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A SURVEY AND A POSITIVE PSYCHOLOGY INTERVENTION ON FRENCH PHD STUDENT WELL-BEING

Gabriel A. B. Marais*	LBBE - UMR 5558, CNRS / Université Claude Bernard Lyon 1, Villeurbanne, France	gabriel.marais@univ-lyon1.fr
Rebecca Shankland	LIP/PC2S - EA 4145, University Grenoble Alpes, Grenoble, France	rebecca.shankland@iut2.univ-grenoble-alpes.fr
Pascale Haag	IRIS - UMR8156- U997, EHESS, Paris, France	ph@ehess.fr
Robin Fiault	Ecole de Psychologues Praticiens de Lyon, Lyon, France, and Psya, Lyon, France	robin.fiault@gmail.com
Bridget Juniper	Work and Well-Being Ltd, Emsworth, UK	bridget.juniper@workandwellbeing.com

* Corresponding author

ABSTRACT

Aim/Purpose	The present work focuses on French PhD students' well-being: an understudied working population thus far, which impedes the development of evidence-based policies on this issue in France.
Background	Research studies from several countries have shown that carrying out a PhD can be a difficult experience resulting in high attrition rates with significant financial and human costs.
Methodology	The two studies presented in this article focus on biology PhD students from University Lyon 1, a very large French university (~40,000 students). A first study aimed at measuring the mental health and well-being of PhD students using generalist and PhD-specific tools. In a second study, we carried out and assessed a positive psychology intervention (PPI) aimed at improving PhD students' well-being.

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Contribution	Our work is one of the first characterizations of French PhD students' mental health and well-being. As with other recent studies conducted in Western countries, we found a high level of mental distress among PhD students. Our work also underlines the importance of taking many dimensions of the PhD (not only supervisor behaviour) in order to understand PhD student well-being. Cultural specificities are highlighted and can help inform the design of interventions adapted to each situation. The PPI showed pre-to-post positive changes on PhD students' well-being. Further research is needed on a larger sample size in order to detect more subtle effects. However, these results are promising in terms of interventions that help reduce PhD student distress.
Findings	Study 1 involved 136 participants and showed that a large fraction of the PhD students experiences abnormal levels of stress, depression, and anxiety. We found that career training and prospects, research experience, and the impact of carrying out a thesis on health and private life have more impact on PhD students' mental health than the supervisors' behaviour. French PhD students' well-being is specifically affected by career uncertainty, perceived lack of progress in the PhD, and perceived lack of competence compared to UK PhD students well-being, which suggests cultural differences about the PhD experience in France compared to other countries. In study 2, the scores of the test and control groups (N = 10 and N = 13, respectively) showed a clear effect of the intervention on reducing anxiety.
Impact on Society	The high levels of mental health issues and reduced well-being in French PhD students reported in this study underline the importance of developing interventions in this field. Improving the supervisor-student relationship is one possibility but is not the only one. Interventions aimed at learning how to cope with the research experience and with the uncertainty with career pathways, and a good balance between PhD work and personal life present other promising possibilities.
Keywords	PhD students, graduate students, doctoral students, well-being, mental health, positive psychology

INTRODUCTION

PhD students are considered a specific hybrid population that sits between working and student populations (e.g., Devos et al., 2016). They are called "students", but, at the same time, they have a work contract (a doctorate grant or another contract, which enables them to support their living). Recent national reports in France have documented that 65-68% of PhD students are paid through a grant, 19% are already part of the working population (e.g., teachers who carry out their thesis during their spare time), while 13-16% have no stable identified revenue. In science, 90% of the doctoral theses receive financial support. Hence, the population of PhD students in science is clearly perceived as an academic working population compared to social sciences where up to 33% have no stable identified revenue (MENESR report, 2015). This is why in the present study we focused on biology PhD students' mental health and well-being.

Mental health and well-being at work has become a major issue in Western countries (for a review, see Martin-Krumm, Tarquinio, & Shaar, 2013). However, it has been an understudied topic in PhD student populations (Devos et al., 2016), and only one study to date has been published on French PhD students' mental health and well-being (Haag et al., 2017). This is problematic for at least two reasons: (1) studies have noted that this population is at risk of chronic stress, anxiety, burnout, and depression (Devos et al., 2016; Evans, Bira, Beltran-Gastelum, Weiss, & Vanderford, 2017; Haag et al., 2017; Levecque, Anseel, De Beuckelaer, Van der Heyden, & Gisle, 2017), (2) specific prevention or treatment programs are needed for this population.

Mental health interventions have increased in many other work settings (Martin-Krumm et al., 2013). There are two main approaches aimed at reducing mental health problems at work. The first approach focuses on curing mental health problems. The second approach focuses on preventing mental health problems and promoting well-being. This approach is more recent, and the emergence of positive psychology research (Seligman & Csikszentmihalyi, 2000) has helped develop studies and interventions in this field. Instead of targeting employees with mental health issues, the positive mental health approach is broader as it aims at developing better working conditions and resilience at work for all employees. Interventions that build resilience have been developed in order to help employees to better cope with difficult situations. They lead to more positive individual outcomes and an increasing number of organizations are adopting this approach worldwide (Martin-Krumm et al., 2013).

In France, the only good quality large-scale survey on mental health at work was conducted in 2003 in various work settings using Karasec's methodology. This survey resulted in categorizing jobs with different levels of mental health risks (Guignon, Niedhammer, & Sandret, 2008). Although in France academics are considered part of the occupational category comprising intellectual professions and management staff, which corresponds to category 2 (Professionals: science, health, teaching) of the International Standard Classification of Occupations (ISCO), they were not included in this survey and there is little data on mental health at work in French academia.

A survey carried out amongst more than 12.000 academics suggested that over 50% experienced high levels of stress at work (SGEN-CFDT report, 2014). However, no validated psychometric tools were used in that survey, and the sample size was strongly biased towards one research institution (Centre National de la Recherche Scientifique, CNRS) and towards technical staff (>80% of the participants). Shortly after this report was released, the CNRS announced a nationwide program to train academic managers (group leaders, heads of department) on psychosocial risks at work, which was carried out in 2015 along with a more detailed survey on 400 technical staff in 2016 in this same research institution. However, one category of French academics was not included in these surveys: the PhD students. Hence, at the time of our study, no data on French PhD students were available. The aim of the present research was to study this population and to develop effective interventions in terms of mental health and well-being tailored for PhD students since they represent a particular category of academics that sit between students and staff in terms of roles and status.

PhD Students' Mental Health

In countries where PhD students' mental health has been studied, there is a consensus that the PhD experience is difficult (Devos et al., 2016; Schmidt & Umans, 2014), characterized by constant peer-pressure, frequent evaluations, poor status, heavy workload, high pressure to publish, deadlines, financial difficulties, and many different activities to deal with (e.g., research, teaching, conferences). Consequently, the dropout rates (% of PhD students not completing the PhD) have been found to be very high in many countries, typically between 30 to 60%, including those with a perceived high-performing research system (Hunter & Devine, 2016; Litalien, 2014; Stubb, Pyhältö, & Lonka, 2012). In the USA for example, the dropout rate for PhD students is currently close to 50%. Such high dropout rates come with significant human and financial costs (Levecque et al., 2017). In France, available data suggest differences between research domains, with dropout rates ranging from 0-5% in STEM fields (Science, Technology, Engineering and Mathematics) to 40-45% in non-STEM fields (MENESR report, 2014; MENESR report, 2015; Miquelard, 2015).

A number of factors affecting mental health and well-being of PhD students have been identified. In past research, much attention has been given to the relationship between the PhD student and the supervisor (discussed in Juniper et al., 2012). Indeed, supervision style, supervisor experience, and frequency of supervision affect emotional exhaustion, burnout, PhD thesis completion, and intention to leave academia and are all potential areas of interest (Cornér, Löfström, & Pyhältö, 2017; Devos et al., 2015; Hunter & Devine, 2016). However, when other environmental/organizational

factors were included in the studies, the relationship between the PhD student and the supervisor did not come out as the significant factor affecting PhD students' well-being (Juniper et al., 2012). University policies, training opportunities, career perspectives (Juniper et al., 2012), working environment, quality of working space, facilities, social relationships at work (Caesens, Stinglhamber, & Luypaert, 2014; Juniper et al., 2012), balance between personal and professional life (Juniper et al., 2012), work engagement versus "workaholism" (Caesens et al., 2014), and type of motivation (*sensu* Deci & Ryan 2002) for the PhD thesis (Litalien, 2014; Stubb et al., 2012) were all shown to affect PhD students' mental health and well-being.

Gender and Cultural Differences in PhD Experience

When comparing data from different countries on the experience of PhD students, various differences appear. PhD dropout rates, for example, vary from one country to another (Hunter & Devine, 2016; Litalien, 2014; Stubb et al., 2012) and may reflect differences between countries in the factors mentioned above, as well as cultural differences in general well-being. The average life satisfaction index (a measure of subjective well-being) in the French population is much lower than that expected given its GDP. This has been called the French unhappiness paradox (Senik, 2014). The same pattern may be found concerning French PhD students' well-being. Haag and colleagues (2017) have recently published a nationwide study on French PhD students' mental health, which included about 2000 participants from different disciplines and universities. This study showed that about 27% of the PhD students report high levels of stress, and about 20% report somatic symptoms (e.g., headache, dizziness, heart pain, breathing difficulty). Stress and somatic symptoms are reduced when PhD students do regular physical activity and enjoy good-quality sleep. The levels of distress are higher for female than for male PhD students. This trend has been reported in previous studies, and the dropout rate has been found to be higher for females, which contributes to the rather severe gender gap observed in academic positions (Haynes et al., 2012; Schmidt & Umans, 2014). Competition between PhD candidates also increases pressure in countries in which academic positions are scarce. In France, for example, after completing their thesis, former PhD students are as likely to be unemployed as the general population (Harfi, 2013; MENESR report, 2014; Miquelard, 2015). Recently, the French government encouraged universities to support PhD students' professional integration through specific courses they can follow in order to develop opportunities other than academic positions. However, except for one program developed in the Ecole des Hautes Etudes en Sciences Sociales (Haag, 2015), which is currently under evaluation, these courses are not oriented towards fundamental dimensions of sustainable well-being such as competencies fostering resilience or engaging in activities that are commensurate with one's values and contribute to enhanced meaning in life. It is therefore important to develop interventions based on positive psychology theory and research in order to enhance PhD students' well-being.

