving students' adoption of performance-approach goals did not affect their test performance. Beyond drawing attention to new issues and the need to replicate and closer investigate this moderation effect, this result interestingly highlights how traditional features of testing evaluations (here: test announcement to students a few days before) can act as decisive markers that performance-oriented students use to determine *when* they should study their course material if they want to make the grade; in particular, it confirms—but only among low-achieving students—that being driven by normative strivings encourages study of course material only when grades are anticipated, a strategy that consequently does not pay off anymore when such a traditional marker is removed.

Overall, the findings presented in this dissertation appear to be quite consistent. Indeed, they highlight and extensively document the distractive consequences of performance-approach goal pursuit, a distraction that is further exacerbated for high-working memory capacity (i.e., high-achieving) individuals when success is not certain. Crucially, this work also presents arguments aiming to integrate these findings with respect to the achievement goal literature, and highlights how performance-approach goals can turn out to boost achievement in the classroom—when tactical planning and implementation of short-cut performance-driven strategies can be implemented. We will now discuss the specific originality of our research with regard to the existing literature, and emphasize its contribution in the light of the debate regarding whether performance-approach goals should be encouraged or not in educational settings (see Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, et al., 2002; Midgley, et al., 2001).

2. Originality of the research

The very fact that we obtained evidence showing that performance-approach goals impair performance is a finding at odd with the majority of the literature on achievement goals. Why is this? We now focus on the theoretical as well as methodological originality of our approach that have allowed us to shed light on a yet unexplored but nonetheless crucial facet of a norm-based goal pursuit.

2.1. Testing the cognitive cost of performance-approach goal pursuit: Why and how?

As a primary concern, our research has aimed to raise the question of the cognitive costs associated with performance-approach goal pursuit. To build our hypothesis, we based our reasoning on the literature documenting goal hyper-accessibility as one of the consequences stemming from goal pursuit (Klinger, 1975; Gollwitzer, 1996; Förster et al., 2005), and argued that in the case of performance-approach goals, this heightened activation might prove disruptive for efficient focus on task-related processes. We expected the investigation of this question—which had notably not yet been addressed in the literature exploring achievement goals—to put the spotlight on an important issue, namely the distractive potential of performance-approach goal pursuit.

Casting our minds back to the introductory part of this dissertation, we may remind the evocation of Klinger's (1975, 2009) Current Concern Theory, which basically posits that becoming committed to a goal increases its accessibility in mind, until the goal is reached or abandoned. In the light of this literature, the very fact that we found evidence that performance-approach goal pursuit heightens the accessibility of goal-related thoughts comes as no surprise. However, while this frequent goal activation in mind is generally admitted as highly functional—by enhancing the individuals' promptness to detect stimuli that should favor goal attainment (Gollwitzer, 1996; Förster et al., 2005)—some researchers have pointed to its counter-productive potential (McVay & Kane, 2010; Watkins, 2008), and argued that being focused on the targeted final end state can slow task execution and progress, by uselessly consuming attentional resources. Such a consequence should specifically emerge when the goal is represented in high-level terms while progress toward its attainment would rather solicit a concrete focus on the activity.

We think our results bring all these elements together. Indeed, our research provides explicit evidence confirming that normative strivings are disruptive for complex task solving, when success at the task is dependent upon successful cognitive immersion in the required mental operations. In line with the aforementioned reasoning, we claim this disruption is precisely rooted in the mismatch lying between on the one hand, the type of concerns that performance-approach goals are prone to elicit—focused on grades and social comparison, which are at the core of normative strivings—and, on the other hand, the behaviors necessary for goal attainment—that is, a focus on the task and the processes involved in its execution. This mismatch thus creates a situation comparable to a dual-task environment—a result that is notably compatible with the distraction theories that underlie the choking under phenomenon, where "pressure fills working memory with thoughts about the situation and its importance that compete with the attention normally allocated to execution" (Beilock et al., 2004, p. 584). In a similar fashion, our findings reveal that frequent activation of thoughts about the desired end state turned out to endanger the elaboration and efficient implementation of concrete means, making the normative goal hyper-accessibility unproductive when it came to effective task execution.

Several of our findings directly backed up this reasoning. Thus, as far as the first line of research is concerned, the decisive role of goal hyper-accessibility is especially corroborated by results stemming from Experiment 3—manipulating neutral versus norm-based goal-related hyper-accessibility—, which pinpoints performance-approach goal content as specifically interfering. Additionally, results emerging from Experiment 4 nicely extended this finding, since they demonstrated how being focused on high-level goal construal considerations eroded the focus on task-related concrete operations that are required for an efficient task solving—a mechanism that reduced cognitive performance, as revealed by the significant mediation analysis. Moreover, the second line of research also brought important information regarding the irrelevance of goal activation during task completion, by showing how high-working memory capacity individuals are especially targeted by distractive concerns during performance-approach goal pursuit. We hypothesized that such an enhanced distraction could result from these individuals' favorable status, leading them to paradoxically experience an additional pressure. The pattern we obtained regarding the accessibility of status-related thoughts further confirmed performance-approach goal pursuit as likely to activate concerns whose content depends for instance on the intensity of stakes and success expectations associated with goal attainment. Notably, this result that mirrors the one obtained in the choking under pressure literature pinpoints for the first time the motivational dynamics underlying underperformance of high-working memory capacity individuals when put under evaluative pressure, and highlights how the importance to succeed well and demonstrate high competence can turn out to be a burden when important stakes such as self-esteem and high status maintenance are also at play—these concerns ironically precipitating a decline in performance.

From a methodological standpoint, it is important to note that the identification of the cause and content of distraction has been rendered possible by the use of various measures tools, that have actually proved to nicely complement the findings obtained with our main dependent variable, namely performance. For instance, the use of the thought-listing questionnaire we have opted for in Experiment 4 in order to assess the intensity of task focus—a method based on retrospective verbal report that was also used in the choking under pressure literature (see DeCaro et al., 2010)—presents the advantage of providing extensive information about the participants' thought content.

Also worth underlining is the use of an accessibility measure, namely the lexical decision task, that we have adapted on two occasions: as a manipulation check so as to confirm the efficacy of our goal manipulation (Experiment 2) and as a measure of the accessibility of thoughts related to status (Experiment 6, second research line). This lexical decision paradigm, which is widely used among researchers interested in the implicit assessment of thought content and goal activation (Förster et al., 2005; Koole et al., 1999; Marsh, Hicks, & Bink, 1998; McCrea, Wieber, & Myers, 2012; see also Förster, Liberman, & Friedman, 2007), is based upon the assumption that when a concept is activated in memory, words that are related to this concept will be recognized faster than those that are non-related (Dijksterhuis & van Knippenberg, 1996; Neely, 1991), resulting in shorter response latencies for words belonging to the former—as compared to the latter—category. Relying on this accessibility task has proved to be fruitful in that it provided reliable information regarding the participants' current concerns during the experimental session. In Experiment 6, in particular, it is plausible to imagine that the activation of status-related thoughts might not even have reached participants' awareness—a reasoning backed up by the argument that individuals might lack introspective insight when it comes to accurately assess the working of their minds and origins of their behaviors (Nisbett & Wilson, 1977). Implicit measures assessing the accessibility of thoughts allow circumventing this issue. We thus contend that researchers interested in the study of achievement goal pursuit from a cognitive or behavioral perspective should consider relying on such accessibility measures, beyond or in complement to self-reports that are still predominantly used in that field, for such a method appears to be trustworthy and might allow shedding some light on processes that self-report measures are not in the best position to reveal.

2.2. Important aspects on which our research differs from the existing literature on achievement goals

The test of the distraction hypothesis notably appeared to challenge achievement goal literature and the acknowledged positive link associating performance-approach goals with high academic achievement. Indeed, embedded in our reasoning was the claim that the methodology most widely used to test the consequences of achievement goals on academic performance, namely longitudinal designs carried out in classroom settings, includes features that turn out to favor rather than disrupt the achievement of performance-approach goal-oriented students. One crucial endeavor was thus to identify and control those features. We will now discuss the crucial points that distinguish our approach from the existing achievement goal literature, and comment on why these differences raise important issues to consider in the study of the achievement goal-performance relationship.

2.1.1. Controlling the implementation of strategies

Our reasoning has led us to suspect that the possibility to implement performance goal-directed strategies—e.g., cheating, surface studying, and vigilance toward teachers' expectations—in long-term settings might favor exam achievement of performance-driven students, hence blurring the interpretation of the goal-performance link found in longitudinal studies. As a first step, we thus have aimed at preventing such strategies to occur so as to prevent them from influencing our performance measurement, and for this the use of laboratory settings has appeared to be a most suitable option. In particular, the most blatant difference between natural and laboratory settings lies in the amount of time during which the individual commits him/herself to the goal pursuit. Thus, while longitudinal measures collected in schools or at University reflect a long-term pursuit occurring in an academic context that stretches over several months, during which students are led to continuously interact with their classmates and teachers, laboratory studies involve short-term goal commitment that only last a few minutes, and both contexts thus necessarily entail different dynamics. We think that the very fact that we observed a detrimental, and not beneficial, impact of performance-approach goal pursuit under such conditions gave first indirect credit to our claim that the positive performance-approach goal-achievement link reported in most longitudinal studies might partly be favored by the implementation of performance-oriented strategies—crucially made possible under long-term goal pursuit.

Then, as a second step, we have set up the third line of research with the aim of manipulating, notably in a classroom setting, the possibility for students to implement those study strategies. Importantly, this longitudinal experiment has demonstrated that if an important marker of scholastic life (namely, announcement of tests in advance) that students potentially rely on in order to study strategically is removed, students' performance-approach goal endorsement no longer predicts test performance—a result that, however, appeared only for low-achieving students, thereby suggesting that high-achieving students rely to a lesser extent on study strategies. While we plan to further investigate the reasons underlying this unexpected moderation, we think this finding gives additional weight to our hypothesis that performance-directed strategies play a crucial role for students who pursue normative performance. Hence, when strategies are removed—be it in a laboratory setting that provides no opportunity for long-term planning, or in students' usual classroom setting with the occurrence of an unanticipated test—, performance-approach goal pursuit does not appear to boost performance.

2.2.2. Measuring performance other than through academic achievement

Let us now pay some attention to the performance measurement we have opted for in this dissertation. Because the studies we conducted in the laboratory aimed to assess cognitive performance as the product of the individual's cognitive immersion in the task solving, we have relied on a resource-demanding modular arithmetic task basically requiring participants to mentally resolve mathematical problems placing high demands on working memory. In addition to enabling a control for inter-individual differences in knowledge and abilities (since this task was unknown to participants until they were introduced to it at the beginning of the laboratory session), using this task's accuracy score as a measure of cognitive performance had the advantage of providing direct indications regarding the amount of cognitive resources directed toward the task solving—thus allowing the detection of distraction effects. As such, the main dependent variable we used in this set of studies indeed proved to successfully measure *cognitive performance*.

Our findings highlight performance-approach goals as detrimental, rather than beneficial, to participants' cognitive performance, and hence stand in contrast with the longstanding profile that emerges from longitudinal research. We contend that these opposing results further back up the view that academic performance as it is traditionally measured in educational settings—i.e., through grades attributed to students' work on final standardized exams or intermediate classroom tests—might not strictly reflect the product of students' cognitive immersion in the study of course content. Indeed, we argue that high test or exam grades can also be successfully reached through the use of superficial, short-cut strategies that circumvent deep efforts and material learning—since exam grades do reward a final outcome without considering the means used to achieve it. For instance, it is quite conceivable that a student who prepares and hides a cheat sheet up his/her sleeve before the exam, just like a student who superficially learns the highlights of a lesson the night preceding the test, or a student who focuses all his/her energy studying a negligible part of the lesson because the teacher has hinted it might be assessed in the upcoming test, should be temporarily quite well equipped to successfully face a scheduled exam and get high grades. Consistent with this view, the overall pattern stemming from our research indeed demonstrates that when such performance-driven stratagems cannot be implemented, the undermining effect of normative strivings on task focus comes out. Building on these considerations, we will now more extensively discuss the theoretical as well as methodological implications of our findings for future perspectives.

3. Critical considerations

We now discuss important methodological as well as theoretical aspects of this research, and evoke some critical considerations that might be raised.

3.1 Comments on our performance-approach goals manipulations

The normative versus appearance sub-components: which one might drive our effects?

In this research, we have opted for a conceptualization and manipulation of performance-approach goals that notably include two major and distinct sub-components: a *normative* sub-component ("I want to outperform my peers") and an *appearance* component ("I want to demonstrate my competences to an audience"). Hence, our experimental manipulation of performance-approach goals has been based on what Hulleman et al. (2010) have referred to as the "evaluative" component, which provides that the "adequate demonstration of ability [(appearance)] is performance compared with the performance of others (normative)" (p. 424). It should be noted that the distinctive consequences of these two sub-components have recently started being widely discussed, since results stemming from the meta-analysis reported by Hulleman et al. (2010)—which reviewed 243 correlational studies that used various self-reported items to measure achievement goals—highlighted an interesting pattern. Indeed, it appeared that measures of performance-approach goals focusing on competence demonstration (e.g., "I feel successful if I show people I'm smart"; Nicholls, Patashnick, & Nolen, 1985) are often associated with deleterious consequences (e.g., a negative relationship with performance outcomes and anxiety) while measures focused on the normative component of performance-approach goals (e.g., "My goal in this class is to do better than others"; Elliot & McGregor, 2001) are most often associated with more positive outcomes (e.g., a null or positive relationship with performance). Notably, this meta-analysis also reported that items mixing the normative and the appearance components (i.e., the evaluative component: "I am striving to demonstrate my ability relative to others in this class"; Elliot & Church, 1997) are most of the times—just as appearance-focused items—negatively associated with performance.

Back to our own findings, these meta-analytical results suggest that the deleterious impact of performance-approach goal manipulation we obtained in our experimental studies could specifically result from and be driven by the activation of appearance and self-presentation concerns—since our manipulation explicitly asked participants to "try to demonstrate their competence" to the experimenter who would "evaluate their performance". We however think that such an inference, although plausible, is premature and would deserve some stringent experimental testing. In particular, the meta-analysis carried out by Hulleman and colleagues is exclusively based on correlational studies, where goal endorsements are measured via self-reports, and it is striking to note that the studies which opted for measuring the "appearance" component of performance-approach goals used items that often do not explicitly refer to a goal pursuit (e.g., "I like school work that lets me show how smart I am"; Midgley, Arunkumar, & Urdan, 1996; "It's important that others know that I am a good student"; VandeWall, 1997; "I feel successful if I show people I'm smart"; Nicholls et al., 1985). This is also true for items measuring the "evaluative" component ("I like to show my teacher that I'm smarter than other kids"; Midgley et al., 1996; "It is very important to me to confirm that I am more intelligent than other students"; Grant & Dweck, 2003). By contrast, items focused on the measurement of the "normative" component do most often explicitly mention a goal pursuit (e.g., "*My goal* in this class is to do better than others"; Elliot & McGregor, 2001; "At school *I try to* score higher than other students"; Skaalvik, 1997; our emphasis). Such differences are not minor, and could plausibly explain why measures of the normative component yielded more positive outcomes than those assessing the evaluative and appearance components of performance-approach goals.

However, and beyond these considerations, we recognize the necessity to disentangle and specify which of the performance-approach goals' subcomponents (normative, appearance, or both) preferentially drives the interfering effect we found, and through which mechanisms. Notably, such an endeavor might result to be challenging, since manipulating one of the goal's component could automatically and implicitly activate the other one. For instance, manipulating instructions that would emphasize the importance to try to outperform others at the task might indirectly prime appearance concerns and thus also motivate participants to appear talented to an audience (e.g., the experimenter, the other participants). Future experimental studies should nonetheless try to address this issue, as it might point to a potentially fruitful new avenue of research.

Did our performance-approach goal instructions reduce performance by reducing feelings of autonomy?

Another interesting comment can be made regarding the wording of our performance-approach goal manipulation, as these instructions notably contain words and expression that can be qualified as controlling (i.e., "you should", "you are asked to") and might hence have lowered participants' feelings of autonomy (Deci & Ryan, 1985); findings obtained by Ryan, Mims, and Koestner (1983) indeed indicate that a controlling language can result in a decrease in participants' intrinsic motivation. Could it be, then, that the impairment of cognitive performance we have observed and replicated in our laboratory studies merely results from a decline in participants' commitment and willingness to get involved in the task solving?

The responses that can be gives to address this criticism are twofold. First, it cannot be denied that the manipulation instructions we relied on in our laboratory studies may have induced a controlling mindset; this comment, however, applies to the whole laboratory setting, and not only to participants from the performance-approach goal condition—since a laboratory setting necessarily brings with it the necessity for a participant to accommodate the experimenter's instructions and complete the task(s) as it is required. This is of course an important point, which reflects one of the key differences between research using experimental manipulations versus research using self-reported measures: in the former case, participants are led to comply with instructions that are designed to activate a specific mindset. Notably, and in the case of our performance-approach goal manipulation, we think that this does not necessarily prevent participants from finding internal reasons to pursue and attain the goal; in particular, the perspective of being provided with individual ranking and evaluative information regarding one's competence could result in boosting participants' choice to get involved in what the instructions ask from them.

Second, and as a corollary to this latter comment, we do not think our results give credit to the assumption that our performance-approach goal instructions have lowered cognitive performance because they decreased participants' motivation to get involved in the task. In particular, it should be noted that such an interpretation of our results, because it challenges the distraction hypothesis—that is, the idea that the distractive manipulation selectively deprives highly demanding tasks from the resources necessary to efficiently solve them—would by contrast imply a decrease in performance regardless of problems' difficulty. However, our manipulations never affected performance in low-demanding modular arithmetic problems, thus allowing ruling out such an alternative possibility.

Did our performance-approach goal implicit priming (Experiment 1) reduce performance by reducing commitment in goal pursuit?

In the very first Experiment reported in Chapter 1, we chose to rely on a goal manipulation that implicitly primed performance-approach goals, through the use of words that had previously been pre-tested. Hence, this goal manipulation did not explicitly mention guidelines directed toward the final end state—like the manipulation based on explicit instructions that we later used—which makes it difficult to ensure that participants truly committed themselves in the active pursuit of performance-approach goals. Thus, one alternative explanation of our findings might for instance propose that participants, following the exposure to performance- and achievement-related words such as success, triumph, pride, started activating positive fantasies and daydreams related to such positive outcomes—which might hence have resulted in eroding efforts and goal commitment (Oettingen, 1996; Oettingen & Hagenah, 2005). The absence of a manipulation check—and the difficulty to accurately check the efficiency of such a subtle and implicit manipulation makes it difficult to refute this alternative possibility. However, we do believe that such an explanation, because it is based on the idea that the goal priming reduces commitment to the task solving, somehow again challenges the distraction hypothesis (see the previous point). Hence, because our manipulations never affected performance in low-demanding modular arithmetic problems, we once again believe that this alternative explanation can probably be ruled out.

Is performance-approach goal pursuit made more complex by a lack of specificity regarding the targeted end state?

As was already evoked in the introductory part of this dissertation, performance-approach goal attainment does not only depend on one's score and level of competence, as it is also determined by others' performance (i.e., negative inter-dependence with others, Deutsch, 1949), which is uncontrollable and often unknown. One could argue that this characteristic complicates the process of goal pursuit, as it may make it difficult for the individual to target and implement specific behaviors directed toward the desired end state. By contrast, it may be easier to elaborate specific guidelines directed toward mastery-approach goals—as the desired end state (mastering the task) may be seen as more concrete. However, it should be noted that the performance-approach goal instructions we relied on in our laboratory experiments provided a precise and concrete definition of what would be evaluated (i.e., accuracy and speed in response time when solving the modular arithmetic problems), of the end state that should be pursued (i.e., reaching a high score and being ranked among the best participants), and of the feedback that would be provided at the end of the experiment (i.e., the individual score and ranking information). It is hence reasonable to think that such instructions gave participants a rather precise representation of the end state they should seek to attain.

Moreover, it should be noted that as far as mastery-approach goals are concerned, the level of specificity of its related end state might strongly vary as a function of the standard for evaluation (i.e., the goal conceptualization) one opts for: if goal-attainment is defined as a function of task mastery (absolute competence), its pursuit could reveal much more vague and abstract that if goal-attainment is defined as a function of self-improvement regarding one's previous level of skills and knowledge (intra-personal competence). Hence, matching the degree of specificity of the instructions that aim at manipulating both performance- and mastery-approach goals is an important issue to consider when one aims at testing and confronting the respective consequences of their pursuits.

Are control conditions truly deprived of any performance-approach goal-related considerations?

In this dissertation, we have repeatedly presented performance-approach goals as strongly primed and promoted by schools and Universities selection processes, and thus as implicitly accompanying students in most of their interactions and actions that take place within the educational environment. For this reason, one might quite relevantly wonder to what extent the *control* conditions of our experimental designs have truly played the role of *default* conditions devoid of any activation of normative strivings, or whether, alternatively, performance-approach goals might still have been at least implicitly present—although to a lesser extent than in the conditions that explicitly motivated participants to endorse this striving. Indeed, our laboratory experiments all took place in a University building, and participants might have been aware that peers had already completed the experiment—hence rendering social comparison most salient. We contend that this criticism, although credible, does not take into account one crucial point: our control conditions made no mention of scores or ranking information. By contrast, and as was highlighted in the introduction of this dissertation, it is the salience of grades and normative evaluation that strongly makes striving for excellence pervasive and thus promotes performance-approach goal endorsement. Within the basic context of a laboratory experiment, these features are not salient. Hence, the possibility that an experimental setting merely asking participants to complete an arithmetic task "as accurately and quickly as they can" with no reference to final scores, evaluation, or social comparison did activate performance-approach goal pursuit seems most unlikely. Furthermore, it can be noted that the pattern stemming from the lexical decision task—used as a manipulation check—in Experiment 2 backs up this assertion.

What relates—and differentiates—our performance-approach goal manipulation from Beilock and colleagues' "Choking under Pressure" manipulation?

Casting our minds back to the introductory part of this dissertation, we might remind that the literature documenting the so-called "Choking under Pressure" phenomenon has constituted a key element of our reasoning that performance-approach goals might prove to be distractive to cognitive performance. Indeed, this phenomenon, which is now well documented in the literature and has been replicated many times (see Beilock & Carr, 2005; Beilock & DeCaro, 2007; Gimmig, Huguet, Caverni, & Cury, 2006) provides a solid empirical evidence in favor of the distraction hypothesis, which we found to successfully account for the impairment of performance reported in our laboratory experiments. However, even if they trigger similar cognitive mechanisms, as well as both implement contexts that are meant to reproduce academic testing situations, it should be noted that important differences do separate our manipulation of performance-approach goals from the Choking manipulation; we now comment these differences.

The manipulation used by Beilock and colleagues is based on three distinct sources of pressure: (a) monetary rewards, (b) peer pressure, and (c) social evaluation. In particular, a closer look at the high-pressure scenario instructions developed by Beilock and colleagues interestingly reveals that the starting point of this scenario constitutes a mastery-approach goal induction, which is explicitly related to the sources of pressure: it is mentioned to participants that they have to improve their performance by 20% relative to their preceding one (intra-personal mastery-approach goal) if they want to earn $5 (the monetary reward) and to not deprive their partner from the same reward (the peer pressure). Thus, their manipulation instructions mix induction of master-approach goals with controlling characteristics of the context (i.e., social evaluation and peer pressure). The authors justify the use of many sources of pressure by presenting their manipulation as an attempt to "capture the real-world phenomenon of choking", arguing that "in academic arenas, monetary consequences for test performance are manifested in terms of scholarships and future educational opportunities, and social evaluation of performance comes from mentors, teachers, and peers" (Beilock et al., 2004, p. 588).

Such a manipulation, despite presenting the advantage of taking into account the multifaceted aspects of testing situations, may nonetheless have two major weaknesses: its deleterious impact on performance comes with a lack of information regarding which component(s) preferentially drive(s) the effect, and it might lack ecological validity, since these various sources of pressure might seldom be simultaneously encountered and explicitly present in usual academic testing situations. By contrast, our performance-approach goal manipulation merely puts the emphasis on social comparison (the mention of upcoming ranking information) and evaluation from an expert (the experimenter) in order to create an evaluative context congruent with the priming of performance-approach goals (and in particular with its normative and appearance sub-components). In that sense, we think our manipulation does somehow more realistically reproduce regular testing situations while simultaneously motivating participants to endorse a specific achievement goal.

3.2 Comments on the experimental setting

What is the ecological validity of our laboratory findings?

Most of the research that is reported in this dissertation has been conducted within the laboratory, which can raise the issue of the generalizability of our findings to more natural settings. In the section detailing the major differences distinguishing our work from the literature on achievement goals (section 2.2 of this General Discussion), we have already mentioned the advantages that this method brought. However, the very fact that we needed to deviate from the natural setting in order to obtain evidence of the distractive consequences of performance-approach goals may lead one to wonder whether this phenomenon indeed truly exists outside the laboratory, and how.

Importantly, our goal here was to identify a *mechanism* more than a phenomenon. In that sense, opting for a laboratory setting appeared as a crucial and judicious decision, since it allowed us to pinpoint for the first time a cognitive mechanism otherwise blurred by long-term academic contexts—and, in particular, distorted by the implementation of strategies. Hence, and as previously outlined, our results do suggest that the positive impact of performance-approach goals on achievement that has so far been widely documented in the literature may result, at least partly, from the way achievement is measured, since it often gives supremacy to the final outcome while according only little weight to the strength of cognitive immersion in the material.

However, this gain in precision, which is an important advantage stemming from the use of laboratory settings, undoubtedly comes with a price—namely, a loss in ecological validity. We do not think this should discard our findings from being applicable to the realm of long-term university life; however, finding direct evidence of such a mechanism within the classroom might be challenging. The research carried out in our third research line underlined the difficulty of this endeavor: indeed, while confirming that characteristics of the evaluative context (usual—with the test planned ahead—versus unusual—with the test unanticipated) play an important role in the interplay between students' normative goal endorsement and their success at the test, the unexpected moderating role played by their initial level also highlighted the importance of taking inter-individual differences into account when investigating long-term, natural settings. We however believe this last research line is promising and should be further investigated.

While goal accessibility appears useless and thus interfering within the laboratory (since activating goal-attainment concerns is distracting to task solving), the same accessibility plausibly has very different consequences within the length of a semester. In particular, we believe its distractive consequences remain, but may nonetheless be counterbalanced by the relevance of the behaviors it may possibly trigger. These behaviors can be unethical (higher tendencies to cheat, exploitation of others; see Pulfrey & Butera, 2013, or Poortvliet et al., 2007), poorly focused on the task and its deep processing (surface processing, focus on the material that will be assessed); they can however also motivate students to produce task-focused efforts and thus be compatible with learning, thereby eliciting the concomitant endorsement of mastery-approach and performance-approach goals—the multiple goal endorsement, which we discuss more thoroughly in a following section (4.2) of this General Discussion. The investigation of what determines the diverse behavioral consequences stemming from performance-approach goal hyper-accessibility in a long-term setting should open the way to fruitful new avenues for future research.

Manipulating versus measuring achievement goals: which differences?

Another important specificity of our first and second research lines, besides the use of a laboratory setting, is related to our preference for manipulating performance-approach goals. Commenting on what distinguishes achievement goals' manipulation from the more common method consisting in measuring their endorsement via self-reported questionnaires appears necessary, as goal manipulation within the lab also indirectly raises the question of ecological validity.