The PERMA Model of Well-being

Well-being has been studied for many decades and comprises mostly subjective well-being (= high positive affect and satisfaction with life, see Diener, 1984) and, more recently, psychological well-being (= experience of life purpose, challenges and growth, see Keyes, Shmotkin, & Ryff, 2002). Based on the results of studies carried out by Keyes and his colleagues (e.g., 2002), Keyes concluded that subjective and psychological well-being should be studied. Seligman's PERMA model of well-being (2011) is thus composed of both aspects. PERMA stands for: Positive emotions, Engagement in challenging and interesting tasks that generate flow (Csikszentmihalyi, 1990), positive Relationships, Meaning in life – in part derived from contributing to something useful for others – and Accomplishment – induced by rewarding tasks, and it was developed as a synthetic model of the determinants of well-being. Research has shown that high levels of the components of the PERMA model reduce negative emotions (Garland et al., 2010), stress (Cohen & Wills, 1985), and depressive symptoms (Seligman, Steen, Park, & Peterson, 2005) and improve resilience (Tugade & Fredrickson, 2004) and satisfaction with life (Kashdan, Mishra, Breen, & Froh, 2009).

Based on this model, the present study aimed at developing and testing the efficacy of a positive psychology intervention for PhD students. In order to be able to choose the most useful intervention, a survey was first carried out in order to identify the specific difficulties encountered by PhD students in France in STEM fields. Previous studies have either focused on very large samples spanning several universities and disciplines or a smaller sample from a specific university. In order to ensure a more homogeneous sample, we chose to focus on one university setting (University Lyon 1, one of the largest French universities with about 40,000 students), and on one discipline (about 900 PhD students in biology). This helps reduce statistical variability due to university contexts and disciplines and enables the researchers to tailor an intervention best suited to the participants. We thus carried out two studies. In study 1, we used an online questionnaire to measure PhD students' mental health and well-being. We included factors known to affect PhD students' well-being based on other studies carried out on the same population, such as sleep, physical activity and motivation types. We also included time spent watching television as it has been shown to affect well-being (Boniwell & Osin, 2013). In study 2, we developed a positive psychology intervention and assessed its efficacy on French PhD students' mental health and well-being.

METHODS

STUDY 1

Participants

We targeted PhD students in biology at the University Lyon 1 (France). This comprised 846 PhD students from four doctoral programmes (http://www.univ-lyon1.fr/recherche/formation-doctorale/): multi-disciplinary doctoral programme in health sciences (EDISS, 287 PhD students); molecular, integrative, and cell biology (BMIC, 278 PhD students); evolution, ecosystem, microbiology, and modelling (E2M2, 166 PhD students); and neurosciences and cognition (NSCO, 115 PhD students). These PhD students were doing their research in 69 different departments/research institutes affiliated with Univ. Lyon 1.

In the doctoral programmes of biology, the expected duration for a PhD thesis has been three years, consistent with most doctoral programmes in STEM in France. An extension of 6 months has been easily granted. Only a minority of students have been authorized to complete for their PhD in over 3.5 years. Grouped together the PhD students in their 4th year or more represented 28% of the PhD students in biology at Univ. Lyon 1 (see Table 2, last column).

Online questionnaire

Our online questionnaire was developed using Limesurvey (https://www.limesurvey.org), a professional tool for online surveys, in which anonymity is guaranteed. The questionnaire was not restricted to a list of participants as we were not able to get the email addresses of the nearly 900 PhD students in biology at Univ. Lyon 1. Instead, the questionnaire was announced publicly using different channels of communication (see below for details). However, we ensured that participants completed the survey only once by checking their IP addresses and the personal/socio-economic data entered (age, gender, department, PhD year, data on parents). All registered IP addresses were different, and we did not find two participants with the same personal/socio-economic data. This suggests that every completed questionnaire was from a unique participant.

The tools included in our questionnaire are detailed in Table 1. The entire questionnaire was in French, which required translating (Table 1). For the jobs and socio-professional categories of the parents, we relied on the eight socio-professional groups (GSP 2011) defined by the French National Institute of Statistics (INSEE). For levels of education categories for parents, we relied on the eight categories (ISCED 2011) of the International Standard Classification of Education that we adapted to the French case (grouping categories 0, 1, 2, 3 into one "<Bac" category, for all people having

stopped before the "Baccalauréat" - a diploma ending high-school - and calling category 4 "Bac or equivalent" for people actually having the "Baccalauréat" diploma but not having higher education diploma). The questionnaire also included a question on whether the respondent would be interested in attending a PPI. The questionnaire had 143 items in total. Tests by beta-testers showed that the questionnaire could be completed in about 25 minutes.

Table 1. Description of the online questionnaire

Tool (in French)	Nature of collected data	# items	Scale	Justification
Personal and socio-economic data	Age, gender, PhD details (including PhD year), parents job/level of education	8	-	To control for socio-economic effects
DASS-21 (Lovibond & Lovibond 1995)	Stress, depression, anxiety	21	0-3	To measure mental health troubles, to be compared with Haag et al., 2017
***Jenkins Sleep Quality Index** (Jenkins, Stanton Niemcryk, & Rose 1988)	Sleep	4	0-5	Previously identified factor affecting mental health (Haag et al., 2017)
Sport index (Gionet & Godin 1989)	Physical exercise	1	0-6	Previously identified factor affecting mental health (Haag et al., 2017)
***Television viewing index** (Hancox, Milne, & Poulton, 2005)	Number of hours watching television per day	2	1-4	Factor potentially affecting well-being (Boniwell & Osin, 2013)
Warwick-Edinburgh-Mental Well-Being Scale (Tennant et al., 2007)	Subjective and psychological well-being (validated on students)	14	1-5	To measure all components of well-being and PERMA dimensions (Seligman, 2011)
Motivation for PhD (Litalien, 2014)	Motivation types (self-determination theory)	15	1-5	Previously identified factor affecting mental health and well-being (e.g., (Litalien, 2014; Stubb et al., 2012))
***Juniper PhD well-being scale** (Juniper et al., 2012)	Seven dimensions (e.g., supervisor, university, health, …)	75	0-5	PhD-specific multifactorial tool to study well-being (Juniper et al., 2012)

***These tools were translated from English to French for this study using the translation/back-translation approach (Brislin 1970; Sinaiko & Brislin 1973)*

The "Motivation for PhD" scale (Litalien, 2014) relies on the self-determination theory (SDT) (Deci & Ryan, 2002), which is supported by numerous studies carried out over the past thirty years. SDT predicts that, in the course of a PhD, self-determined motivation will lead to greater engagement and academic success, as well as higher levels of well-being compared to constrained motivation. Deci and Ryan (2002)'s types of motivation include intrinsic motivation, which refers to doing an activity for its own sake, for interest and enjoyment (i.e., "I do a PhD because I like doing research and discussing my work with others"), and four types of extrinsic motivation (integrated, identified, introjected, and external), which refer to engaging in an activity as a means to an end that is separate from the activity itself. All these types make a self-determined continuum, in descending order: intrinsic, integrated, identified, introjected and external. External motivation consists in performing a behaviour in order to obtain a reward or avoid a punishment (i.e., "I do a PhD to get a well-paid job afterwards"). Next comes the introjected motivation, in which an individual is driven by internal pressure such as guilt or shame (i.e., "I do not abandon my PhD because I do not want to disappoint my su-

pervisor"). Then comes the identified motivation, in which behaviours are more internalized, accepted, and valued and are considered important in themselves (i.e., "I do a PhD because it is a good opportunity to enlarge my skills"). Integrated motivation refers to the most self-determined form of extrinsic motivation in which behaviours fully correspond to the individual's goals, values, beliefs and needs (i.e., "I do a PhD because I am a curious person"). SDT often distinguishes two broader categories of motivation: autonomous motivation (intrinsic, integrated, and identified) and controlled motivation (external and introjected).

The Juniper PhD well-being scale (hereafter called JPWBS) included the initial 75 items that Juniper et al. (2012) generated at the start of the study and not the 50 that they identified at the end to be most significant among the British PhD students. This assumed that the significant items could differ between British and French PhD students. To make sure that the 75 items from Juniper et al. (2012) would fully cover all the relevant issues for the French PhD students studied here, we added an open question asking whether they had experienced other issues not already listed. Only two participants (<2% of all participants) indicated additional issues: the fact that one had a baby during the PhD and that the workspace was dirty. Given this very small percentage of additional items, we did not change the original 75 items.

The questionnaire was active from May 2nd to 20th, 2016 (3 weeks). The launch of the questionnaire was announced by email to the directors and deputy-directors of all four doctoral programmes cited above, to the people in charge of the PhD student associations associated with these doctoral programmes (BiodocsLyon, http://www.biodocslyon.com, DocE2M2, http://doce2m2.univ-lyon1.fr et Estigma: http://estigma.org) and to 23 heads of department for which we had their email addresses to spread the news (and the URL of the questionnaire) to the their respective PhD student population.

Data processing and analysis

From the raw answers to the DASS-21 test (Lovibond & Lovibond, 1995), we computed the stress, anxiety, and depression scores using DASS-21 developer guidelines and the relevant items (Lovibond & Lovibond, 1995). The raw answers to the motivation type test were used to compute the scores of the different motivation types: intrinsic, integrated, identified, introjected, external and also autonomous (intrinsic + integrated + identified) and controlled (introjected + external) following Litalien (2014) guidelines.

JPWBS results were analysed using the impact score approach based on the authors' guidelines (Juniper et al., 2012; Juniper, White, & Bellamy, 2009). The impact score for every item was defined as:

$$IS(\text{item } i) = \text{frequency}(\text{item } i) \times \text{mean}(\text{item } i) \qquad (1)$$

With the frequency being the number of answers > 0 divided by the total number of answers for the item i, the mean being the mean of all answers > 0 of item i, i would vary from 1 to 75.

We used impact score and not a multivariate analyses tool as the impact score allowed us to identify both items affecting the well-being of many participants as well as items having a very strong impact on the well-being of a minority of individuals (Juniper et al., 2012; Juniper et al., 2009).

Study 2

Intervention

Initially, we had planned to tailor the positive psychology intervention according to the results of study 1 in order to target specific mental health and well-being variables. However, as the results of study 1 underlined that the PhD experience seem to affect many mental health and well-being variables, we used a generalist positive psychology intervention called CARE (Coherence, Attention, Relationship, Engagement) developed by Shankland et al., (2016). This intervention is an 8-week program

composed of several positive psychology practices that affect all the dimensions of well-being as described by Seligman's PERMA model (Seligman 2011). This choice was also based on past research showing that too specific programmes might not fit well with a target population's needs and thus might fail (Challen, Machin, & Gillham, 2014; Faro, 2013). The efficacy of the CARE programme was evaluated pre-/post-treatment using the same online questionnaire as in study 1.

Participants

In order to minimize the effects of PhD students having different working environments on the results, we focused on a single department for this study. This way all the PhD students shared the same working environment. The department that we chose was 'Laboratoire de Biométrie et Biologie Evolutive' (LBBE, UMR CNRS 5558), the largest department in biology at University Lyon 1 with about 250 employees including 56 PhD students (http://lbbe.univ-lyon1.fr). This department was chosen for practical reasons (easy communication with the head of the department and the PhD students, and easy access to the department).

Online questionnaire, test/control groups, assessment of the programme

Before starting study 2, and in agreement with ethical standards in research in humanities, we gave an oral presentation of about 1 hour (questions included) to the PhD students in order to explain the context and the purpose of the study. About 30 PhD students attended the presentation. To exclude a "yea saying" effect (Moss, 2008 and references therein), an invitation to complete the online questionnaire was not sent directly after the presentation but two weeks later. All the PhD students affiliated to LBBE received the invitation. The online questionnaire is detailed in Table 1. Invitations were sent using Limesurvey with individual code access (generated by Limesurvey) in order to guarantee that only PhD students invited to fill the questionnaire would do so and only once. Answers were anonymous as in study 1. 23 PhD students replied (Table 8). The questionnaire was used to identify the PhD students willing to participate in the PPI. The 10 PhD students who replied that they were interested in the PPI were selected for our test group (N = 10). The rest of the PhD students (who replied that they were NOT interested in a PPI) constituted our control group (N = 13). The collected data were used for our pre-treatment (t1) assessment. t1 data collection took place mid-March (during 10 days) 2016 – 2-3 weeks before the PPI – and t2 data collection took place late-May/June (during one month) – 0-4 weeks after the PPI.

For the post-treatment (t2) assessment, the PhD students filled a simplified version of the questionnaire with only 103 items. The section on 'personal and socio-economic data' was shortened. The section on JPWBS included the most significant items (with impact score ≥ 1) found in study 1, that is, 41 (instead of 75) as done in Juniper et al. (2012). Although answers were anonymous, data collected at t1 and t2 on the same participant were regrouped using a code that participants were asked to keep with them. This was double-checked by verifying that the IP addresses and the personal and socio-economic data for any given participant in t1 and t2 matched.

Data processing and analysis were carried out as in study 1 (see section "study 1"). However, data from study 1 and study 2 were treated separately, that is, data from study 2 were not included in study 1 in order to avoid (1) an overrepresentation of PhD students from LBBE in study 1 and (2) duplicated datapoints (some students from LBBE might have filled the questionnaire for both study 1 and 2). We cannot estimate precisely the overlap between datasets from both studies, as questionnaires were anonymous. However, in study 1, only 4 PhD students from LBBE replied to the online questionnaire (~3% of all participants of study 1). Overlap between studies 1 and 2 participants must have comprised between 0 to 4 PhD students.

The CARE programme

Two instructors (RF and GABM) implemented the CARE programme (Shankland, Kotsou, & André, 2015; Shankland et al., 2016) with 10 participants. A plan based on both PhD students' and in-

structors' availabilities in order to maximize the rate of participants' attendance was developed. The programme was seven weeks long and took place between April and May 2016. We did a 1 hour and 45 minutes session with participants and instructors followed by a week of home-practice. Participants experienced six standard sessions plus a 3-hour-long session followed by two weeks of home-practice. The full content of the sessions and the details of the practices are detailed in the supplementary material (Appendix A). An attendance sheet was filled out by the participants at the beginning of each session. The average attendance rate was 80-100% for all sessions except the last one (50%) due to professional constraints experienced by some participants. Individual attendance rate varied between 71 to 100% for 9 out of 10 participants. One participant attended only 57% of the sessions.

For both studies 1 and 2, all analyses, statistical tests, and figures were done using the R software (https://www.r-project.org) or MS Excel.

FINDINGS

STUDY 1

In total, 136 PhD students completed the questionnaire (Table 2) - a 16% participation rate taking into account the whole population of PhD biology students at University Lyon 1 (see Methods). Participants were from 40 different departments, which represented about 57% of all the departments in biology at the University Lyon 1. Our sample included 73.5% of female participants compared to 56% of female PhD students in biology overall (Table 2). This indicated a clear bias towards females as observed in other studies on well-being (e.g., Levecque et al., 2017). Participants were in their 1st, 2nd, 3rd and 4th year or more. Compared to the doctoral school's statistics (Table 2), 2nd and 3rd year students were over-represented and 4th year or more were under-represented in our sample.

Table 2: Online questionnaire results

	Numbers	% in our sample	% in the whole population**
All*	136	-	-
Complete	125	91	-
Female PhD students	100	73.5	56
Male PhD students	36	26.5	44
1st year	32	23.5	25.5
2nd year	44	32.35	25.3
3rd year	44	32.35	21.2
4th year or more	16	11.8	28

**Only partially filled questionnaires with at least the first test fully filled (DASS-21) have been included, 9 out of these partially filled 11 questionnaires were >50% complete*

***This includes all the PhD students in biology at Univ. Lyon 1 using official statistics provided by the service of doctoral studies of Université de Lyon (UdL), see Methods*

Mental health and well-being global measurements among PhD students

DASS-21 results showed that a large fraction of PhD students had an abnormal level of stress, depression, and anxiety (between ~42 to ~56%) or even severe to extremely severe levels (between ~20 to ~27%, see Table 3). Scores for stress, depression, and anxiety were highly correlated, which suggests that the same people tended to suffer from the three (stress/depression: spearman coefficient

(Rs) = 0.56; stress/anxiety: Rs = 0.59; anxiety/depression: Rs = 0.55 with p-values < 10^{-3} in all cases).

Table 3. DASS-21 scores (stress, depression, anxiety)

	Stress*	Depression*	Anxiety*
Abnormal levels**	55.9%	53.7%	41.9%
Severe to extremely severe levels**	27.2%	21.3%	19.8%

** % of participants (N = 136)*

*** using the score thresholds described in the DASS-21 manual*

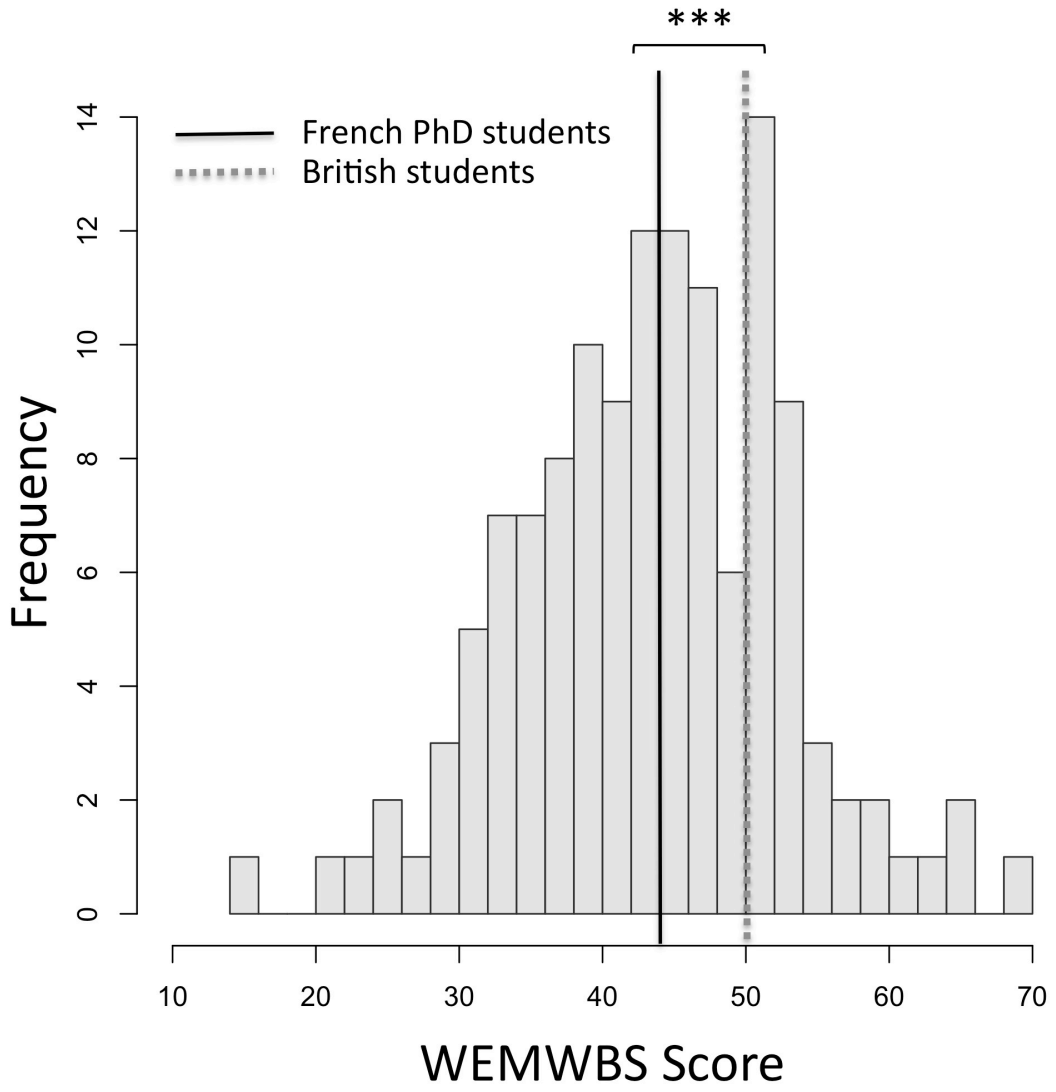

Figure 1: Distribution of the WEMWBS scores

The mean score (44) was compared to that of a reference British sample (50) (see Tennant et al., 2007). Student t-test is significant (p-value = 8.15×10^{-12}).

The average WEMWBS score, which gives a global measurement of well-being – both subjective and psychological – and thus captured all the dimensions of well-being in the PERMA model (see Table 1), was 43.8 for our sample (median is 44, see Figure 1). We compared this score to that of a reference sample on which the WEMWBS was developed and whose median and mean was 50 (Tennant et al., 2007). Our sample had a significantly lower score than that of this reference sample (Student t-test p-value = 8.15×10^{-12}).