Our preference for manipulating rather than measuring achievement goals was motivated by literature that has recently documented how self-presentation concerns can influence and distort participants' self-reports. In particular, Darnon et al. (2009; see also Dompnier et al., 2009) have demonstrated that students who explicitly report endorsing performance-approach goals are perceived by others (be they peers or teachers) as low in likability—which motivates them to refrain from reporting high levels of normative goals' adoption. In order to circumvent this bias, we opted for goal manipulation. However, with a goal manipulation, the major challenge consisted of recreating academic testing situations, while at the same time motivating participants to endorse performance-approach goals within the experiment time frame. It was therefore important to rely on trustworthy manipulations. In our very first laboratory experiment, we chose to develop an implicit performance-approach goal manipulation and, in order to do so, we decided to run a pilot study aiming at determining the words most related to performance-approach goals. This pilot study not only allowed us to select performance-approach and neutral words, but also to provide an independent assessment of these words and avoid manipulation checks. Indeed, a self-reported measure would have been inappropriate to assess this implicit manipulation, and a measure of accessibility like the one used in Experiment 2 would have been too similar to the manipulation and aroused suspicion. Then, for the remaining of our experiments, we relied on implicit instructions that had previously been pretested, validated and found to have separate effects from a performance-avoidance goal manipulation by Darnon, Harackiewicz et al. (2007, pilot study). Importantly, the Lexical Decision Task we used in Experiment 2 also confirmed its efficacy; thus, we consider this goal manipulation as trustworthy.

It is important to note that besides the aforementioned self-presentation concerns, opting for the measurement of inter-individual differences in goal orientations through the use of achievement goal scales also raises important issues, since the scales' items one opts for necessarily reflect a specific conceptualization of each goal. In that sense, they only capture the construct that they aim to measure. In the third research line, we used Elliot and McGregor's scale (2001) in order to measure performance-approach goals; notably, these three items focus on assessing the *normative* component of performance-approach goals, thereby bringing no direct information regarding the *appearance* component, which is however an important part of our performance-approach goal manipulation.

3.3 A comment on the seeming contradictions between results stemming from our laboratory versus natural setting studies

The finding we obtained in our third research line, that is, the study carried out among French high-school students, highlighted an unexpected moderating role of students' initial level, therefore raising interrogation regarding the mechanisms responsible for this moderation. Moreover, this finding might be read as being in contradiction with some of our laboratory results. We now review why their respective results are not inconsistent.

Because the second research line demonstrated high-WMC individuals as being more prone to experience the interfering consequences of performance-approach goal activation, it might appear counterintuitive and surprising that the expected surface strategies associated with normative goal pursuit only appeared among low-level students in Experiment 7. We wish to clarify, however, some important differences between these two experiments, in order to render clearer how these two findings can be coherently integrated. First, even if WMC has often been found to be positively correlated with academic achievement and performance at various cognitive tasks, we do not wish to assimilate WMC as was measured in the second research line with the initial level variable of Experiment 7—the latter representing the average grade obtained by each student in the physics and chemistry class. Indeed, this score does not represent a reliable measure of academic achievement, and we prefer to merely refer to it as a baseline level in the class in which our experiment took place. However, a similarity can nonetheless be established between these two measures, given that being among the top achievers within the classroom may convey a perception of oneself as belonging to a high-status group—just as explicitly hypothesized for high-WMC individuals in the second research line.

Another crucial distinction yet remains: the laboratory experiments did not assess the same cognitive processes than the longitudinal one. Indeed, both research lines aimed at testing different facets of one general hypothesis, whose goal was to disentangle the differences between *achievement,* as it is usually defined and assessed in educational settings, and *learning / cognitive immersion* within the task or course. Hence, while the two laboratory studies examining the interplay between WMC and performance-approach goal endorsement focused on testing the distraction hypothesis—with the idea that the distraction might be exacerbated among high-WMC participants—the longitudinal study aimed at examining how normative goal endorsement influences strategic studying in the classroom. For this reason, the dependent variables we relied on were notably distinct: the final multiple-choice questionnaire did not measure pure cognitive performance as the modular arithmetic task did. Rather, it assessed students' learning as the product of the attention devoted to course content during class as well as their work on the material out of lessons. This measure hence does not provide information regarding the distraction hypothesis; similarly, our laboratory studies do not provide information regarding the extent to which low- versus high-WMC individuals usually rely on strategic studying. As a consequence, we believe that the two results are not contradictory.

As far as the longitudinal study is concerned, the pattern obtained for high-achievers is however puzzling. Indeed, data indicated that performance-approach goal endorsement is (marginally) positively related with test performance in the unscheduled test announcement condition—suggesting that normative goal endorsement is adaptive among those students. Furthermore, when the test had been scheduled ahead, high-achievers obtained a high score whatever their goal endorsement, which is also contrary to what was expected. As an explanation of this result, we propose that strategic studying may have triggered different behaviors among low- and high-achievers. In particular, while performance-oriented low-achievers seemingly heavily rely on test-focused study strategies, for high-performers, public high expectations of success coming from various sources (e.g., the teacher, classmates, or parents) might create—especially among those students whose motivation is strongly focused on striving to outperform others and demonstrate competence—a performance pressure related to the desire to maintain their positive status and image in the classroom. Such appearance concerns may consequently push them to pay more attention and be more actively involved in class (i.e., when their behaviors is the most visible; see Monteil & Huguet, 2002) than their low-performing counterparts and than their high-performing but not performance-focused counterparts, resulting in a regular and steady processing of course content. Hence, strategic studying stemming from normative strivings may take different forms as a function of students' position within the classroom: while low-performers would choose to mass their study of course material to periods preceding a test, high-achievers—for whom appearance concerns would be most salient—would rather opt for more active behaviors during class. Such an explanation remains of course speculative, and will need to be addressed in further research.

3.4 Reflection on the role played by mastery-approach goals in the observed effects

Our research has been focused on exploring the interplay between a single goal endorsement—namely, performance-approach goals—and performance. Notably, the vast majority of research on achievement goals has so far adopted a similar perspective, testing the impact of single goal adoption on academic outcomes, and research taking into account the possibility—and assessing the impact—of simultaneous *multiple* achievement goals' pursuit is scarce. However, the endorsements of mastery and performance goals have never been explicitly conceptualized as mutually exclusive, and are actually not inconsistent with each other (Harackiewicz, Barron, & Elliot, 1998). For instance, a student might very plausibly aim at both outperforming peers at tests (performance-approach goals) and increase his/her knowledge and learn from the course (mastery-approach goals; Barron & Harackiewicz, 2000). This is confirmed by correlational studies, in which students' mastery and performance-approach goal endorsement in the classroom have frequently been found to be positively correlated (Archer, 1994; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Lee & Anderson, 1993; Meece, Blumenfeld, & Hold, 1988; Roeser, Midgley, & Urdan, 1996; see Harackiewicz et al., 1998, for a review), confirming that students can and do pursue multiple goals in their classes.

How could this be integrated to our research? Even if we never experimentally tested the interactive effects between mastery and performance goals, we believe that findings stemming from Experiment 4 might bring interesting information and suggestions regarding how both goals might be successfully integrated when pursued simultaneously. Indeed, casting our minds back to this experiment, we may remind that performance-approach goal pursuit produced the highest performance when coupled with a concrete mindset designed to focus participants' attention on the immediate demands of the task. Hence, it suggests that the detrimental consequences of performance-approach goals can be alleviated if future-oriented concerns related with goal-attainment are quieted in favor of a focus on the more immediate demands of the task. In that, our "performance-approach goals plus *how*" condition has possibly primed a successfully structured goal pursuit, where participants adaptively focused on the task *mastery* and the immediate task requirements while inhibiting thoughts devoted to other situational components directly associated to the targeted end state (e.g., the score of other participants, one's desire to succeed at the task) but irrelevant for the most immediate requirements. Of course, the inference that the "how thinking" manipulation activated a mastery-approach goal remains speculative, but is nonetheless plausible and interesting. Such a result would indeed suggest that in the case of a concomitant pursuit of both mastery- and performance-approach goals, mastery-approach goal pursuit could immunize the individuals from the detrimental consequences of normative striving. This possibility will be more extensively discussed in a following (4.2) section.

3.5 A quick comment on cultural differences between the United States of America and Switzerland

Casting our minds back to the very introduction of this manuscript, the opening words of this dissertation were quoted from a high-achieving student enrolled in an American high school—those schools preparing the most "talented" students to get access to the so-called Ivy League schools, an association of Universities and colleges in the USA that have a high reputation for scholastic achievement and social prestige. Thereafter, we kept on indirectly referring to the American educational system all through the manuscript—a tendency reinforced by the fact that most of the literature we relied on to build our reasoning and hypotheses has been carried out within American Universities or high schools. One might thus wonder whether our reasoning is truly applicable to the cultural environment where it has been tested—namely, Switzerland and France.

The USA are well-known for their competitive, cut-throat University context that explicitly promotes excellence and normative striving; indeed, being admitted to one of the Ivy League schools gives access to social prestige while providing high chances of future achievement, which hence gives rise to a fierce struggle among students in order to occupy the top positions and get accepted in one of them. Such a competitive environment thus exacerbates normative pressure, and even triggers implementation of high-risk behaviors such as "study drugs" taking—which we mentioned earlier in this manuscript. However, these extreme behaviors are not exclusively observed among American students, as shown by recent empirical evidence revealing that 1 in 7 Swiss University students across most academic disciplines reported resorting to the prescription of "smart" drugs in order to improve their concentration and grades, mainly prior important exams (Maier, Liechti, Herzig, & Schaub, 2013). Relatedly, French students' strikingly high feelings of pressure and anxiety often make headlines in the press (see Fraissard, 2013; Matlack, 2013), which attributes pupils' school stress to the salience of grades and competition that is mostly conveyed by teachers and parents and reinforce the meritocratic education system (Carson, 2007). We thus believe that striving for excellence and pressure to succeed are also at a high level within the population that we have tested, and might probably be as strong as among American educational settings. In particular, the world economic crisis has exacerbated the perceived need to secure a high-profile job and a wealthy future. Put together, such considerations underline the relevance of our approach, as well as the necessity to further investigate the consequences stemming from the growingly pervasive promotion of excellence in other countries than the United States.

4. Considerations and Implications for future research perspectives

4.1. When achievement does not necessarily mean learning: Comments on the ambiguity of the educational system

The preceding considerations necessarily raise the question of what grades that are dispensed in classroom and educational environments actually measure. Indeed, while their primary function is to assess students' learning and understanding of the course content, it seems that they are prone to be boosted by superficial study strategies that are ironically not mainly directed toward learning. Why is this?

We suggest that this paradox is in line with the no less paradoxical double aim of educational settings that was evoked in the introductory part of this dissertation, since the *educational* function of schools and Universities, which are primarily designed to increase pupils' and students' knowledge, coexists with their *selective* function, which requires that the most deserving students must be distinguished from the less deserving ones. We have previously evoked research pointing out performance-approach goals as associated with poor levels of social desirability, since their endorsement is neither promoted by teachers' official discourse nor appreciated among students; however, despite this undesirable profile displayed by the official discourse, students are perfectly aware of performance-approach goals' social utility. Indeed, the selective function of most academic settings is often highly salient to students' eyes, and has been hypothesized to catalyze performance-approach goal endorsement (see Darnon et al., 2009); for this reason, endorsing a motivation in accordance with the selection processes might somehow be seen as adaptive—even if it means adopting behaviors that undermine the other (educational) function. In particular, it is coherent to reason that the pursuit of performance-approach goals—since it makes normative performance a more central concern than learning—turn out to favor the selection of behaviors that will facilitate its attainment, regardless of the means used for that; in that sense, performance-driven students might relegate learning and task focus to a position of second importance, and prefer to turn toward less effortful—yet effective for achievement—strategies. In line with this reasoning, we join Michaels and Miethe's (1989) words which underlined that "cheating and other shortcuts may become normative adaptations to pressures to excel in a highly selective market" (p. 883).

Pressure to perform and rise above others are widely emphasized by the growing salience of competition and high stakes in educational institutions (Astin, 1993; Pryor et al., 2010), which led Gallant and Drinan (2006) to consider that "whereas students historically may have attended higher education in order to learn for learning's sake, students now often perceive college or university as a stepping stone toward another end goal—a career, or more particularly, financial and status reward" (p. 845). One consequence of this trend, which places a tremendous importance on academic achievement seen as a determinant of what is often represented as success in life, is that "how [students] get that credential is often less important than simply getting it" (McCabe & Trevino, 1996, p. 29).

It is additionally interesting to mention the findings that stem from research that have focused on the specific pressure experienced by high-achieving students issued from high-performing high-schools, in particular regarding the consequences of such pressure on those students' scholastic behaviors and perceptions (Conner et al., 2010; Galloway et al., 2014; Pope, 2001). Pope (2001) has highlighted how pressure to maintain or increase their high-achiever status, mainly coming from parents and teachers but also sometimes being self-imposed, can lead these students to sacrifice their interests and willingness to look deeper into some topics, in order to comply with the teachers expectations and behave in accordance with what they think the school officials will most reward. As an illustration, results reported by Galloway et al. (2014) showed that even when students find themselves overloaded with homework that they do not think will promote their learning, they still keep doing it conscientiously if they consider it as a necessary condition for the attainment of high achievement. As two students put it, "Sometimes I get assignments that just take up a lot of time and are hardly useful; these prevent me from getting as much sleep as I'd like, and I don't even learn from them"; "(…) so many pointless, mundane assignments that take up large amounts of time without actually learning anything in class" (p. 504). It is interesting to note that this finding, beside pinpointing how the desire to be recognized as a high achiever has the potential to elicit behaviors that may jeopardize learning, also puts the spotlight on how teachers' methods (here, the tendency to overload students with homework) can turn out to be at odds with the promotion of learning and intellectual development.