Factors affecting mental health and well-being of PhD students

We analysed the correlations between previously known factors affecting mental health and well-being of PhD students (see Introduction and Table 1) and our measurements (Table 4). Correlations between sleep disorders and mental health problems were strong and significant, which has been observed before (Haag et al., 2017). Practicing sport was marginally correlated to well-being. Watching television was correlated to anxiety. Motivation types for the PhD students were correlated to both mental health and well-being scores, as observed previously (Litalien, 2014). Intrinsic motivation (where pleasure is the main driver) was strongly correlated to well-being. Introjected motivation (relying on internal pressure as the main driver) was correlated positively to mental health problems and negatively to well-being. Findings for other motivation types were non-significant but consistent with those for intrinsic and introjected motivation types, i.e., other autonomous motivation types (integrated, identified) tended to be positively associated with well-being and the other controlled motivation type (external) showed the opposite trend (data not shown). When regrouped into two types: autonomous (intrinsic + integrated + identified, see Methods) and controlled (external + introjected, see Methods), similar but somewhat weaker correlations were found (Table 4).

Table 4. Correlations between different parameters and our measurements of mental health and well-being

	Stress†	Depression†	Anxiety†	WEMWBS†
Sleep disorders	**0.52******	**0.33*****	**0.46******	**-0.29****
Sport practice	ns	ns	ns	**0.17** p=0.056
TV viewing (week)	ns	ns	ns	ns
TV viewing (weekend)	ns	ns	**0.24***	ns
Autonomous motivation	ns	**-0.23***	ns	**0.39******
Controlled motivation	ns	**0.17***	**0.21***	ns
Intrinsic motivation	ns	**-0.22***	ns	**0.44******
Introjected motivation	**0.21***	**0.36*****	**0.26***	**-0.22***

† *Spearman coefficients and p-values are shown,*
***** $p < 10^{-5}$, *** $p < 10^{-4}$, ** $p < 10^{-3}$, * $p < 0.05$, * ns = not significant*

PhD experiences affecting mental health and well-being

To study how PhD experiences affect mental health and well-being, we used JPWBS, a tool specifically developed for PhD students (Juniper et al., 2012). JPWBS includes 75 items grouped in seven broad domains (see Methods and Table 5). The analysis of the raw data was done using the impact score following the authors' recommendations (see Methods). The results are presented in Table 6 and showed that items with the highest impact score were from the 'career' domain. About 93% of the PhD students reported that their well-being was reduced by the uncertainty about the next step in their career and by being worried by their professional future. The self-assessed impact on well-being is around 3.8 on a scale of 0-5, which is high. Certain items from the 'research' domain were also very high on that list (frustration, demotivation because of lack of results/progress). In the top five items with the highest IS, the item on the effect of research work on stress was reported by 91% of the PhD students (with a mean effect of ~3.5), which is consistent with the results of the DASS-21.

Table 5. List of 7 domains affecting PhD student well-being assessed by JPWBS

Domain	Description
Career	Perceived impact of opportunities for training and career progression on well-being of PhD students
Research	Perceived impact of the research experience on well-being of PhD students
Health and private life	Perceived impact of research role on well-being of PhD students in terms of affecting private life, psychological and physical health status
Supervisor	Perceived impact of the supervisor behaviour on well-being of PhD students
Social	Perceived impact of the social aspects of the research role on well-being of PhD students
Facilities	Perceived impact of university facilities on well-being of PhD students
University	Perceived impact of the wider university activity on well-being of PhD students

Table 6. The top 30% items in JPWBS

IS*	Freq.	Mean	Questions	Domains
3.552	0.928	3.828	*Being unclear about the next stage of your career after your PhD?*	Career
3.544	**0.936**	**3.786**	***Being unsure about your future career prospects?***	**Career&**
3.328	**0.920**	**3.617**	***Feeling demotivated as you are not making the progress you had hoped for?***	**Research&**
3.232	0.944	3.424	*Feeling frustrated/demotivated by your results and apparent lack of progress?*	Research
3.184	0.912	3.491	*Experiencing high levels of stress because of your research?*	Health, private life
2.976	**0.888**	**3.351**	***Lacking belief in your ability to complete your PhD successfully?***	**Research&**
2.880	0.888	3.243	*Lacking confidence in your ability to conduct research to the necessary standard?*	Research
2.768	0.872	3.174	*Having a high workload that impacts on your private life?*	Health, private life
2.696	0.864	3.120	*Lacking enthusiasm about your research?*	Research
2.576	0.808	3.188	*Being frustrated with the college's administration systems?*	University
2.488	0.816	3.049	*Making unreasonably high demands of yourself in the name of research?*	Health, private life
2.472	0.840	2.943	*Feeling constantly tired and run-down because of your workload?*	Health, private life
2.464	0.816	3.020	*Experiencing a persistent low mood because of your research?*	Health, private life
2.384	0.720	3.311	*Becoming physically unfit because of your workload?*	Health, private life
2.352	0.776	3.031	*Feeling disappointed in your own abilities as an academic researcher?*	Research
2.352	0.752	3.128	*Experiencing poor quality sleep because of your studies?*	Health, private life

IS*	Freq.	Mean	Questions	Domains
2.144	0.744	2.882	*Having insufficient feedback during your PhD to check progress?*	Supervisor
2.072	0.656	3.159	*Feeling unsupported by your supervisor?*	Supervisor
2.064	0.688	3.000	*Being unable to balance your research with home demands?*	Health, private life
1.920	0.624	3.077	*Being unclear about your entitlements? eg holiday*	University
1.904	0.696	2.736	*Having inadequate career advice?*	Career
1.880	0.648	2.901	*Lacking training on publication skills? e.g.. referencing, submissions*	Career
1.872	0.680	2.753	*Feeling uninvolved with the wider research environment outside of your department?*	Social
1.800	0.568	3.169	*Lacking motivation to complete your PhD in a timely manner?*	Research
1.752	0.568	3.085	*Feeling isolated from other research colleagues in your department?*	Social

** Items are ordered by decreasing impact score (IS); frequency (Freq.) and mean of the score (Mean) of an item in the sample are indicated as well. The full results are presented in the supplementary material (Appendix B).*

& *Items significant in this study and not in Juniper et al. (2012).*

In the top 30% items with the highest IS, we found that 'health and private life' items were statistically over-represented (Table 7). Out of 11 items in this domain, eight were found in the top 30% (Fisher test p-value = 0.0049). Another over-represented domain was "research" (Fisher test p-value = 0.0051). Only one domain was under-represented: facility (Fisher test p-value = 0.046). When ordering domains using mean IS, we found that research, career, and health and private life domains had the strongest impact on the well-being in our sample of PhD students, whereas facility had the lowest. The supervisor domain only had a mild impact.

Table 7. Mean impact score (IS) of the seven domains affecting PhD student well-being

	Career	Research	Health and private life	Supervisor	Social	Facility	University
✝top 30%	ns	OVER*	OVER*	ns	ns	UNDER*	ns
Mean IS	1.796	2.450	2.255	1.446	1.163	1.099	1.288
★Importance	3	1	2	4	6	7	5

✝ *Presence of all items of a given domain in the top 30% with the highest IS (see table 6). OVER = over-represented, UNDER = under-represented (tested with Fisher exact test).*
***** $p < 10^{-5}$, *** $p < 10^{-4}$, ** $p < 10^{-3}$, * $p < 0.05$, * ns = non significant.*
5 out of the 75 items not assigned to any domain were excluded from this analysis.
★ *Based on mean IS.*

STUDY 2

For this study, we worked on a single department sample. First, we collected data using the same questionnaire as in study 1 and got 23 completed forms, representing 41% of all PhD students within the department (Table 8). The data collection was independent for studies 1 and 2, and, although we cannot access precisely the overlap between datasets from studies 1 and 2 (as our questionnaire was anonymous), it was likely to be very small (see Methods). As in study 1, female PhD students were slightly over-represented in our sample (69.5% compared to 53.6% for the whole department, see Table 8). Results for DASS-21 and WEMWBS are similar to those found in study 1: abnormal

levels of stress/depression/anxiety for 52-61% of the PhD students, and severe/extremely severe for 17-22%. Mean WEMWBS score was 45.8 (median is 45.5). These findings suggest the department that we picked for study 1 is not an outlier compared to other biology departments at University Lyon 1.

Table 8. Online questionnaire results for the intervention in positive psychology

	Numbers	% in our sample	% in the whole population
All*	23	-	-
Complete	21	91	-
Female PhD students	16	69.5	53.6
Male PhD students	7	30.5	46.3
Test group**	10	43.5	-
Control group***	13 (6)	56.5	-

**Only partially filled questionnaires with at least the first test fully filled (DASS-21) have been included*
***All the PhD students from the 'test' group had fully filled questionnaire*
****at t2, only 6 PhD students from control group filled the online questionnaire*

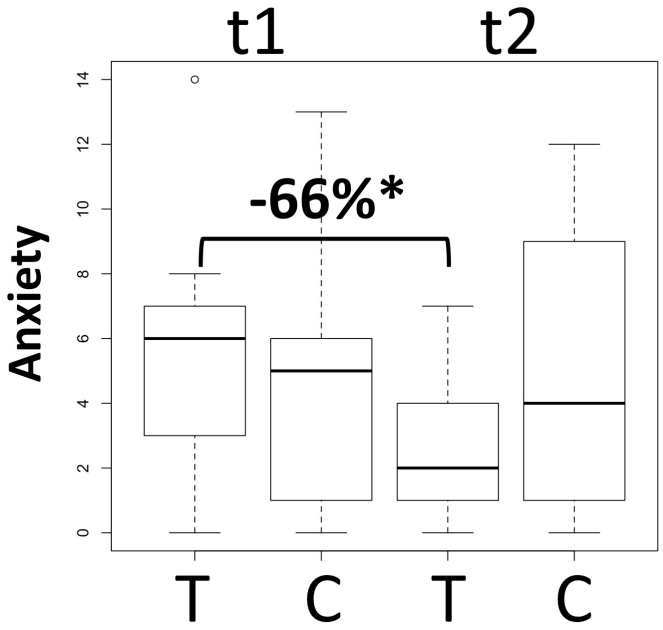

Figure 2. Anxiety scores pre-PPI (t1) and post-PPI (t2) for test and control groups
For the test group, only PhD students who attended more than 70% of the PPI were included (see Methods). The percentage indicates the extent of the change from t1 to t2 for the test group. Statistical significance was tested using a paired-unilateral Wilcoxon test. t1 and t2 results were not significantly different for the control group and were significantly different for the test group (p-value = 0.00966). T = test group. C = control group.

The test group from this department attended the PPI that we set up (see Methods). It was compared to a control group that did not attend the PPI (see Table 8 for sample sizes of the groups). The efficacy of the PPI was assessed pre-PPI (t1) and post-PPI (t2) using the same questionnaire used in study 1 (see Methods). The test group showed a reduction of DASS-21 scores and an increase of WEMWBS scores compared to the control group. However, only the reduction in anxiety

was both strong and significant (Figure 2). Results were weaker and non-significant for the other scores such as sleep problems (-30%), stress (-20%), depression (-16%) and WEMWBS (+9%).

DISCUSSION

A High Level of Mental Distress among French PhD Students

The results of study 1 are consistent with the Haag et al. (2017) multi-university study and confirm high levels of stress among French PhD students (this study: ~56%, Haag et al., 2017: ~27%). Our work also showed that not only is stress pervasive among PhD students but also anxiety and depression. These latter variables were not studied in Haag et al. (2017). A large number of PhD students in our sample show abnormal levels of anxiety (~42%) and depression (~54%). A high level of mental distress has been recently reported in several studies. A recent large-scale study in Belgium (N = 3659) found that ~1/3 of the PhD students were at risk of having or already developing a common psychiatric disorder, especially depression (Levecque et al., 2017). In the USA, 43–46% of PhD students in the biosciences were depressed at Berkeley University, and a majority of PhD students reported "more than average" current stress or "tremendous" stress at Arizona University (Evans, Bira, Beltran-Gastelum, Weiss, & Vanderford, 2017). A multi-country study (32 countries and 2,643 respondents) found a similar trend with PhD students having moderate to severe anxiety, depression and stress rates of 41%, 39%, and 82% respectively (Evans et al., 2017). Although these studies differ in their methodology (e.g., psychometric tools: DASS-21 in this study; PSS-14 in Haag et al., 2017; GHQ in Levecque et al., 2017; GAD07, PHQ09 and PSS-14 in Evans et al., 2017), they all point to a similar observation: mental distress among PhD students seems to be a major issue in many countries. Evans and colleagues (2017) have even described this situation as the "mental health crisis in graduate education."

The well-being index is significantly lower in our sample than in a reference British student sample (Tennant et al., 2007). However, the British students in the reference sample were not all PhDs, and this comparison is therefore limited. Future research should focus on obtaining multi-country WEMWBS data for PhD students to be able to make meaningful comparisons.

Factors Correlated with PhD Students Well-Being: Supervisor's Behaviour is not the Strongest

Consistent with the Haag et al.'s (2017) multi-university study, we found correlations with mental health problems, reduction in well-being, and sleep disorders (particularly strong for anxiety and stress). We also found a weak correlation between well-being and sport practice consistent with a protecting effect of physical exercise on stress reported in Haag et al. (2017). We found correlations between our measurements of mental health and well-being and motivation types as observed in Litalien (2014), except that identified motivation (and not intrinsic as found here) was most correlated with well-being in Litalien (2014). As in other countries, motivation types appear to be a key factor to consider in studies on PhD students well-being in France.

We found that the impact of the supervisor on the PhD students' well-being was not as strong as usually viewed in articles on PhD student well-being, which extends conclusions of Juniper et al. (2012) on British PhD students. Other domains such as career training and prospects, research experience, the impact of carrying out a thesis on health and private life have stronger mental health consequences. As in Juniper et al. (2012), we found that the university facilities had a minor impact on PhD student well-being, which is consistent with one of the primary conclusions of positive psychology: material comfort above a certain threshold does not have a strong influence on well-being (reviewed in Seligman, 2011).

Cultural Specificities of the Experience of Doing a PhD in France

France is known to be a country with reduced well-being compared to what is expected given its GDP, with cultural specificities being possibly responsible for this trend (Senik, 2014). To understand better the specificities of the French PhD students, we focused on the results of JPWBS and, in particular, on the items that were significant in our study and not in the original study on British PhD students (Juniper et al., 2012). We found three such items:

1) *Being unsure about your future career prospects? (Q74)*
2) *Feeling demotivated as you are not making the progress you had hoped for? (Q77)*
3) *Lacking belief in your ability to complete your PhD successfully? (Q116)*

These three items were in the top 10 items with the highest IS (ranked 3, 4 and 7 respectively, see Table 6). These items point towards career uncertainty, perceived lack of progress in the thesis, and lack of confidence affecting specifically the well-being of French PhD students. These items could represent cultural differences of doing a PhD in France compared to the UK. Quite strikingly, as many as 94% of the PhD students in our sample were worried about their professional future (Q74). OECD data suggest that the value of a PhD in the job market is different between France and UK (Harfi, 2013). In France, the unemployment rate of PhDs is 9%, in the UK, it is only 2% (Harfi, 2013). The case of the French PhDs is unique: the unemployment rate is three times that of the average rate of the OECD countries. Additionally, PhDs are underrepresented in private research (13% of the researchers), which is dominated by engineers (54% of the researchers, see Harfi, 2013). The situation of PhDs in biology and chemistry is the worst of all with PhDs unemployed 12% and 13% respectively, higher than the average rate for all workers of 10% (Harfi, 2013).

Methodological Limitations

Socio-economic factors, gender, and year of PhD may affect well-being and mental health, and these could represent confounding factors in study 1. Indeed, we observed a significant effect of gender on DASS-21 and WEMWBS scores, female PhD students having higher levels of stress and anxiety and a lower well-being index as found in previous work. The level of education of the mother also had an effect on stress and anxiety (non-parametric Kruskal-Wallis ANOVA p-value = 0.040 and 0.022 respectively). The year of PhD also had an effect on stress levels; 3rd years and 4th years and more showed higher levels of stress than the 1st and 2nd years (non-parametric Kruskal-Wallis ANOVA p-value = 0.030). A linear model approach or other equivalent approaches could be useful to disentangle the effects of all these factors on well-being and mental health of PhD students. With N = 136, our sample, however, had a limited statistical power and such an approach was not feasible. A larger dataset would be needed. PhD students drawn from a few disciplines and universities to increase sample size (as done for example in Levecque et al., 2017) could be a solution (but see below the discussion on representation).

The representation of our sample is also an important limitation to the generalisation of our conclusions. Statistics from the doctoral programmes suggest that our sample is female-biased and depleted in late-years PhD students (Table 2). Note however that in most studies on PhD student mental health and well-being (with the notable exception of Levecque et al., 2017), representation is not assessed. Those studies are usually, indeed, open to any university/discipline. The authors usually do not have data on PhD student number, gender, and other relevant data from the universities/disciplines of the participants, and they are not able to compare the profiles of their participants to the PhD student populations that they belong to. In addition, they are not able to compute the rate of participation, as they usually do not know the total number of PhD students in the universities/disciplines of the participants. The rate of participation of these studies, however, is probably very low and much lower than the 16% found in study 1, as they include dozens of universities and

different disciplines (and the total number of targeted PhD students is probably very large). Another potential source of bias is if PhD students with mental health or well-being problems were more prone to answer the online questionnaire. However, results (of DASS-21 and WEMWBS for example) were very similar between PhD students from all the departments in biology (study 1) and from a single department (study 2) despite very different participation rates (respectively 16% and 41%), which suggest this bias is unlikely here.

Implications for Supervision and University Policies of French PhD Students

JPWBS that we used here gave interesting information that could be used to improve supervision in the university that we studied. Items about lack of feedback on progress of the thesis or lack of support from the supervisor and other items about supervisor behaviour featured in the list of the 30% most significant items (Table 6) and in the list of significant items (Appendix B). However, our study clearly showed that supervision is not the only domain that should be targeted by programs to improve PhD students' mental health and well-being, and that other domains may be more important. Uncertainty with career prospects, research experience, the impact of the PhD on health and private life appeared to have a stronger impact on PhD students' mental health and well-being than supervision. This information could be used to build future specifically targeted PPIs for PhD students, training programmes for supervisors (see Haag, 2017 for more discussion on this point) and university policies about PhD.

Interestingly, about 50% of our online questionnaire respondents declared that they were interested in attending a PPI. Our study 2 aimed at assessing the feasibility of such a PPI in a French university. Our results are encouraging as the attendance rate was good and the assessment of the PPI using mental health and well-being indexes suggested the PPI had a positive effect. However, our study included too few PhD students to have enough statistical power to detect moderate to subtle effects of the PPI on mental health and well-being, and only the very large effect on anxiety was found to be significant. The next step is surely to launch larger PPI programmes involving more PhD students. Our study suggests that the CARE program is potentially interesting. Other PPI (such as BEST-doc, Haag, 2015) are also relevant. One important aspect for the PPIs to be successful, however, is the motivation of the participants as noted in other contexts (Layous & Lyubomirsky, 2014). Another study showed modest effects of CARE on the well-being of a sample of undergraduate students, whose participation to this PPI was mandatory (Shankland et al., 2016). Student participation to PPIs probably needs to be on a voluntary basis.

Conclusions

In conclusion, our results showed that a large fraction of the PhD students experienced abnormal levels of stress, depression, and anxiety, in line with what has been recently observed in several other countries. Supervisor behaviour is not the sole aspect of the PhD experience that affects the PhD students' mental health and well-being. Our results showed that career training and prospects, research experience, the impact of carrying out a thesis on health and private life had a stronger effect. French PhD student well-being was specifically affected by career uncertainty, perceived lack of progress in the PhD and perceived lack of competence, which points towards possible cultural differences of experiencing a PhD in France and in other countries (i.e., UK). In our second study on carrying out a PPI with PhD students, comparing the scores of the test and control groups showed a clear effect of the intervention on reducing anxiety. Our work provides data on mental health and well-being of French PhD students that were lacking, and assesses a PPI for PhD students. These data will be a useful base from which to start mental health and well-being programmes for French PhD students and fuel the development of evidence-based policies to support their well-being.

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REFERENCES

Boniwell, I., & Osin, E. (2013). Au delà de la gestion du temps: De l'usage du temps, de la performance et du bien-être. (Beyong time management: time usage, performance and well-being) In C. Martin-Krumm, C. Tarquinio, & M. Shaar (Eds.), *Psychologie positive en environnement professionnel* (pp. 209-234): De Boeck.

Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of Cross-cultural Psychology, 1*(3), 185-216. https://doi.org/10.1177/135910457000100301

Caesens, G., Stinglhamber, F., & Luypaert, G. (2014). The impact of work engagement and workaholism on well-being: The role of work-related social support. *The Career Development International, 19*(7), 813-835. https://doi.org/10.1108/CDI-09-2013-0114

Challen, A. R., Machin, S. J., & Gillham, J. E. (2014). The UK Resilience Programme: A school-based universal nonrandomized pragmatic controlled trial. *Journal of Consulting and Clinical Psychology, 82*(1), 75. https://doi.org/10.1037/a0034854

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*, 310-357. https://doi.org/10.1037/0033-2909.98.2.310

Cornér, S., Löfström, E., & Pyhältö, K. (2017). The relationship between doctoral students' perceptions of supervision and burnout. *International Journal of Doctoral Studies. 12*, 91-106. https://doi.org/10.28945/3754

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper and Row.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Devos, C., Boudrenghien, G., Van der Linden, N., Azzi, A., Frenay, M., Galand, B., & Klein, O. (2016). Doctoral students' experiences leading to completion or attrition: A matter of sense, progress and distress. *European Journal of Psychology of Education, 32*(1), 61-77. https://doi.org/10.1007/s10212-016-0290-0

Devos, C., Van der Linden, N., Boudrenghien, G., Azzi, A., Frenay, M., Galand, B., & Klein, O. (2015). Doctoral supervision in the light of the three types of support promoted in self-determination theory. *International Journal of Doctoral Studies, 10*, 438-464. https://doi.org/10.28945/2308

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*, 542-575. https://doi.org/10.1037/0033-2909.95.3.542

Evans, T. M., Bira, L., Beltran-Gastelum, J., Weiss, L. T., & Vanderford, N. (2017). Mental health crisis in graduate education: The data and intervention strategies. *The FASEB Journal, 31*(1 Supplement), 750-757.

Faro, A. (2013). Um modelo explicativo para o bem-estar subjetivo: Estudo com mestrandos e doutorandos no Brasil. (A model for subjective well-being: a study with Master and PhD students in Brazil). *Psicologia: Reflexão e Crítica, 26*(4), 654-662. https://doi.org/10.1590/S0102-79722013000400005

Garland, E. L., Fredrickson, B., Kring, A. M., Johnson, D. P., Meyer, P. S., & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review*, *30*(7), 849–864. https://doi.org/10.1016/j.cpr.2010.03.002

Gionet, N. J., & Godin, G. (1989). Self-reported exercise behavior of employees: A validity study. *Journal of Occupational and Environmental Medicine, 31*(12), 969-973. https://doi.org/10.1097/00043764-198912000-00007

Guignon, N., Niedhammer, I., & Sandret, N. (2008). *Les facteurs psychosociaux au travail: une évaluation par le questionnaire de Karasek dans l'enquête "Sumer" 2003* (Psychosocial factors at work: using Karasec questionnaire in the "Sumer" 2003 survey). Retrieved from http://travail-emploi.gouv.fr/IMG/pdf/dares-karasek.pdf

Haag, P. (2015). *Report on the participatory action research: Well-being, health and work during the PhD*. Retrieved from https://wellbeing.hypotheses.org/200

Haag, P. (2017). Analyser et évaluer la relation entre doctorant et directeur de thèse. Quels cadres théoriques et quels outils en psychologie? (Analysing and assessing the relationship between PhD student and supervisor. What are the theoretical frameworks and psychometric tools?). *Emulations, 21*, 19-38.

Haag, P., Shankland, R., Osin, E., Boujut, E, Cazalis, F., Bruno, A.-S., & Gay, M.-C. (2017). Perceived stress and physical health among French university PhD students. *Pratiques Psychologiques*. Advance online publication. Retrieved from https://www.researchgate.net/profile/Evgeny_Osin/publication/317330392_Stress_percu_et_sante_physique_des_doctorants_dans_les_universites_francaises/links/59f75cd5a6fdcc075ec7b40e/Stress-percu-et-sante-physique-des-doctorants-dans-les-universites-francaises.pdf

Hancox, R. J., Milne, B. J., & Poulton, R. (2005). Association of television viewing during childhood with poor educational achievement. *Archives of Pediatrics & Adolescent Medicine, 159*(7), 614-618. https://doi.org/10.1001/archpedi.159.7.614

Harfi, M. (2013). *Les difficultés d'insertion professionnelle des docteurs: Les raisons d'une « exception française*. (The difficulties in finding a job of the Ph doctors: The reasons of a "French exception"). Retrieved from http://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/archives/DT_2013-07-Doctorants-final-22-10-valHM.pdf

Haynes, C., Bulosan, M., Citty, J., Grant-Harris, M., Hudson, J., & Koro-Ljungberg, M. (2012). My world is not my doctoral program… or is it? Female students' perceptions of well-being. *International Journal of Doctoral Studies, 7*(1), 1-17. https://doi.org/10.28945/1555

Hunter, K. H., & Devine, K. (2016). Doctoral students' emotional exhaustion and intentions to leave academia. *International Journal of Doctoral Studies, 11*, 35-61. https://doi.org/10.28945/3396

Jenkins, C. D., Stanton, B.-A., Niemcryk, S. J., & Rose, R. M. (1988). A scale for the estimation of sleep problems in clinical research. *Journal of Clinical Epidemiology, 41*(4), 313-321. https://doi.org/10.1016/0895-4356(88)90138-2

Juniper, B., Walsh, E., Richardson, A., & Morley, B. (2012). A new approach to evaluating the well-being of PhD research students. *Assessment & Evaluation in Higher Education, 37*(5), 563-576. https://doi.org/10.1080/02602938.2011.555816

Juniper, B., White, N., and Bellamy, P. (2009). Assessing employee wellbeing: Is there another way? *International Journal of Workplace Health Management, 2*(3), 220-230. https://doi.org/10.1080/02602938.2011.555816

Kashdan, T. B., Mishra, A., Breen, W. E., & Froh, J. J. (2009). Gender differences in gratitude: Examining appraisals, narratives, the willingness to express emotions, and changes in psychological needs. *Journal of Personality, 77*, 691-730. https://doi.org/10.1111/j.1467-6494.2009.00562.x

Keyes, C. L. M., Shmotkin, D., & Ryff, C. D. (2002). Optimizing well-being: The empirical encounter of two traditions. *Journal of Personality and Social Psychology, 82*, 1007-1022. https://doi.org/10.1037/0022-3514.82.6.1007

Layous, K., & Lyubomirsky, S. (2014). The how, why, what, when, and who of happiness: Mechanisms underlying the success of positive activity interventions. In J. Gruber & J. Moscowitz (Eds.), *The light and dark side of positive emotions* (pp. 473-495). New York: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199926725.003.0025

Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. *Research Policy, 46*(4), 868-879. https://doi.org/10.1016/j.respol.2017.02.008

Litalien, D. (2014). *Persévérance aux études de doctorat (Ph. D.): Modèle prédictif des intentions d'abandon.* (PhD persistence: a predictive model for dropping out intentions). Université Laval.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*(3), 335-343. https://doi.org/10.1016/0005-7967(94)00075-U

Martin-Krumm, C., Tarquinio, C., & Shaar, M. (2013). Psychologie positive et monde du travail: Entreprises, insitutions et associations. (Positive psychology at work: companies, institutions and associations). In C. Martin-Krumm, C. Tarquinio, & M. Shaar (Eds.), *Psychologie positive en environnement professionnel* (pp. 15-22). De Boeck.

MENESR report. (2014). *L'état de l'emploi scientifique en France* (Situation of the scientific employment in France). Retrieved from: http://cache.media.enseignementsup-recher-che.gouv.fr/file/Personnels_ens._sup_et_chercheurs/20/1/rapport_emploi_scientifique_2014_382201.pdf

MENESR report. (2015). *Repères et références statistiques 2015* (Statistical landmarks and references 2015). Retrieved from http://cache.media.education.gouv.fr/file/2015/67/6/depp_rers_2015_454676.pdf

Miquelard, G. (2015). *Quelques chiffres sur le doctorat et les docteurs.*(Some figures about PhD and Ph doctors). Retrieved from http://blog.educpros.fr/guillaume-miquelard-et-paul-francois/2015/12/08/quelques-chiffres-sur-le-doctorat-et-les-docteurs/

Moss, S. (2008). Acquiescence bias. Retrieved from http://www.sicotests.com/psyarticle.asp?id=154

SGEN-CFDT report. (2014). *Enquête sur les conditions de travail dans la recherche* (personnels Biatss et ITA) (Survey of the work conditions in academia). Retrieved from http://sgencfdt.vjf.cnrs.fr/IMG/pdf/Enquete_SGEN_2014_ITA_Biatss_v3_.pdf

Schmidt, M., & Umans, T. (2014). Experiences of well-being among female doctoral students in Sweden. *International Journal of Qualitative Studies on Health and Well-being*, *9*, 23059. https://doi.org/10.3402/qhw.v9.23059

Seligman, M. E. P. (2011). *Flourish: A visionary new understanding of happiness and well-being*. Simon and Schuster.

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist, 55,* 5-14. https://doi.org/10.1037/0003-066X.55.1.5

Seligman, M.E.P., Steen, T., Park N., & Peterson, C. (2005). Positive psychology progress. *American Psychologist, 60*, 410-421. https://doi.org/10.1037/0003-066X.60.5.410

Senik, C. (2014). The French unhappiness puzzle: The cultural dimension of happiness. *Journal of Economic Behavior & Organization, 106*, 379-401. https://doi.org/10.1016/j.jebo.2014.05.010

Shankland, R., Kotsou, I., & André, C. (2015). *Programme CARE*. Paper presented at the International Congress on Mindfulness and Compassion, San Francisco.

Shankland, R., Kotsou, I., Garnier, S., Jacquet, J., Herrero, A., Fiault, R., & Tessier, D. (2016). *Efficacy of mindfulness and positive psychology interventions: Underlying mechanisms.* European Conference on Positive Psychology, Angers, June.