In sum, we think that the aforementioned findings and comments underline how the ambiguities stemming from the educational system might ironically entail the promotion of strategic academic behaviors—and ultimately reward them, even if they are, by essence, at odds with the learning process. From an educational viewpoint, this underlines the need to replace learning and cultivation of task interest, often pointed as a key to long-term studying and persistence (Hidi, 1990; Hidi & Harackiewicz, 2000), at the heart of students' concerns. Also, from a theoretical standpoint, we suggest that researchers interested in the investigation of performance-approach goals' consequences on achievement in the classroom should consider moving toward a multifaceted measurement of students' achievement that would go beyond the mere collection of their final exam performance. In line with these recommendations, it is interesting to note that Harackiewicz, Barron, Pintrich, et al. (2002) have already evoked the necessity to reflect upon "what traditional measures of performance such as grades reflect" as well as on the need to "extend our investigations to include more qualitative measures of performance"—even if they nonetheless emphasized their trust in the reliability of exam grades, that they argued to be "the most widely accepted measure of academic performance" (p. 642). On the basis of our findings, we contend that the measurement of academic achievement might be improved and made more accurate through, for instance, the use of unanticipated tests, or a long-term learning assessment testing knowledge retrieval a few months after the course.

Moreover, from a political standpoint, such considerations necessarily lead us to reflect on the political stakes that may lie behind the pervasive promotion of excellence and salience of the selection process. Indeed, the willingness to control, develop and enhance competence and achievement within schools and Universities represent an important concern for the vast majority of the world's governments, and has given rise to a wide variety of policy initiatives. In particular, conservative governments often favor initiatives whose aim at obtaining higher standards and greater accountability comes along with decisions to increase students' standardized testing as well as comparisons between schools on the basis of their achievement outcomes. A famous example of such policies is the High-Stakes Testing reform implemented in the United States under Reagan's presidency—a reform movement that was partly influenced by a report written by the National Committee on Excellence in Education (*A Nation at Risk*, 1983), which denounced rising mediocrity as a serious threat to the US ability to compete in the world economy in the future. This (controversial) threat was taken seriously and thus gave rise to the implementation of institutional practices based on more frequent testing as well as high-stakes consequences associated with test outcomes—administering rewards versus sanctions on the basis of results. This reform notably led to disappointing results—which may come as no surprise considering literature that document the deleterious consequences of learning methods based on incentives and punishments (Deci & Ryan, 1985)—but has nevertheless not been abandoned, and most American States still pursue high-stakes testing policies. This has notably elicited extreme behaviors, as it motivates teachers and school administrators to exclusively prepare students on important stakes so as to reach the schools' top ranking, which result in financial bonuses and awards.

High-stakes testing policies do represent a glaring example of how economic concerns and neoliberal values can impact the implementation of institutional practices that in turn exert a powerful influence on individuals' focus and behaviors. In the introduction of this dissertation, we have already evoked how teachers' teaching styles and tendencies to promote competition may influence students' goals and motivation. In line with this, Pulfrey and Butera (2013) have found evidence showing that adherence to neo-liberal values of self-enhancement (which is known to be influenced by the extent to which a country pursues neo-liberal, free-market capitalism; Schwartz, 2007) predicts the motivation to obtain social approval, which in turn positively predicts performance-approach goal adoption and condoning of cheating behaviors. Hence, students might very well perceive that more importance and emphasis is placed on the outcome than on learning, leading them to neglect the latter. In sum, we believe that a change in educational practice, mainly focused on quieting outcome concerns and placing more importance on the quality of learning, may be easier said than done, due to the powerful influence exerted by higher-order neoliberal societal values and economic stakes.

4.2. Making performance-approach goals compatible with task focus: Arguments in favor of the multiple goal perspective

In this dissertation, we have argued and demonstrated how the pursuit of performance-approach goals trigger concerns that disrupt concrete and deep focus on the task—sometimes labeled *flow*, referring to a focus "only on the behavior at hand, effectively squeezing out task-irrelevant thoughts" (Leary et al., 2006, p. 1809). We have also reviewed work depicting performance-approach goals as inimical to task exploration and resulting in a tendency to relegate learning to the second place. However, what if a student committed to normative strivings simultaneously pursues the goal to learn as much as possible from course content and to satisfy his/her interests while facing challenging material? This situation, which has been evoked previously in this General Discussion and refers to a *multiple goal* endorsement, is plausible if we consider the fact that self-reported mastery- and performance-approach goals have often been found to be positively correlated in the literature (see Harackiewicz et al., 1998). It also makes practical sense, for instance in higher education, where advanced students might be strongly motivated to acquire knowledge and learn new skills in view of their career aspirations while at the same time feeling a need to comply to the selection processes through focusing on trying to outperform others, in order to successfully pass the exams. While empirical research investigating this phenomenon is still scarce, Barron & Harackiewicz (2000, 2001) have proposed the hypothesis that the most beneficial motivational pattern might result from high endorsement of both mastery and performance goals (*interactive* goal hypothesis), suggesting that "regardless of their independent effects, mastery and performance goals interact, such that individuals who endorse both goals are notably advantaged in achieving a particular achievement outcome" (Barron & Harackiewicz, 2001, p. 708). In line with this hypothesis, Darnon, Dompnier, Gilliéron and Butera (2010) have further suggested the possibility that multiple goals trigger an adaptive motivational dynamic where "mastery goals actually serve performance goals", and hence "performance is achieved via mastery and not via other strategies" (p. 220). In accordance with this assumption, we will now argue why, in our opinion, multiple goal endorsement might allow alleviating the maladaptive outcome stemming from performance-approach goals while simultaneously favoring task focus and achievement-directed behaviors.

Could mastery-approach goal pursuit be susceptible to carry distraction and disruptive thoughts in a similar fashion than performance-approach goals? Because the decisive role played by the mismatch existing between goal content and low-level task processes has no theoretical relevance in the case of mastery-approach goals, we contend this should be most unlikely. Indeed, mastery goals' emphasis on the desire to learn and enhance one's knowledge and skills should match task processing. One may argue that mastery-approach goal pursuit could elicit concerns related with goal-attainment (in particular since clear feedbacks indicating task mastery or efficient self-improvement are seldom provided by the environment) that could also disrupt efficient focus on the task. However, mastery-approach goal endorsement has been repeatedly associated with an overall "consistent and mostly favorable" profile in the literature (Senko et al., 2011, p. 27), and linked with adaptive behaviors such as intrinsic interest (Rawsthorne & Elliot, 1999), high self-efficacy and willingness to cooperate with others (Poortvliet & Darnon, 2010), persistence in the face of failure (Dweck, 1986), use of deep processing strategies in the face of challenge (Anderman et al., 1998; Elliot et al., 1999), and low cheating intentions (Anderman & Danner, 2008)—all outcomes that suggest mastery-approach goal endorsement as being congruent with task focus and successful cognitive immersion in task-related processes.

While the research reported in this dissertation points to the maladaptive consequences stemming from performance-approach goals which are prone to erode the attention devoted to a task or activity completion, we do not wish to adopt a moralistic approach by jumping to the easy conclusion that performance-approach goals should be banished from classrooms and educational structures, in that sense, we join Elliot and Moller's (2003) considerations that "the eradication of all normative strivings, including performance-approach goals, is neither a realistic, nor even a desirable aim", given that "normative comparison and competition are deeply engrained in our cultural fabric" (p. 351). We would rather like to underline why we think that a motivational configuration where normative strivings coexist with the desire to learn and acquire new task-related knowledge might be a particularly adaptive one, in that it might circumvent performance approach goals' deleterious consequences for task focus while allowing the individual to behave in accordance with the selection processes present in most educational structures.

In particular, we argue that endorsing mastery-approach goals simultaneously to performance-approach goals may present the advantage to keep the individuals' attention focused on the desire to intensively understand the task to be performed or studied (e.g., a course content) and promote its deep processing, which we claim would represent a major benefit, by alleviating the distractive profile of normative strivings we have documented in this dissertation. Moreover, and as an important corollary, this multiple goal adoption would also inhibit students' tendency to opt for short-cut, superficial study strategies (e.g. surface processing) or unethical behaviors (e.g., cheating, exploitation of others), since the desire to learn would be a main concern; in that, we join Darnon et al. (2010) viewpoint that "one's pursuit of mastery goals could be a step toward the pursuit of performance goals ("mastering more than others")"—since it seems reasonable to assume that the choice of learning, mastery-driven strategies would supplant superficial or unethical behaviors and be used as means to successfully outperform others.

Finally, we claim that when embedded within a multiple goal endorsement, performance-approach goals could additionally present the advantage of adaptively making students' more sensitive to important information regarding the evaluative context and the specific behaviors that might be rewarded, thereby enhancing their chances to be favorably evaluated. This argument is in accordance with Elliot et al.'s (2005) comment that "the use of others as performance referents in [performance-approach] goals fosters a more external focus on the evaluative environment and on what is needed for optimal performance attainment", and also joins the notion of *vigilance* introduced by Senko et al. (2013) in their assessment of the learning agenda hypothesis. Importantly, we think such strategies, when coupled with adaptive, task-focused behaviors, could actually prove to play a decisive role regarding students' successful progression within the selective educational systems. For instance, while the mere pursuit of mastery-approach goals has sometimes been suggested as triggering material study as a function of one's interest and regardless of assignments or teachers' expectations—a study method that can jeopardize optimal academic achievement (Senko & Miles, 2008)—, the simultaneous pursuit of both mastery-approach and performance-approach goals could lead to the implementation of more adaptive patterns. Indeed, it could allow fostering both a strong focus on course content and learning while at the same time motivating students to channel their efforts and resources towards what is explicitly required from them and what will be particularly valued by the assessment body. Students might then be most adaptively armed to satisfy both the *selective* and *educational* functions of academic structures.

Conclusion

In this dissertation, we have aimed at studying performance-approach goals through the lens of a cognitive approach, which led us to bring together literature stemming from different lines of research—achievement goals, goal pursuit, choking under pressure—that have so far developed independently from each other. This approach has proved to be fruitful, and we believe our findings encourage cross-fertilization between these research areas.

This dissertation contributes to show how the desire to outperform others and appear talented is susceptible to take an overriding importance in students' life, ironically carrying the potential to jeopardize crucial outcomes such as task focus and performance. Moreover, it suggests that the salience of goal-attainment concerns might spoil the savor of the goal pursuit and of the activity completion itself. In closing, we might quote the words of advice that an advanced American student addressed to a younger peer engaged in intense competition to get access into an Ivy [the Ivy League, an association of Universities and colleges in the USA that have a high reputation for scholastic achievement and social prestige]: “If you are going to go for the result, you might as well enjoy the process of getting there, and then if you don’t get the result you actually want, at least be satisfied that you enjoyed yourself” (Pope, 2001, p. 44).

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APPENDIXES

1. Modular arithmetic task instructions

“Cher(e) participant(e),

Lors de cette expérience, votre tâche sera de résoudre une série de problèmes. Ceux-ci vont apparaître sur l'écran. En voici un exemple: $17 \equiv 5 \pmod{6}$

Votre tâche consistera à dire si ces problèmes sont "vrais" ou "faux" selon la consigne suivante.

Cette affirmation est-elle vraie? $17 \equiv 5 \pmod{6}$

Deux étapes permettent de résoudre ce problème:

- Premièrement, il faut soustraire le deuxième chiffre au premier: 17 - 5 = 12
- Deuxièmement, il faut diviser le résultat obtenu (ici, 12) par le mod (ici, 6): 12 / 6 = 2

L'affirmation est dite "vraie" si la différence entre les 2 premiers nombres entiers est divisible par le chiffre entre parenthèses. Autrement dit, le résultat final doit être un nombre entier.

Dans notre exemple, le résultat final est 2, il s'agit d'un nombre entier. L'affirmation est donc vraie.

A présent, voyons quelques autres exemples concrets de résolution.

Cette affirmation est-elle vraie? $35 \equiv 19 \pmod{2}$

Pour y répondre, vous devez effectuer mentalement les opérations suivantes:

- Soustraire 19 de 35: 35 - 19 = 16
- Puis diviser ce résultat par 2. Le résultat est-il un nombre entier?

Oui, car 16 est divisible par 2. En effet, 16 / 2 = 8, et 8 est un nombre entier.

L'affirmation est donc vraie.

Cette affirmation est-elle vraie? $19 \equiv 7 \pmod{7}$

- Premièrement, soustraire 7 de 19: 19 - 7 = 12
- Puis, diviser ce résultat par 7.

Mais 12 n'est pas divisible par 7, car le résultat (1,714) n'est pas un nombre entier.

L'affirmation est donc fausse.

Vous devrez donc résoudre plusieurs problèmes de ce type.

Pour information, les recherches dans ce domaine ont clairement montré que le taux de réussite à cet exercice est égal chez les hommes et chez les femmes.

Avant que le problème apparaisse sur l'écran, vous verrez un signe "+" au centre de l'écran. Il s'agit simplement d'un point de fixation, qui vous signale que le problème va apparaître.

Pour chaque problème, n'essayez pas de deviner le résultat: faites le calcul.

Si l'affirmation est "vraie", appuyez sur la touche jaune "V" (à droite).

Si l'affirmation est "fausse", appuyez sur la touche jaune "F" (à gauche).

Il est important que vous mainteniez respectivement vos index gauche et droit sur ces 2 touches, de manière à pouvoir répondre aussi vite que possible.

Une phase d'entraînement va vous permettre de vous familiariser avec la tâche. Vos réponses ne seront pas enregistrées.
Après chacune de vos réponses, l'ordinateur vous dira si vous avez donné la réponse correcte ou non.
Quand vous êtes prêt(e), appuyez sur la barre ESPACE pour débuter l'entraînement.