Sinaiko, H. W., & Brislin, R. W. (1973). Evaluating language translations: Experiments on three assessment methods. *Journal of Applied Psychology, 57*(3), 328. https://doi.org/10.1037/h0034677

Stubb, J., Pyhältö, K., & Lonka, K. (2012). The experienced meaning of working with a PhD thesis. *Scandinavian Journal of Educational Research, 56*(4), 439-456. https://doi.org/10.1080/00313831.2011.599422

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., . . . Stewart-Brown, S. (2007). The Warwick-Edinburgh mental well-being scale (WEMWBS): Development and UK validation. *Health and Quality of Life Outcomes, 5*(1), 1. https://doi.org/10.1186/1477-7525-5-63

Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology*, *86*(2), 320–333. https://doi.org/10.1037/0022-3514.86.2.320

APPENDIX A. DESCRIPTION OF THE CARE PROGRAMME CARRIED OUT IN STUDY 2

List of the 8 sessions of the CARE programme, session content, practices carried out at home, schedule. For more information see Shankland, Kotsou and André (2015) and Shankland et al., (2016) or contact rebecca.shankland@univ-grenoble-alpes.fr

Week (date of session)	In-session practices	Home practices
1. April 11	▪CARE and participants presentation ▪What went well ▪My best possible self	▪What went well diary ▪Values in action (VIA) test
2. April 18	▪Character strengths, values in action	▪What went well diary ▪Using character strengths
3. April 25	▪Positive reframing of the environment ▪Self-compassion, positive playlist	▪Positive photo-report ▪Positive activity
4 & 5. May 4	▪Savouring (food, smell, person, music, etc…) ▪Positive future ▪Positive past	▪Savouring ▪Gratitude journaling ▪Small steps towards change
6 May 18	▪List of positive role models ▪Gratitude letter	▪Five acts of kindness ▪Gratitude journaling
7. May 23	▪Gratitude letter and gratitude visit ▪Self-compassion, be your own best friend: self-compassion letter	▪Gratitude letter and gratitude visit ▪Self-compassion letter
8. May 25	▪Present moment attention to the body ▪Participant feedback on CARE	

Session	Session content	Practices at home	Schedule
1	1. The two instructors introduce themselves, the program, the schedule. They discuss the group's rules: confidentiality, kindness, non-judgment, etc. Participants introduce themselves, give their aims about the program. 2. The first practice is named "What went well" (Seligman, Peterson & Park, 2005[1]) and invites the participants to remember 1 positive and significant event in their lives that had positively influenced them and share it with another participant. During the dialogue, they are invited to observe in real time their body sensations, emotions, and thoughts. This is done to show them that remembering a good memory can improve temporarily their well-being. When repeated every day, this can change the way they see their everyday life in a positive manner. 3. The second exercise is "My best possible self" (Roberts et al., 2005)[2]. Participants imagine themselves in the future (10 years) supposing that everything they tried was a success in their professional activity, hobbies, relationships. This exercise is made to help participants to design a flourishing future for their life.	1. What went well journal: every evening, write 3 good things that happened during the day. 2. The Values In Action questionnaire was developed by Seligman and Peterson[3] and helps the participants identify their character strengths, which one are easy to use for them and which are less often used.	April 11
2	Character strengths: each participant share with the group what are their "signature strengths", e.g., the 5 strengths they use often and easily. They give examples of when they use it in their daily life. Then, they think by group of 3 how they can use more often and differently their strengths in their everyday life. For example, somebody who is good at "honesty" can decide to tell more often what she/he feels when discussing with somebody else.	1. What went well: 3 good things everyday 2. Students plan to use in a different way one of their signature strengths during the week.	April 18

[1] Seligman, M. E. P., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress: Empirical validation of interventions. *American Psychologist, 60*(5), 410-421.

[2] Roberts, L. M., Dutton, J. E., Spreitzer, G. M., Heaphy, E. D., & Quinn, R. E. (2005). Composing the reflected best-self portrait: Building pathways for becoming extraordinary in work organizations. *Academy of Management Review*, *30*(4), 712-736.

[3] Peterson, C., & Seligman, M. E. (2004). *Character strengths and virtues: A handbook and classification* (Vol. 1). Oxford University Press.

Session	Session content	Practices at home	Schedule
3	1. Positive reframing of the environment: each participant is invited to think about what is good, constructive, positive, or beautiful about her/his environment. The environment here is what surrounds the person: the place where she/he works, the city, region, country, medical/political systems, etc. 2. Self-compassion: it consists on thinking "what is good for me, what makes me feel good, what activity energises me?" 3. Positive playlist: think about every song you love hearing and that makes you feel comfortable.	1. Positive photo-report: each participant takes 1 or more pictures of beautiful/positive/inspiring things/places/acts they encounter in their daily environment. 2. Positive activity: each person plans 5 activities (e.g., visiting a friend, having a coffee at a terrace, walking in Nature) until the next session.	April 25
4 and 5	1. Savouring[4] (smell, person, food, activity…): each participant takes a slice of clementine and during 10 minutes, the instructor invites students to watch it thoroughly, smell it, and taste it as it was the first time of their life. The mindset is "you are a researcher and discover this new phenomena". The aim is to really savour it and make the pleasure last. Each participant is invited to think about moments in their week, when they could enjoy more an activity, a relation with somebody, a meal, etc. 2. Positive past: this exercise includes a discussion about gratitude, its definition and implications. Each one writes on a paper details about situations that made them feel grateful in the past week. This could be somebody who had offered them a coffee, seeing two children laughing in the street, a beautiful sunset, etc. 3. Positive future: each participant thinks about their own childhood dreams and discuss the values that are behind these dreams. Which values are still important to them in their current life?" They identify an action/ a project linked with some values that they could plan during the next weeks.	1. Savouring: each participant plans a few moments in the weekend when they will intentionally savour a meal, or a moment with a relative, or a nice landscape. Students note in a journal which moment they chose and what they felt about it. 2. Small steps towards change: each participant plans a few moments in the next week for an activity that make them closer to their child's dream. For example, if they want to live close to Nature, they could watch what type of house they could live in when they will be able to afford buying a house. 3. Gratitude journaling: every evening, each participant writes 3-5 things they feel grateful for. A compliment, a meal, the sun shining, etc.	May 4th

[4] Bryant, F. B., & Veroff, J. (2017). *Savoring: A new model of positive experience*. Psychology Press.

Session	Session content	Practices at home	Schedule
6	1. List of positive role models: list some inspiring people (e.g. family members, well-known or popular people, writers, philosophers…) and what is inspiring about these people for each one. What are their character strengths and how these can help each participant to achieve their own goals? 2. Gratitude letter: think about your life, who contributed to your important life moments? It could be a teacher, a family member or a friend. Think about a person whom you would like to thank for what he/she was or did for you. Then write down a gratitude letter to this person. You can either keep it for you, send it, or read it to the person concerned.	1. Five acts of kindness: plan until the next session 5 acts that will cause a positive reaction towards somebody or something (example: protect the environment by bicycling to their workplace instead of driving the car) 2. Gratitude Journaling: continuation of last session's practice.	May 18
7	1. Gratitude letter and visit: each one finishes writing the letter. Then, participants think about when, how and where they could read the letter or send it to the recipient. 2. Self-compassion letter: everyone writes a letter. In the first part, they imagine a close friend who is having a difficult time and criticising him/herself. Each participant writes a letter about what they could tell him/her to support, listen, empathically. In the second part, they think about the last moment when they failed something or when they lost their self-confidence. Then, they read the letter as if they were "their own best friend".	1. Gratitude letter: everyone is invited to read it in front of the concerned person – or – send it; or transform it into a SMS if it feels uncomfortable to read it out as it is. 2. From now on, when they notice they are criticising themselves, participants can get the letter and read it to remember how it is possible to be kind towards oneself.	May 23

Session	Session content	Practices at home	Schedule
8	1. Present moment attention to the body: each participant is guided through a meditation which consists in observing each part of their own body with attention and with a non-judgmental attitude. It starts with the feet on the flat floor and going step by step through each part of the body towards the head. It helps students to be more aware of their body, to care about it, and to become more aware of the signals the body sends through emotions and sensations. 2. CARE feedbacks: participants share with the group different information: what is the first thing they have learned; what helped them most; how they plan to carry on the practices; recommendation they can make to improve the program.		May 25

APPENDIX B. LIST OF JPWBS ITEMS WITH IMPACT SCORE > 1

In our online questionnaire, JPWBS items are numbered from Q62 to Q136. Items are ordered by decreasing impact score (IS); frequency (Freq.) and mean scores (Mean) of an item in the sample. The '&' symbol highlights items significant in this study and not in Juniper, Walsh, Richardson, & Morley (2012).

Items	IS	Freq.	Mean	Questions-French	Questions-English	Domains
Q100	2.064	0.688	3.000	Senti(e) dans l'impossibilité de concilier votre travail avec vos obligations personnelles.	Being unable to balance your research with home demands?	Health, private life
Q102	2.384	0.720	3.311	Devenu(e) moins en forme physiquement à cause de votre charge de travail.	Becoming physically unfit because of your workload?	Health, private life
Q103	1.360	0.440	3.091	Pas senti(e) faire partie d'une équipe de recherche.	Not feeling part of a team?	Social
Q104	1.448	0.528	2.742	Pas eu la reconnaissance que vous méritez pour votre travail de la part de votre directeur de thèse.	Not getting the recognition you deserve from your supervisor for your work?	Supervisor
Q108	1.568	0.584	2.685	Manqué d'encadrement par rapport à la conception et à la réalisation de votre recherche.	Lacking practical guidance on designing and conducting your research?	Supervisor
Q109	2.576	0.808	3.188	Eté frustré(e) avec le fonctionnement administratif de l'université.	Being frustrated with the college's administration systems?	University