[Entraînement non enregistré: 6 items, dont 3 low-demand, 3 high-demand.]

Stop! Prenez quelques secondes pour vous relaxer.
L'entraînement va se poursuivre.
Afin de pouvoir en bénéficier au mieux, il est important que vous essayiez d'être aussi rapide et exact que possible.
Restez bien concentré(e)s pendant toute la durée de l'exercice.

Lorsque vous êtes prêt(e), vous pouvez appuyer sur la barre ESPACE pour commencer la série de problèmes.

[Bloc 1, 24 problèmes, mesure baseline]

Stop! Vous pouvez prendre quelques secondes pour vous relaxer.
L'entraînement est à présent terminé. A partir de maintenant, vos réponses seront enregistrées.

[Manipulations expérimentales, voir ci-dessous].
[Bloc 2].

2. Material used in Chapter 1

2.1. Experiment 1

2.1.1. Instructions for the priming task

[Consignes présentant la tâche d'arithmétique modulaire]
[Bloc 1 - Baseline]

« Cette première série de problèmes est à présent terminée.
Avant de passer à la série suivante, vous allez effectuer une courte tâche qui a pour but de placer temporairement en repos votre mémoire de calcul, tout en gardant active votre mémoire lexicale. Cette tâche implique des mots qui vont apparaître un à un, soit sur la partie inférieure, soit sur la partie supérieure de l'écran.
Votre tâche sera de détecter la position du mot sur l'écran.
- Si le mot apparaît sur la partie supérieure de l'écran, appuyez sur la touche pastillée blanche H en haut du clavier.
- Si le mot apparaît sur la partie inférieure de l'écran, appuyez sur la touche pastillée blanche B en bas du clavier.
Dès que vous êtes prêt(e) pour débuter cette tâche, appuyez sur la barre ESPACE. »

[Tâche de priming]

« L'exercice de résolution de problème va maintenant reprendre. Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses.
A partir de maintenant, vos réponses seront enregistrées.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes.»

2.1.2. Words used in the priming task

Performance-approach goal condition:
triomphe, capacité, mieux, challenge, excellent, langage, gloire, réussite, éclairage, mérite, concours, journal, comparaison, évaluation, graphisme, accomplissement, fierté, écran, victoire, ascension, classement, sélection, supériorité, performance, premier.
Control condition:
discours, feuille, style, alphabet, parole, langage, nouvelle, dictionnaire, éclairage, clavier, information, journal, aspect, registre, graphisme, architecture, écriture, écran, magazine, esthétique, calligraphie, actualité, vocabulaire, couleur, lumière.

2.2. Experiment 2

2.2.1. Instructions specific to each experimental condition

Performance-approach goal instructions:

« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle vos compétences vont être évaluées par des expérimentateurs.
Il faut que cette évaluation soit la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, d'avoir un bon score à cette tâche, et de montrer vos compétences.

Beaucoup d'étudiants vont réaliser cette tâche, et les scores seront classés les uns par rapport aux autres. Ce serait bien que vous essayiez de vous démarquer positivement, c'est-à-dire de réussir mieux que la plupart des participants. En résumé, ce qui vous est demandé ici, c'est de mettre en avant vos compétences, vos capacités.

Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses. Montrez le meilleur de vos capacités.

Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

Control condition instructions:
« Cette étude a pour objectif de tester la résolution de problèmes sur les nombres entiers.
Pour cela, nous avons opté pour une tâche qui soit la plus méconnue possible du / de la participant(e) avant l’expérience. En résumé, ce qui nous intéresse ici, c’est le processus d’intégration d’une nouvelle consigne de résolution de problèmes.

Nous vous rappelons brièvement cette consigne. Pour chaque problème, la première étape est de soustraire le second chiffre au premier. Ensuite, il vous faut diviser le résultat obtenu par le chiffre entre parenthèses. Si le résultat final est un nombre entier : appuyez sur la touche jaune « V » à droite du clavier. Si le résultat final n’est pas un nombre entier : appuyez sur la touche jaune « F » à gauche du clavier.

Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses.

Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

2.2.2. Lexical Decision Task instructions

« La dernière tâche que nous vous demandons d'effectuer est courte, et sollicite votre mémoire verbale. Des mots et des non-mots (= mots n'existant pas dans la langue française) vont apparaître un par un sur l'écran.

Votre tâche sera simplement de **détecter s'il s'agit de mots ou de non-mots**.

S'il s'agit d'un mot, appuyez sur la touche jaune "V" (à droite du clavier).

S'il s'agit d'un non-mot, appuyez sur la touche jaune "F" (à gauche).

Essayez d'être le/la plus rapide possible.

Appuyez sur la barre ESPACE pour commencer. »

2.2.3. Lexical Decision Task words

Words related to performance-approach goals:

score, comparaison, sélection, mérite, meilleur, classement, compétence, évaluation, capacité, réussite, fierté, supériorité, challenge, premier, performance, succès.

Filler words:

conducteur, éclairage, accord, sympathique, écriture, parole, langage, esthétique, agréable, écran, aspect, vocabulaire, actualité, magazine, rembourser, fantaisiste.

Non-words:

plamese, étriter, orligue, malgate, verbris, volable, vrisque, prétambre, platiride, subode, coudin, pannin, enlivons, blantion, lilasion, resirent, sacritre, isonteur, équitres, pauriche, bliacre, greuple, toumeau, parline, sixière, chlarpe, aporles, renvers, satisée, motalve, guerdenvant, tounerolime.

2.3. Experiment 3

2.3.1. Instructions specific to each experimental condition

Control condition instructions:

« Cette étude a pour objectif de tester la résolution de problèmes sur les nombres entiers.

Pour cela, nous avons opté pour une tâche qui soit la plus méconnue possible du / de la participant(e) avant l'expérience. En résumé, ce qui nous intéresse ici, c'est le processus d'intégration d'une nouvelle consigne de résolution de problèmes.

Nous vous rappelons brièvement cette consigne. Pour chaque problème, la première étape est de soustraire le second chiffre au premier. Ensuite, il vous faut diviser le résultat obtenu par le chiffre entre parenthèses. Si le résultat final est un nombre entier : appuyez sur la touche jaune « V » à droite du clavier. Si le résultat final n'est pas un nombre entier : appuyez sur la touche jaune « F » à gauche du clavier.
Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

Performance-approach goal condition instructions:
« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle vos compétences vont être évaluées par des expérimentateurs.
Il faut que cette évaluation soit la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, d'être bon, d'avoir un bon score à cette tâche, de montrer vos compétences.
Beaucoup d'étudiants vont réaliser cette tâche, et les scores seront classés les uns par rapport aux autres. Ce serait bien que vous essayiez de vous démarquer positivement, c'est-à-dire de réussir mieux que la plupart des participants. En résumé, ce qui vous est demandé ici, c'est de mettre en avant vos compétences, vos capacités.
Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses. Montrez le meilleur de vos capacités.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

Performance-approach goals + Neutral topic hyper-accessibility condition instructions:
« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle vos compétences vont être évaluées par des expérimentateurs.
Il faut que cette évaluation soit la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, d'être bon, d'avoir un bon score à cette tâche, de montrer vos compétences.
Beaucoup d'étudiants vont réaliser cette tâche, et les scores seront classés les uns par rapport aux autres. Ce serait bien que vous essayiez de vous démarquer positivement, c'est-à-dire de réussir mieux

que la plupart des participants. En résumé, ce qui vous est demandé ici, c'est de mettre en avant vos compétences, vos capacités.
Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses. Montrez le meilleur de vos capacités.

L'expérience essaie aussi de prendre en compte les particularités du matériel utilisé, afin de s'assurer qu'il n'influe pas sur la lecture des problèmes. Le format graphique des problèmes, ainsi que la luminosité de l'écran, ont été contrôlés, afin d'assurer une bonne lisibilité. Ces précautions ont pour objectif de mettre en place un environnement propice au bon déroulement de la tâche.
Il est désormais l'heure de commencer et de vous concentrer sur la tâche. Maintenant que vous avez lu ces dernières informations, n'y pensez plus pendant la résolution des problèmes.
Pendant toute la durée de l'exercice, évitez de penser aux particularités graphiques des problèmes. Essayez également d'éliminer toutes les pensées liées à la forme et à la position des stimuli. Par exemple, évitez de focaliser vos pensées sur la luminosité de l'écran.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

Performance-approach goals + Goal topic hyper-accessibility condition instructions:
« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle vos compétences vont être évaluées par des expérimentateurs.
Il faut que cette évaluation soit la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, d'être bon, d'avoir un bon score à cette tâche, de montrer vos compétences.
Beaucoup d'étudiants vont réaliser cette tâche, et les scores seront classés les uns par rapport aux autres. Ce serait bien que vous essayiez de vous démarquer positivement, c'est-à-dire de réussir mieux que la plupart des participants. En résumé, ce qui vous est demandé ici, c'est de mettre en avant vos compétences, vos capacités.
Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses. Montrez le meilleur de vos capacités.

En résumé, votre score sera évalué par des expérimentateurs et vous sera communiqué à la fin de l'exercice. Il est important que vous réussissiez un maximum. Essayez d'‘obtenir un excellent score final. Il sera comparé à celles des autres participants et votre classement vous sera également communiqué: vous devez réussir mieux que les autres, cette comparaison doit vous être favorable.

Il est désormais l'heure de commencer et de vous concentrer sur la tâche. Maintenant que vous avez lu ces dernières informations, n'y pensez plus pendant la résolution des problèmes.
Pendant toute la durée de l'exercice, évitez de penser que vous devrez avoir un très bon score final. Essayez également d'éliminer toutes les pensées liées au score des autres participants. Par exemple, évitez de penser à vouloir être meilleur que les autres.

Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

3. Material used in Chapter 2

3.1. Instructions specific to each experimental condition

Control condition:

« Cette étude a pour objectif de tester la résolution de problèmes sur les nombres entiers.
Pour cela, nous avons opté pour une tâche qui soit la plus méconnue possible du / de la participant(e) avant l'expérience. En résumé, ce qui nous intéresse ici, c'est le processus d'intégration d'une nouvelle consigne de résolution de problèmes.

Nous vous rappelons brièvement cette consigne. Pour chaque problème, la première étape est de soustraire le second chiffre au premier. Ensuite, il vous faut diviser le résultat obtenu par le chiffre entre parenthèses. Si le résultat final est un nombre entier : appuyez sur la touche jaune « V » à droite du clavier. Si le résultat final n'est pas un nombre entier : appuyez sur la touche jaune « F » à gauche du clavier.
Vous allez devoir résoudre une série de problèmes, exactement comme lors de la phase d'entraînement que vous venez de réaliser. Comme précédemment, privilégiez l'exactitude et la rapidité des réponses.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

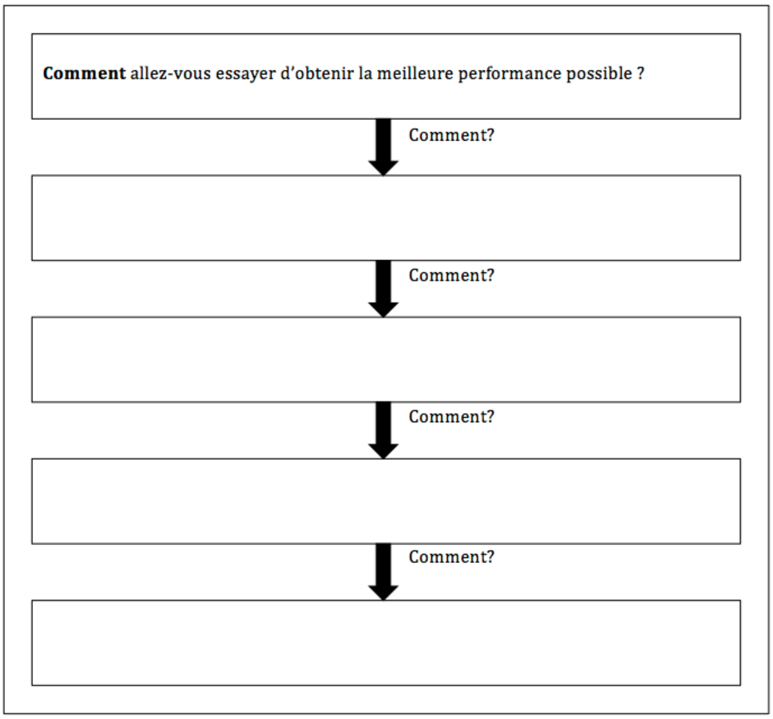
Performance-approach goal condition:

« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle votre performance générale sera évaluée par un expérimentateur, sur la base de votre score de bonnes réponses et de votre rapidité. A la fin de l'étude, nous imprimons pour chaque participant un document contenant le résultat de cette évaluation, ainsi que le classement obtenu comparativement aux autres participants.
Cette évaluation doit être la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, rapide, et ainsi de montrer vos compétences.

Beaucoup d'étudiants ont déjà réalisé cette tâche, et les scores sont classés les uns comparativement aux autres. Il est donc important que vous essayiez de vous démarquer positivement, c'est-à-dire que vous réussissiez mieux que la plupart des participants. Vous allez devoir résoudre une série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez d'obtenir un score élevé, en ayant le plus grand nombre de bonnes réponses, et en étant le plus rapide possible. Montrez le meilleur de vos capacités.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes.

Performance-approach goal + "how" orientation:
« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle votre performance générale sera évaluée par un expérimentateur, sur la base de votre score de bonnes réponses et de votre rapidité. A la fin de l'étude, nous imprimons pour chaque participant un document contenant le résultat de cette évaluation, ainsi que le classement obtenu comparativement aux autres participants.
Cette évaluation doit être la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, rapide, et ainsi de montrer vos compétences.
Beaucoup d'étudiants ont déjà réalisé cette tâche, et les scores sont classés les uns comparativement aux autres. Il est donc important que vous essayiez de vous démarquer positivement, c'est-à-dire que vous réussissiez mieux que la plupart des participants. Vous allez devoir résoudre une série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez d'obtenir un score élevé, en ayant le plus grand nombre de bonnes réponses, et en étant le plus rapide possible. Montrez le meilleur de vos capacités.

Mais avant que vous ne commenciez cette nouvelle série de problèmes, nous vous proposons tout d'abord d'effectuer un court travail de réflexion dont la procédure a été reconnue comme facilitant la résolution de plusieurs types de tâches.
Plus précisément, nous vous demandons de vous poser la question suivante:
« **Comment** allez-vous essayer d'obtenir la meilleure performance possible ? » Pour cela, vous devrez remplir ce type de feuille:



Voici un exemple visant à illustrer ce qui vous est demandé:
Admettons que le bien-être ressenti dans votre vie quotidienne soit important pour vous.

- **Concrètement**, *comment* pouvez-vous y parvenir? …Peut-être en trouvant un emploi, ou en ayant accès à l'éducation.

- *Comment* pouvez-vous réaliser ces choses-là? …Peut-être, en obtenant une qualification universitaire.

- *Comment* obtenir cette qualification? …Une réponse pourrait être : en vous impliquant au sein du milieu universitaire.

- *Comment* pouvez-vous vous impliquer? …Par exemple, comme aujourd'hui, en participant à une expérience.

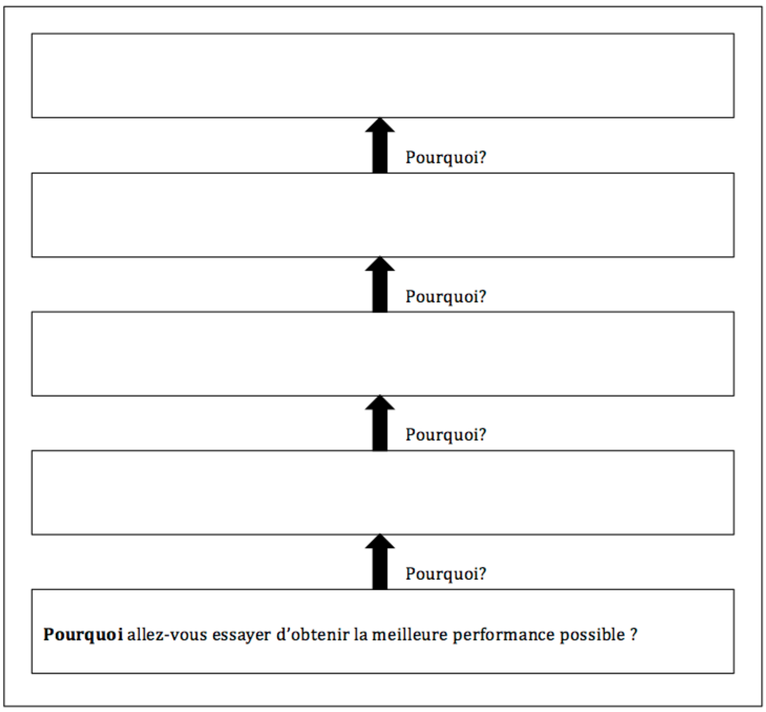
Maintenant, focalisez-vous sur la question suivante :
« Comment allez-vous essayer d'obtenir la meilleure performance possible durant la tâche de résolution? »
A présent, vous pouvez appeler l'expérimentatrice qui va vous fournir la feuille sur laquelle vous pourrez noter vos réponses. »

[Une fois la feuille remplie: Bloc 2].

Performance-approach goal + "why" orientation:

« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle votre performance générale sera évaluée par un expérimentateur, sur la base de votre score de bonnes réponses et de votre rapidité. A la fin de l'étude, nous imprimons pour chaque participant un document contenant le résultat de cette évaluation, ainsi que le classement obtenu comparativement aux autres participants.
Cette évaluation doit être la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, rapide, et ainsi de montrer vos compétences.
Beaucoup d'étudiants ont déjà réalisé cette tâche, et les scores sont classés les uns comparativement aux autres. Il est donc important que vous essayiez de vous démarquer positivement, c'est-à-dire que vous réussissiez mieux que la plupart des participants. Vous allez devoir résoudre une série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez d'obtenir un score élevé, en ayant le plus grand nombre de bonnes réponses, et en étant le plus rapide possible. Montrez le meilleur de vos capacités.

Mais avant que vous ne commenciez cette nouvelle série de problèmes, nous vous proposons tout d'abord d'effectuer un court travail de réflexion dont la procédure a été reconnue comme facilitant la résolution de plusieurs types de tâches.
Plus précisément, nous vous demandons de vous poser la question suivante:
« **Pourquoi** allez-vous essayer d'obtenir la meilleure performance possible ? » Pour cela, vous devrez remplir ce type de feuille:



Voici un exemple visant à illustrer ce qui vous est demandé. Actuellement, vous être en train de participer à une expérience.

- *Pourquoi* faites-vous cela ? …Peut-être, dans le but de vous impliquer dans le milieu universitaire.

- *Pourquoi* vous impliquez-vous dans le milieu universitaire ? …Peut-être afin d'obtenir un diplôme.

- *Pourquoi* obtenir un diplôme universitaire ? …Une réponse pourrait être : afin de trouver un travail, d'accéder à l'éducation.

- *Pourquoi* est-ce important pour vous de trouver un travail ou d'accéder à l'éducation ? …Peut-être parce que vous considérez que cela est nécessaire à votre bien-être dans la vie quotidienne.

Maintenant, focalisez-vous sur la question suivante :

« Pourquoi allez-vous essayer d'obtenir la meilleure performance possible durant la tâche de résolution? »

A présent, vous pouvez appeler l'expérimentatrice qui va vous fournir la feuille sur laquelle vous pourrez noter vos réponses. »

[Une fois la feuille remplie: Bloc 2].

3.2. Thought Listing Questionnaire

Veuillez s'il-vous-plaît **lister ci-dessous toutes les pensées qui vous ont occupé l'esprit pendant la résolution de la 2^e série de problèmes, c'est-à-dire pendant la phase enregistrée** (il n'est pas nécessaire de faire des phrases) :

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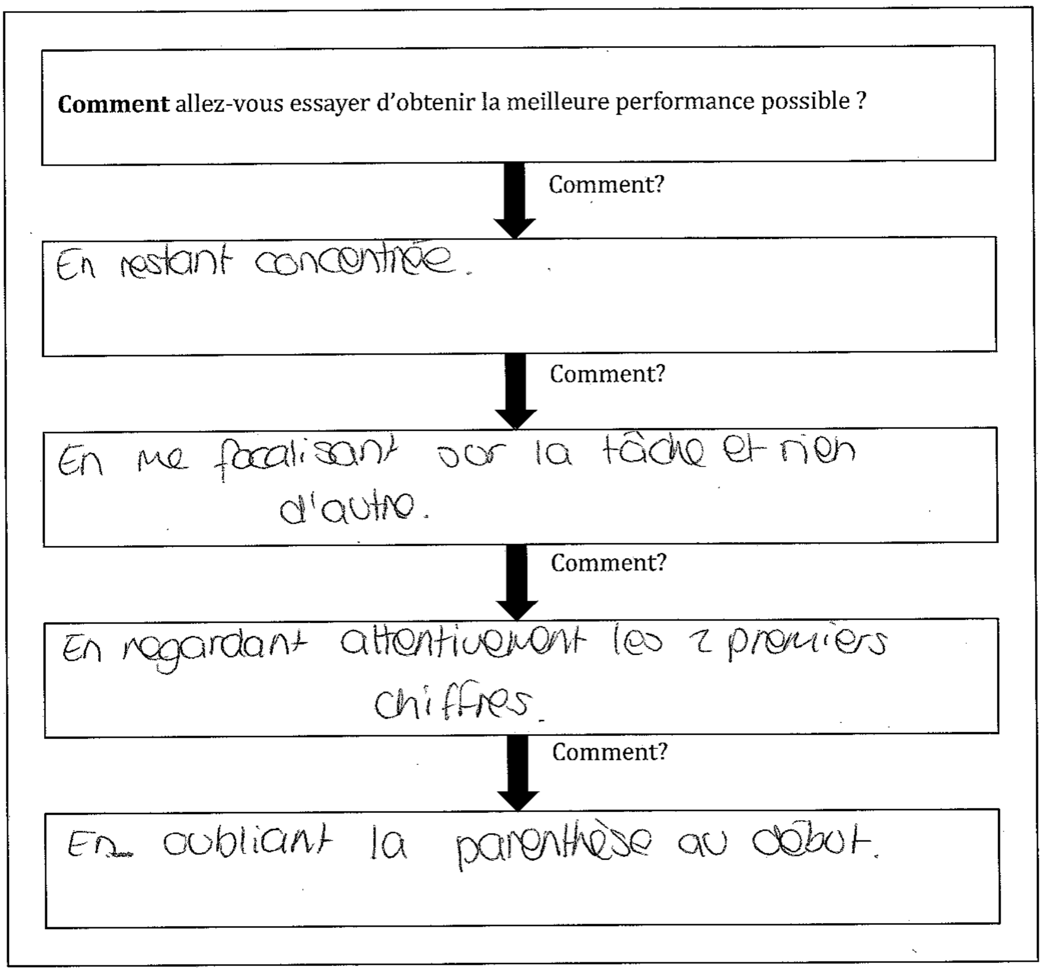
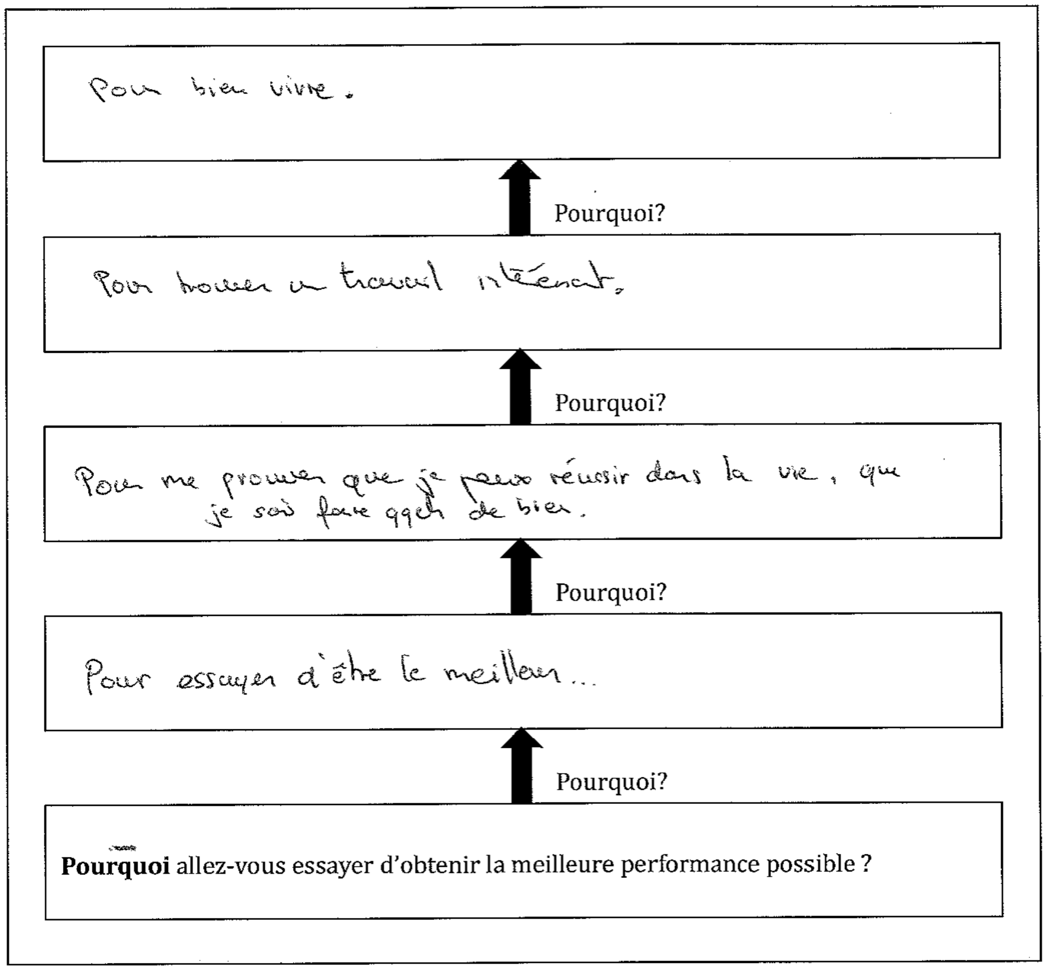
3.3. Example of a « how » diagram as completed by a participant



3.4. Example of a « why » diagram as completed by a participant



3.5. Example of one thought listing questionnaire as completed by a participant

Veuillez s'il-vous-plaît **lister ci-dessous toutes les pensées qui vous ont occupé l'esprit pendant la résolution de la 2e série de problèmes, c'est-à-dire pendant la phase enregistrée** (il n'est pas nécessaire de faire des phrases) :

- calculs appris par coeur (à l'école primaire)
- faire vite
- bien répondre
- j'entendais quelqu'un d'autre à l'ordinateur, ça m'a mis
- x la pression...
- certains calculs étaient un peu " compliqués" ~~et~~ d'autres
- très simples
-
-
-
-
-
-
-
-
-
-
-
-

4. Material used in Chapter 3

4.1. Experiment 5

4.1.1. Instructions specific to each experimental condition

Mastery-approach goal condition:

« Cette étude a pour objectif de tester le rôle de la mémoire de travail dans l'apprentissage d'une activité de résolution de problèmes sur les nombres entiers.