Items	IS	Freq.	Mean	Questions-French	Questions-English	Domains
Q110	1.920	0.624	3.077	Pas bien compris vos droits (par ex: le nombre de jours de congés).	Being unclear about your entitlements? eg holiday	University
Q111	2.472	0.840	2.943	Senti(e) constamment fatigué(e)/épuis(e)é à cause de votre charge de travail.	Feeling constantly tired and run-down because of your workload?	Health, private life
Q113	2.352	0.776	3.031	Senti(e) déçu(e) avec vos capacités en tant que chercheur.	Feeling disappointed in your own abilities as an academic researcher?	Research
Q114	1.608	0.536	3.000	Pas senti(e) en mesure de demander de l'aide à votre directeur de thèse.	Not feeling able to ask for help from your supervisor?	Supervisor&
Q116	2.976	0.888	3.351	Douté de vos compétences pour réaliser une bonne thèse.	Lacking belief in your ability to complete your PhD successfully?	Research&
Q117	1.080	0.384	2.813	Senti(e) exploité(e) par votre directeur de thèse.	Feeling exploited by your supervisor?	Supervisor&
Q121	1.152	0.424	2.717	Pas senti(e) comme faisant partie de la politique de recherche de votre laboratoire.	Not feeling part of your department's wider research programme?	Social
Q122	1.264	0.488	2.590	Pensé que les intérêts des doctorants ne sont pas suffisamment défendus par les représentants des étudiants/des personnels.	Believing that the interests of PhDs are inadequately represented by union bodies?	University
Q123	1.560	0.504	3.095	Eu des problèmes de santé à cause de votre travail (par ex: troubles musculo-squelettiques, problèmes de dos).	Experiencing physical health conditions because of your work? eg RSI, back problems	Health, private life
Q124	1.552	0.504	3.079	Eu des difficultés à vous alimenter sainement à cause d'un emploi du temps surchargé.	Being unable to eat healthily because of your heavy research schedule?	Health, private life
Q126	2.352	0.752	3.128	Eu des problèmes de sommeil à cause de la thèse.	Experiencing poor quality sleep because of your studies?	Health, private life
Q130	1.304	0.504	2.587	Amené(e) à travailler avec des équipements obsolètes.	Having to work with outdated equipment?	Facilities
Q132	1.592	0.592	2.689	Eu à travailler dans des conditions difficiles (par ex: avec trop peu de lumière. avec du bruit).	Having to work under difficult conditions? eg poor lighting, noise levels	Facilities
Q133	1.160	0.456	2.544	Pas senti(e) appartenir à une communauté des étudiants en thèse de l'université.	Not feeling part of a wider post-graduate community at the college?	Social

Items	IS	Freq.	Mean	Questions-French	Questions-English	Domains
Q134	1.320	0.560	2.357	Eu à effectuer trop de taches administratives.	Having to deal with too much paperwork and bureaucracy?	University
Q135	1.328	0.472	2.814	Pas bien compris les politiques menées par l'université.	Being unclear about college policies?	University
Q136	1.072	0.464	2.310	Pas senti(e) de considération pour votre travail dans votre laboratoire.	Not feeling respected for your contribution by others within your department?	Social
Q62	3.552	0.928	3.828	Eté hésitant(e) par rapport à la prochaine étape de votre carrière après le doctorat.	Being unclear about the next stage of your career after your PhD?	Career
Q63	1.184	0.400	2.960	Eu un directeur de thèse qui connaît mal de votre domaine de recherche.	Having a supervisor who is unfamiliar with your field?	Supervisor
Q64	1.872	0.680	2.753	Senti(e) déconnecté(e) de l'environnement scientifique au delà de votre laboratoire.	Feeling uninvolved with the wider research environment outside of your department?	Social
Q65	1.520	0.520	2.923	Trouvé difficile de payer vos dépenses courantes.	Finding it difficult to cover your basic living expenses?	Health, private life
Q66	2.880	0.888	3.243	Eu des doutes sur vos capacités à mener un projet de recherche selon les standards en vigueur.	Lacking confidence in your ability to conduct research to the necessary standard?	Research
Q67	1.904	0.696	2.736	Eu des conseils par rapport à votre carrière insuffisants.	Having inadequate career advice?	Career
Q68	2.144	0.744	2.882	Eu trop peu de feedback sur l'avancement de votre travail de thèse.	Having insufficient feedback during your PhD to check progress?	Supervisor
Q69	2.696	0.864	3.120	Manqué d'enthousiasme à propos de votre recherche.	Lacking enthusiasm about your research?	Research
Q70	1.504	0.560	2.686	Manqué de soutien technique par rapport à l'utilisation d'équipement.	Lack of technical support for research equipment?	Facilities
Q71	1.800	0.568	3.169	Manqué de motivation pour terminer votre thèse dans les temps.	Lacking motivation to complete your PhD in a timely manner?	Research
Q72	1.752	0.568	3.085	Senti(e) isolé(e) des autres collègues chercheurs dans votre laboratoire.	Feeling isolated from other research colleagues in your department?	Social
Q73	2.072	0.656	3.159	Senti(e) un manque de soutien de la part de votre directeur de thèse.	Feeling unsupported by your supervisor?	Supervisor

Items	IS	Freq.	Mean	Questions-French	Questions-English	Domains
Q74	3.544	0.936	3.786	Eté incertain(e)/inquiet(e) par rapport à votre futur professionnel.	Being unsure about your future career prospects?	Career&
Q75	1.520	0.560	2.714	Manqué de formations pour des compétences transversales (par ex: presentations, planning. communication).	Lacking training for transferable skills? eg presentations, planning, communication	Career
Q76	1.288	0.520	2.477	Manqué d'occasions de faire connaissance et d'interagir avec les autres personnes du laboratoire.	Lacking sufficient opportunities to socialise with others within your department?	Social
Q77	3.328	0.920	3.617	Senti(e) démotivé(e) parce que votre thèse n'avançait pas aussi vite que vous l'espériez.	Feeling demotivated as you are not making the progress you had hoped for?	Research&
Q79	1.040	0.448	2.321	Eu un lieu de travail de mauvaise qualité (par ex: petit bureau ou coin de paillasse exigu).	Having a poor quality workplace? eg cramped office or lab	Facilities
Q80	1.880	0.648	2.901	Manqué de préparation à la publication d'articles (par ex: bibliographie, rédaction/soumission d'articles).	Lacking training on publication skills? eg referencing, submissions	Career
Q81	1.088	0.416	2.615	Manqué d'Facilitiess adaptées sur votre lieu de travail (par ex: pour la cantine, pour la pratique sportive).	Having inadequate facilities at your place of work? eg canteen, gym	Facilities
Q82	1.248	0.440	2.836	Manqué d'opportunités d'enseigner ou d'encadrer des étudiants.	Lacking opportunities to teach or tutor?	Career
Q83	3.184	0.912	3.491	Ressenti de hauts niveaux de stress à cause de votre travail de recherche.	Experiencing high levels of stress because of your research?	Health, private life
Q84	3.232	0.944	3.424	Senti(e) frustré(e) par vos résultats / découragé(e) par le manque de résultats dans votre thèse.	Feeling frustrated/demotivated by your results and apparent lack of progress?	Research
Q85	1.480	0.520	2.846	Senti(e) mal préparé(e) par rapport au manque de cadre formel d'une thèse.	Feeling ill-equipped to deal with the lack of formal structure on a PhD programme?	Career
Q86	2.768	0.872	3.174	Eu une charge de travail élevée qui a affecté votre vie privée.	Having a high workload that impacts on your private life?	Health, private life
Q87	1.544	0.576	2.681	Trouvé que votre expérience avec la thèse ne correspondait pas à ce que vous aviez imaginé.	Finding that your PhD experience is different to what you had envisaged initially?	Research

Items	IS	Freq.	Mean	Questions-French	Questions-English	Domains
Q88	2.488	0.816	3.049	Pris beaucoup trop sur vous pour mener à bien votre travail de recherche.	Making unreasonably high demands of yourself in the name of research?	Health, private life
Q89	1.600	0.528	3.030	Eu trop peu la possibilité de voir votre directeur de thèse.	Having insufficient access to your supervisor?	Supervisor&
Q90	2.464	0.816	3.020	Senti(e) souvent déprimé(e) à cause de votre thèse.	Experiencing a persistent low mood because of your research?	Health, private life
Q91	1.168	0.400	2.920	Senti(e) sans possibilité de vous confier à vos collègues à propos des problèmes que vous rencontrez.	Feeling unable to confide in colleagues about problems?	Social
Q92	1.424	0.568	2.507	Manqué de formation pour développer vos compétences techniques.	Lacking training to develop your technical research skills?	Career
Q93	1.568	0.560	2.800	Eté découragé(e) à avoir des initiatives dans votre travail de recherche.	Being discouraged to display initiative in your research?	Research
Q96	1.336	0.544	2.456	Manqué d'occasions de faire connaissance et d'interagir avec des étudiants d'autres laboratoires.	Lacking opportunities to socialise with students from other departments?	Social
Q98	1.480	0.432	3.426	Senti(e) abandonné(e) par votre directeur de thèse.	Feeling abandoned by your supervisor?	Supervisor&
Q99	1.240	0.488	2.541	Senti(e) cantonné(e) à une thématique de recherche trop spécialisée.	Feeling 'trapped' in your area of specialisation?	Research

BIOGRAPHIES

Dr. Gabriel Marais has a PhD in biology and works as a CNRS scientist at the University of Lyon 1. He also has a degree in positive psychology from University Grenoble Alpes and in parallel to his activities in biology, he is involved in projects about well-being at work and positive management in academia.

Gabriel Marais, LBBE - UMR 5558, Université Lyon 1, Bat. Mendel, 16 r. R. Dubois, Villeurbanne 69622, France, gabriel.marais@univ-lyon1.fr

Dr. Rebecca Shankland has a PhD in psychology and is associate professor at University Grenoble Alpes. She is vice-president of the French Association for Positive Psychology (AffPP). Her research studies aim at developing positive psychology interventions and assessing their effects and underlying mechanisms, in particular emotion regulation and psychological flexibility. She carries out studies in various settings: schools, organizations, and clinical settings. She has published various articles and books on mindfulness and positive psychology interventions.

Dr. Pascale Haag is a psychologist and an associate professor at the EHESS (École des Hautes Etudes en Sciences Sociales/School of Advanced Studies in Social Sciences in Paris). Pascale was a professional musician before completing a PhD in Sanskrit grammar in 2002. Her research mainly focused on the philosophy of language and on the history of Indian linguistic theories until 2011. In addition, she studied psychology at the University of Paris Nanterre, where she earned a M.A. in psychology in 2013. She is currently working on a PhD in Psychology on the predictors of well-being and psychological distress among doctoral students. She is the founder of the Lab School Network, which brings together re-searchers, educators, and representatives of the public and private sectors as well as NGO members in order to generate change and inspire renewal within the current system of education.

Robin Fiault is a clinical psychologist trained in positive psychology. He works in Lyon with companies and institutions to help employees to reduce stress and enhance well-being at work, with the consulting company Psya. He is also a mindfulness instructor, guiding different groups learning meditation at the CNRS. His interventions are based on different approaches: positive psychology, mindfulness, emotional competencies and non-violent communication. He is also a positive psychology and mindfulness teacher at the Ecole des Psychologues Praticiens.

Dr Bridget Juniper is founder and director of Work and Well-Being Ltd. She is a Chartered Occupational Psychologist with a PhD in the measurement of employee well-being.