Dans la vie quotidienne, le calcul mental est, très souvent, assez peu exercé. Cependant, de nombreuses études démontrent que sa pratique est utile, non seulement pour effectuer des tâches mathématiques, mais également et surtout pour favoriser la fluidité et la rapidité du fonctionnement cognitif en général.

Dans des études antérieures, nous avons observé que la pratique de la tâche mathématique que vous êtes en train de réaliser entraîne une assimilation rapide de son fonctionnement, et une amélioration progressive des opérations mentales. En résumé, la tâche que vous réalisez ici peut vous être profitable sur le long terme. Notez que pour cela, il est nécessaire que vous focalisiez votre attention sur la maîtrise des calculs requis pour résoudre chaque problème de façon correcte et rapide.

A présent, vous allez devoir résoudre une nouvelle série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez au maximum de maîtriser l'exercice, en gardant en tête l'aspect positif de sa pratique, afin qu'elle puisse vous être profitable.

Dès que vous êtes prêt(e) et suffisamment concentré(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

Performance-approach goal condition:

« Cette étude a pour objectif de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Il s'agit d'une tâche pour laquelle votre performance générale sera évaluée par un expérimentateur, sur la base de votre score de bonnes réponses et de votre rapidité. A la fin de l'étude, nous vous distribuerons un document contenant votre résultat personnel à cette évaluation, ainsi que le classement obtenu comparativement aux autres participant(e)s.

Cette évaluation doit être la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, rapide, et ainsi de montrer vos compétences.

Beaucoup d'étudiant(e)s ont déjà réalisé cet exercice, et les scores sont classés les uns comparativement aux autres. Il est donc important que vous essayiez de vous démarquer positivement, c'est-à-dire que vous réussissiez mieux que la plupart des participant(e)s.
Vous allez devoir résoudre une nouvelle série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez d'obtenir un score élevé, en ayant le plus grand nombre de bonnes réponses, et en étant le plus rapide possible. Montrez le meilleur de vos capacités.

Dès que vous êtes prêt(e) et suffisamment concentré(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

4.1.2. OSPAN task instructions

« Lors de cette expérience, vous allez devoir mémoriser des suites de lettres apparaissant sur l'écran, tout en résolvant des problèmes mathématiques simples. Dans quelques instants, vous pourrez vous entraîner afin de vous familiariser avec l'exercice et son fonctionnement. Tout d'abord, nous allons nous familiariser avec la partie de l'exercice impliquant de mémoriser des lettres.
Pour l'entraînement qui va suivre, des lettres vont une par une apparaître sur l'écran. Essayez de mémoriser ces lettres, dans l'ordre tel que présenté.
Après l'apparition de 2-3 lettres, apparaîtront sur l'écran 12 choix de lettres avec, à côté de chacune d'elle, une case à cocher. Votre tâche sera de rappeler les lettres présentées, dans l'ordre dans lequel vous les avez vues. Pour cela, utilisez la souris pour cocher, dans le bon ordre, les lettres vues. Les lettres cochées vont apparaître en bas de l'écran.
Lorsque vous avez sélectionné toutes les lettres dans le bon ordre, cliquez sur la case **EXIT** qui se situe en bas à gauche de l'écran.
Si vous avez fait une erreur que vous souhaitez corriger, cliquez sur la case **CLEAR** pour recommencer.
Si vous avez oublié une lettre, cliquez sur la case **BLANK** à l'emplacement exact de cette lettre.
Gardez en tête qu'il est très important que vous rappeliez les lettres dans leur ordre de présentation. Si vous en avez oublié une, utilisez la case **BLANK** à l'endroit correspondant.

A présent que vous avez compris la partie « lettre » de l'exercice, nous allons vous présenter la partie impliquant les mathématiques.
Un problème mathématique comme celui-ci va apparaître à l'écran :

$$(2 * 1) + 1 = ?$$

Dès que le problème apparaît, faites l'opération mentale afin de trouver la réponse. Par exemple, ici, la bonne réponse est 3. Dès que vous avez trouvé la bonne réponse, vous devrez cliquer sur la souris.

Ensuite, sur l'écran suivant apparaîtra un nombre, ainsi que 2 cases, l'une marquée **TRUE** (VRAI) et l'autre marquée **FALSE** (FAUX).
Si ce nombre affiché sur l'écran est correct, vous devrez cliquer sur la case **TRUE**.
A l'inverse, si le nombre proposé est incorrect, vous devrez cliquer sur la case **FALSE**.
Par exemple, si vous voyez apparaître le problème suivant : (2 * 2) + 1 = ? et que le nombre proposé sur l'écran suivant est 5, alors cliquez sur la case **TRUE**, car la réponse proposée est correcte. De même, si vous voyez apparaître le problème suivant : (2 * 2) + 1 = ? et que le nombre proposé sur l'écran est 6, alors cliquez sur la case **FALSE**, car la réponse proposée est fausse.
Immédiatement après votre réponse, l'ordinateur vous dira si votre réponse est juste ou non.

Il est TRES important que vous répondiez correctement aux problèmes. Il est également important que vous essayiez de résoudre les problèmes aussi rapidement que possible.
Lorsque vous vous sentez prêt-e, cliquez avec la souris pour débuter l'entraînement aux problèmes. »

[Entraînement opérations]

« A partir de maintenant, vous allez réaliser les deux exercices (lettres et problèmes mathématiques) en même temps. Dans la prochaine série d'entraînement, un problème apparaîtra à l'écran ; vous devrez y répondre, comme précédemment. Après votre réponse, une lettre apparaîtra : vous devrez la mémoriser.
Au cours du précédent entraînement, l'ordinateur a calculé le temps moyen que vous avez mis à résoudre les problèmes. A présent, si vous dépassez ce temps moyen pour répondre, l'ordinateur va automatiquement passer à l'écran suivant, c'est-à-dire afficher la lettre à mémoriser. Dans ce cas, vous ne pourrez pas donner la réponse au problème, et celui-ci sera donc considéré comme une erreur. Pour cette raison, il est vraiment important que vous résolviez chaque problème rapidement, et sans faire d'erreurs.

Après la présentation de la première lettre à mémoriser, un autre problème vous sera présenté, et, après votre réponse, une autre lettre apparaîtra, que vous devrez également mémoriser.
A la fin de la série, un écran de rappel apparaîtra. Utilisez la souris pour sélectionner dans l'ordre les lettres qui vous ont été présentées. Il est important que vous les rappeliez dans l'ordre vu ; si vous en avez oublié une, cliquez sur la case **BLANK** à la place de celle-ci.
Il est important de résoudre rapidement et correctement les problèmes mathématiques. Assurez-vous d'avoir correctement résolu le problème avant de passer à l'écran suivant.

Après chaque problème, l'ordinateur ne vous dira plus si vous avez répondu juste ou non. A la fin de chaque série, un feed-back vous sera donné, concernant le nombre de lettres correctement rappelées, et votre % de bonnes réponses aux maths. Lors de ce feed-back, vous verrez un nombre en rouge, en haut à droite de l'écran. Il s'agit de votre % de bonnes réponses aux problèmes de maths depuis le début de l'étude. Il est TRES IMPORTANT que ce % soit d'au moins 85%. En effet, nous ne pouvons utiliser les données que lorsque ce score est supérieur ou égal à 85%.

Donc, pour que nous puissions utiliser vos données, vous devez obtenir au moins 85% de bonnes réponses TOUT EN faisant de votre mieux pour mémoriser et rappeler le plus de lettres possibles dans le bon ordre. »

[Entraînement opérations + mémorisation]

« L'entraînement est terminé.

La partie enregistrée sera similaire à l'entraînement: vous aurez à résoudre des séries de problèmes tout en mémorisant les lettres présentées. Lorsqu'apparaît l'écran de rappel, sélectionnez les lettres dans l'ordre dans lequel elles ont été présentées, puis cliquez sur la case **EXIT**. Si vous avez oublié une lettre, cliquez sur la case **BLANK**.

Certaines séries contiendront davantage de problèmes et de lettres que d'autres.

Il est important que vous vous concentriez au maximum à la fois sur la mémorisation des lettres et sur la résolution des problèmes. Concernant les problèmes, gardez à l'esprit qu'il vous faut travailler le plus vite et le plus correctement possible.

Gardez également à l'esprit que votre score total de bonnes réponses doit être maintenu à **au moins 85%.**

Si vous n'avez pas de question, cliquez sur la souris pour débuter l'expérience. »

4.2. Experiment 6

4.2.1. Instructions introducing the OSPAN task

« Cher-e participant-e,

Ainsi qu'il vous l'a été expliqué au début de la phase précédente, la première partie de l'expérience [= Bloc 1, arithmétique modulaire] était un entraînement, vos réponses n'étaient pas enregistrées. A présent, vous allez réaliser une nouvelle tâche, qui va vous être expliquée en détail sur les écrans suivants.

Cette tâche que vous allez débuter partage des similitudes avec la précédente, notamment en termes des capacités nécessaires à son exécution, car elle implique également la mémoire de travail et le calcul mental.

Appuyez sur la barre ESPACE pour commencer cette nouvelle tâche. »

4.2.2. Instructions manipulating the bogus feedback

« Dans quelques instants, vous allez entamer la dernière partie du test. Au préalable, le score que vous avez obtenu lors du test précédent va vous être donné sur l'écran suivant, à titre informatif. Ce score est calculé en fonction du nombre de bonnes réponses - pondéré par la difficulté des questions -, ainsi que de votre rapidité de réponse.

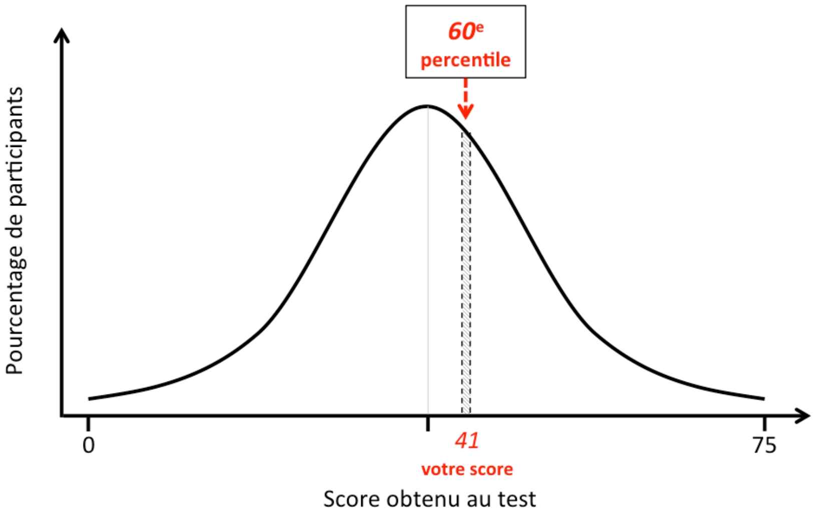
Comme beaucoup de personnes ont déjà effectué ce test, le logiciel va également vous indiquer comment vous vous classez comparativement aux autres participants. »

Average feedback condition:

Pour ce test, le score peut aller de 0 (minimum) à 75 (maximum).

Vous avez obtenu un score de: 41

→ ce qui comparativement aux autres participants vous classe dans le: ***60*****e** **percentile**.



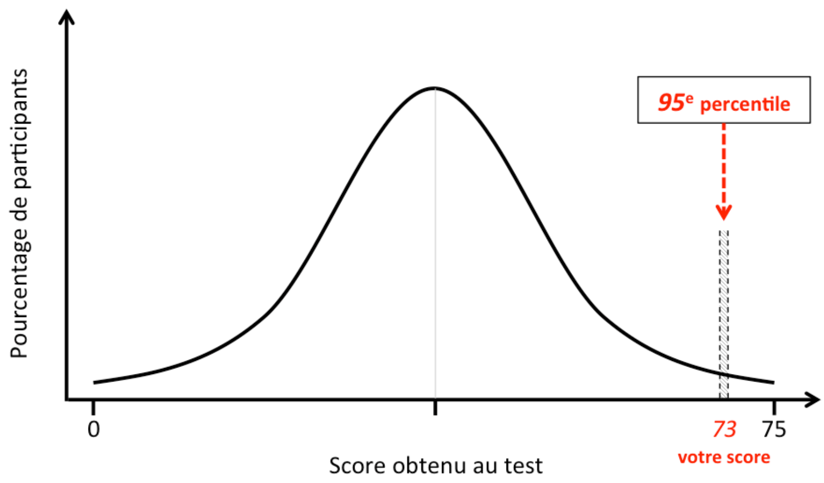
Appuyez sur la barre ESPACE pour passer à l'écran suivant

Positive feedback condition:

Pour ce test, le score peut aller de 0 (minimum) à 75 (maximum).

Vous avez obtenu un score de: 73

→ ce qui comparativement aux autres participants vous classe dans le: ***95***e **percentile**.



Appuyez sur la barre ESPACE pour passer à l'écran suivant

4.2.3. Performance-approach goal instructions (following the Ospan and the feedback)

« A présent, il est temps de débuter la dernière partie de l'étude. Lors de cette dernière partie, vous allez pouvoir vous remémorer la première tâche que vous avez réalisée au début de l'expérience. En effet, vous allez à nouveau résoudre des problèmes arithmétiques, comme ceux qui vous ont été présentés dans la première partie. Cette tâche, tout comme la précédente, implique le calcul mental et la mémoire de travail.

Nous vous rappelons brièvement la consigne de résolution.

Cette affirmation est-elle vraie? 35 = 19 (mod 2). Pour y répondre, vous devez effectuer mentalement les opérations suivantes: Soustraire 19 de 35: 35 - 19 = 16; Puis diviser ce résultat par 2. Le résultat est-il un nombre entier? Oui, car 16 est divisible par 2. En effet, 16 / 2 = 8, et 8 est un nombre entier. L'affirmation est donc vraie.

Pour chaque problème, n'essayez pas de deviner le résultat : faites le calcul.

Si l'affirmation est "vraie", appuyez sur la touche jaune "V" (à droite). Si l'affirmation est "fausse", appuyez sur la touche jaune "F" (à gauche). Il est important que vous mainteniez respectivement vos index gauche et droit sur ces 2 touches, de manière à pouvoir répondre aussi vite que possible.

Attention : Cette dernière phase n'est plus un entraînement, vos réponses seront enregistrées.
Notre objectif est de tester le lien entre la mémoire de travail et la performance dans la résolution de problèmes sur les nombres entiers. Pour la phase qui va suivre, votre performance générale sera évaluée par un expérimentateur, sur la base de votre score de bonnes réponses et de votre rapidité. A la fin de l'étude, nous vous distribuerons un document contenant votre résultat personnel à cette évaluation, ainsi que le classement obtenu comparativement aux autres participant(e)s.
Cette évaluation doit être la meilleure possible. Autrement dit, il s'agit pour vous de vous montrer performant, rapide, et ainsi de montrer vos compétences.

Beaucoup d'étudiants ont déjà réalisé cette tâche, et les scores sont classés les uns comparativement aux autres. Il est donc important que vous essayiez de vous démarquer positivement, c'est-à-dire que vous réussissiez mieux que la plupart des participants.
Vous allez devoir résoudre une série de problèmes, comme lors de la phase d'entraînement que vous venez de réaliser. Essayez d'obtenir un score élevé, en ayant le plus grand nombre de bonnes réponses, et en étant le plus rapide possible. Montrez-vous meilleur que les autres.
Dès que vous êtes prêt(e), appuyez sur la barre ESPACE pour commencer cette nouvelle série de problèmes. »

4.2.4. Lexical Decision Task instructions

see above (p. 196, 2.2.2.)

4.2.5. Lexical Decision Task words

Status words:
pouvoir, hiérarchie, privilèges, autorité, mérite, influence, statut, patron, riche, position

neutral words:
plante, orchestre, itinéraire, balade, déjeuner, réverbères, distance, lettres, vitre, nature

non-words:
mélotionce, atcale, anneur, fibine, prentitier, prelors, enselons, domentin, fipas, serdre, repule, dicement, totuva, lenclalier, caslais, recroure, mabricial, vipantait, nopélition, voige

5. Material used in Chapter 4

5.1. Questionnaire measuring students' achievement goals in the physics and chemistry class

UNIL | Université de Lausanne

Institut des sciences sociales

Bonjour,

Nous sommes une équipe de recherche de l'Université de Lausanne. Nous conduisons une enquête mesurant les opinions des élèves vis-à-vis de leurs études. Pour ce faire, nous vous serions très reconnaissants de remplir le questionnaire suivant. Cela ne devrait vous prendre que 5-10 minutes. Il n'y a ni bonnes ni mauvaises réponses, et toutes les informations que vous fournirez seront traitées de façon confidentielle. Nous vous encourageons donc à répondre aux questions le plus sincèrement possible.

Nous vous remercions d'avance de votre collaboration !

Ces propositions correspondent à différents **types de buts** que vous pouvez avoir ou ne pas avoir **pour vos études**. Veuillez indiquer dans quelle mesure chacune des propositions est vraie pour vous**. Toutes les questions qui suivent concernent le cours de Physique. Pour y répondre, pensez donc à vos cours de Physique.**

	Pas du tout vrai pour moi	**Pas vrai pour moi**	**Plutôt pas vrai pour moi**	**Sans avis**	**Plutôt vrai pour moi**	**Vrai pour moi**	**Très vrai pour moi**
Dans ce cours, il est important pour moi de mieux réussir que les autres élèves.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je désire maîtriser complètement le contenu des cours de physique.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Ma peur d'échouer dans ce cours est souvent ce qui me motive.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mon but dans ce cours est d'avoir de meilleures notes que la plupart des élèves.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

	Pas du tout vrai pour moi	Pas vrai pour moi	Plutôt pas vrai pour moi	Sans avis	Plutôt vrai pour moi	Vrai pour moi	Très vrai pour moi
C'est important pour moi de comprendre le contenu des cours de physique de façon aussi approfondie que possible.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Parfois j'ai peur de ne pas comprendre le contenu de ce cours de manière aussi approfondie que je le souhaiterais.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je veux seulement éviter d'échouer dans ce cours.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je suis parfois soucieux/se du fait que je pourrais ne pas apprendre tout ce qu'il y a à apprendre dans ce cours.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Mon but dans ce cours est d'éviter de mal réussir.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Il est important pour moi de bien réussir comparativement aux autres élèves dans ce cours.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je m'inquiète de ne pas apprendre autant que je le pourrais dans ce cours.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je veux apprendre autant que possible des cours de physique.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Je m'efforce d'éviter de moins bien réussir comparativement aux autres élèves.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Enfin, merci d'indiquer :

Votre prénom : __________________________

Votre date de naissance : _________________________

Votre sexe :   M / F

Votre langue maternelle: ____________________________________

Merci beaucoup !!

5.2. Final test

Nom :

Prénom :

Classe :

QCM PHYSIQUE-CHIMIE

A chaque question peuvent correspondre **aucune, une seule ou plusieurs propositions correctes**.
Attention : pour une question donnée, votre réponse ne sera considérée comme juste que si toutes les propositions correctes sont cochées.

- **Question 1 :**

Une espèce chimique	□ n'existe pas dans la nature. □ est toujours issue d'une fabrication par l'être humain. □ peut être naturelle, synthétique ou artificielle. □ naturelle n'est jamais dangereuse pour l'être humain.

- **Question 2 :**

Une espèce chimique	□ est naturelle si elle est présente dans la nature. □ est synthétique si elle est fabriquée par l'être humain. □ est artificielle si elle n'existe pas dans la nature. □ naturelle ne pourra jamais être copiée par l'être humain.

- **Question 3 :**

Un corps pur	□ est une substance constituée d'une seule espèce chimique. □ est une substance constituée de plusieurs espèces chimiques. □ est présent uniquement dans la nature. □ ne peut pas être fabriqué par l'être humain.

- **Question 4 :**

Un mélange	□ n'est pas présent dans la nature. □ est constitué de plusieurs espèces chimiques. □ peut être constitué d'une seule espèce chimique. □ peut être constitué de différents corps purs.

- **Question 5 :**

Un mélange homogène	□ est constitué d'espèces chimiques miscibles entre elles. □ est constitué d'espèces chimiques non miscibles entre elles. □ est constitué d'un seul corps pur. □ est constitué uniquement d'espèces chimiques naturelles.

- **Question 6 :**

Un mélange hétérogène	□ est constitué d'espèces chimiques non naturelles. □ est constitué d'espèces chimiques non miscibles entre elles. □ est constitué de plusieurs phases. □ est constitué uniquement d'espèces chimiques naturelles.

- **Question 7 :**

L'expression de la masse volumique	□ est $\rho = \frac{V}{m}$ □ est $\rho = \frac{m}{V}$ □ est $\rho = m \times V$ □ est $\rho = m \times V^2$

- **Question 8 :**

L'unité de la masse volumique	□ peut être en g/mL □ peut être en g.mL □ peut être en $kg.m^{-3}$ □ n'existe pas

- **Question 9 :**

L'unité de la densité d'un liquide ou un solide	□ peut être en g/mL □ peut être en g.mL □ peut être en $kg.m^{-3}$ □ n'existe pas

- **Question 10 :**

La solubilité du glucose (sucre) dans l'eau à 20°C est 700 g/L	□ l'indication 20°C est inutile car la température ne joue aucun rôle la plupart du temps. □ signifie qu'on peut dissoudre au maximum 700g de glucose dans de l'eau à 20°C en vue d'obtenir 1L d'eau sucrée. □ signifie qu'un litre de sucre pèse 700g. □ l'eau est le solvant.

- **Question 11 :**

La solubilité du sulfate de cuivre dans l'eau à 20°C est 317 $g.L^{-1}$	□ signifie que le soluté est le sulfate de cuivre. □ signifie que si on introduit moins de 317g de sulfate de cuivre dans une fiole jaugée de 1L et que l'on complète à l'eau distillée à 20°C, le mélange obtenu après agitation sera homogène. □ signifie que le sulfate de cuivre flotte sur l'eau. □ l'eau est le solvant.

- **Question 12 :**

Le benzaldéhyde est une espèce chimique présente dans l'essence d'amande amère. On l'utilise dans la frangipane notamment.	□ filtrer le mélange. □ filtrer le mélange, ajouter au filtrat de l'éthanol puis agiter fortement et laisser décanter et écarter la phase aqueuse.

Le benzaldéhyde est peu soluble dans l'eau et très soluble dans l'éthanol, l'acétone et l'éther. L'éthanol et l'acétone sont miscibles à l'eau. L'éther et l'eau ne sont pas miscibles. Un peu de frangipane a été écrasée dans de l'eau. Pour extraire le plus possible de benzaldéhyde dissous dans le mélange, il faut :	□ filtrer le mélange, ajouter au filtrat de l'acétone puis agiter fortement et laisser décanter et écarter la phase aqueuse. □ filtrer le mélange, ajouter au filtrat de l'éther puis agiter fortement et laisser décanter et écarter la phase aqueuse.

- **Question 13 :**

Le cyclohexane est un solvant de densité 0,78. Il est non miscible à l'eau	□ Si on mélange le cyclohexane et l'eau, le mélange sera hétérogène. □ Le mélange de l'eau et du cyclohexane donnera deux phases, la phase supérieure sera l'eau. □ Un millilitre d'eau pèse plus lourd qu'un millilitre de cyclohexane. □ Après une forte agitation et un temps de repos suffisamment long, le mélange sera homogène.

- **Question 14 :**

Lors d'une expérience d'hydrodistillation (entraînement à la vapeur). Par exemple des zestes d'orange broyés dans de l'eau.	□ On cherche à extraire principalement de l'eau. □ On cherche principalement à extraire des huiles essentielles. □ On cherche à réaliser une réaction chimique entre l'eau et le zeste d'orange. □ On cherche à extraire les sucres présents dans le zeste.

- **Question 15 :**

Dans un montage d'hydrodistillation (entraînement à la vapeur). Par exemple de la lavande dans de l'eau.	□ Le réfrigérant à circulation d'eau permet de condenser les vapeurs issues du ballon. □ L'eau qui circule dans le réfrigérant entre par le bas et sort par le haut. □ L'eau qui circule est froide par économie mais avec de l'eau chaude cela fonctionnerait mieux. □ L'eau ajoutée dans le ballon sert uniquement à ne pas faire « attacher » la lavande dans le ballon lors du chauffage.

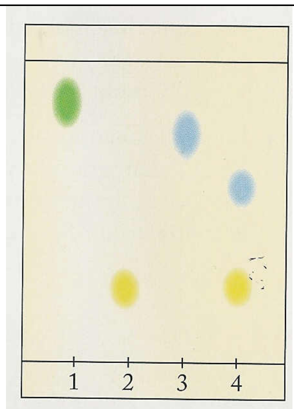
- **Question 16 :**

Lors d'une expérience d'hydrodistillation (entraînement à la vapeur). Par exemple des zestes d'orange broyés dans de l'eau.	□ Les huiles essentielles sont extraites et toute l'eau introduite reste dans le ballon. □ Le mélange extrait présente deux phases. □ Le mélange obtenu est appelé distillat. □ Les huiles essentielles restent dans le ballon et l'eau introduite est extraite.

- **Question 17 :**

Utilisation d'une ampoule à décanter : On vient de verser le distillat obtenu par hydrodistillation dans une ampoule à décanter. Le mélange contient des huiles essentielles de lavande. L'éther est un solvant dans lequel les huiles essentielles sont davantage miscibles que dans l'eau. L'éther n'est pas miscible à l'eau.	□ La phase qui contient principalement les huiles essentielles est appelée phase organique. □ La densité des huiles essentielles étant inférieure à 1, la phase qui les contient est en-dessous de la phase aqueuse. □ On ajoute de l'éther et on agite alors fortement. On peut alors ôter sans danger le bouchon afin que le mélange décante. □ On ajoute de l'éther, on agite fortement et on dégaze. Après avoir attendu suffisamment longtemps, le mélange ne présente qu'une seule phase.

- **Question 18 :**

Une encre verte est analysée par chromatographie. Pour cela, on réalise les dépôts suivants : (1) : vert chlorophylle E 140 (2) : jaune tartrazine E 102 (3) : bleu patenté E 131 (4) : encre verte à analyser.		□ L'encre verte est un mélange d'espèces chimiques. □ L'encre verte est un mélange de (2) et de (3). □ L'encre verte contient de la chlorophylle. □ L'encre verte contient de la tartrazine.

- **Question 19 :**

On analyse l'huile essentielle de lavande obtenue par hydrodistillation grâce à une chromatographie sur couche mince. On effectue les dépôts suivants : 1er dépôt : huile essentielle de lavande 2e dépôt : linalol commercial 3e dépôt : acétate de lynalyle de synthèse		□ L'huile essentielle de lavande est un corps pur. □ L'huile essentielle de lavande contient du linalol. □ L'acétate de lynalyle est un corps pur. □ L'huile essentielle de lavande ne contient pas d'acétate de lynalyle.

- **Question 20 :**

On analyse l'huile essentielle de lavande obtenue par hydrodistillation grâce à une chromatographie sur couche mince. On effectue les dépôts suivants : 1er dépôt : huile essentielle de lavande 2e dépôt : linalol commercial 3e dépôt : acétate de lynalyle de synthèse		□ Le trait du haut est la ligne de dépôt. □ Le rapport frontal du linalol est de 0,4. □ L'unité du rapport frontal est le cm. □ Le trait du bas est le front de l'éluant.