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**ALL YOU NEED IS SELF-DETERMINATION:  
INVESTIGATION OF PHD STUDENTS' MOTIVATION  
PROFILES AND THEIR IMPACT ON THE DOCTORAL  
COMPLETION PROCESS**

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Mikaël De Clercq*	Université Catholique de Louvain, Louvain-la-Neuve, Belgium	<a href="mailto:mikael.declercq@uclouvain.be">mikael.declercq@uclouvain.be</a>
Mariane Frenay	Université Catholique de Louvain, Louvain-la-Neuve, Belgium	<a href="mailto:mariane.frenay@uclouvain.be">mariane.frenay@uclouvain.be</a>
Assaad Azzi	Université Libre de Bruxelles, Bruxelles, Belgium	<a href="mailto:aazzi@ulb.ac.be">aazzi@ulb.ac.be</a>
Olivier Klein	Université Libre de Bruxelles, Bruxelles, Belgium	<a href="mailto:olivier.klein@ulb.be">olivier.klein@ulb.be</a>
Benoit Galand	Université Catholique de Louvain, Louvain-la-Neuve, Belgium	<a href="mailto:benoit.galand@uclouvain.be">benoit.galand@uclouvain.be</a>

\* Corresponding author

**ABSTRACT**

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Aim/Purpose	The present study aimed at (1) identifying the naturally occurring patterns of motivation among doctoral students and (2) assessing their impact on the doctoral completion process.
Background	Grounded in the self-determination theory, the paper investigated needs satisfaction and the doctoral completion process.
Methodology	Two complementary methods were used. First, k-mean clustering was used to classify 461 doctoral students according to their feelings of competence, autonomy and relatedness. Second, the completion process of these five profiles was investigated through multi-group path analyses.
Contribution	This paper provided a motivational perspective on doctoral completion process that highlighted significant individual differences.

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Findings	Five profiles were identified corresponding to different combinations of satisfaction of their innate psychological needs. The results also revealed significant differences in the completion process from one motivation profile to another.
Recommendations for Practitioners	The doctoral supervision needs to consider the specificities of the patterns of motivation among doctoral students.
Recommendations for Researchers	A more important investigation of motivational patterns is required to fully understand the doctoral completion process.
Impact on Society	A better consideration of motivational profiles would increase doctoral students' well-being and their persistence.
Future Research	The effect of motivation and context on student satisfaction and professional efficiency could be further explored.
Keywords	PhD student, motivation, retention, quantitative research, person-centered approach, supervisor

## INTRODUCTION

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Doctoral studies can be conceived as the pinnacle of education. Over-achievers have gone through a rigorous selection process to get there (Ali & Kohun, 2006). Yet, despite previous outstanding academic performance, around 50% of doctoral students drop out (Ampaw & Jaeger, 2012; Jairam & Kahl, 2012; Wollast et al., 2018) giving rise to negative psychological consequences for them (Ali & Kohun, 2006; Levecque et al., 2017) and their supervisors (Devos et al., 2016). Compared to other tertiary education degrees, the rate of doctoral degree completion is the lowest (Ampaw & Jaeger, 2012). As doctoral students are an important part of the faculty workforce (e.g., graduate assistantships, producers of innovative research), this level of dropout can also seriously impair the efficiency of faculty teaching and research.

In this regard, a growing number of researchers have tried to understand this wide-reaching issue by investigating the determinants of doctoral completion. To date, several factors have been found to be associated with doctoral completion, such as gender (Groenvynck et al., 2013; Visser et al., 2007), supervisor support (Bair & Haworth, 2004; Peltonen et al., 2017), intention to persist (Miller, 2013), sense of progress (Marais et al., 2018), exhaustion (Cohen, 2011; Hunter & Devine, 2016) and appropriation of the doctoral project (Devos et al., 2017).

Nevertheless, these studies suffer from three important limitations that we wanted to overcome in the present study. First, most studies that have investigated doctoral completion are qualitative, limiting the generalizability of the findings (De Clercq et al., 2019). Second, the small number of quantitative studies suffer from methodological weaknesses (e.g., low sample or cross-sectional design). An important limitation lies in the lack of multivariate approaches to doctoral degree completion. Understanding this complex phenomenon, however, requires the consideration of multiple factors in interaction. Third, the motivation layer of the process is still underdeveloped and deserves further consideration (Lynch et al., 2018). Using a multivariate approach, the current research aimed at providing new insights to gain a better picture of the interplay between motivational and psychological factors at stake in doctoral completion.

### *A MOTIVATIONAL PERSPECTIVE ON DOCTORAL COMPLETION*

Several scholars emphasized the relevance of developing a more thoughtful understanding of the impact of doctoral student motivation on completion (Gardner, 2010; Mason, 2012). The first studies to address this question endorsed a qualitative design (Brailsford, 2010; Gardner, 2010). Brailsford (2010) identified a variety of intrinsic and extrinsic motives for starting doctoral studies. Gardner

(2010) reported the importance of student opportunity for self-direction to reinforce student engagement. In Gardner's study (2010), doctoral students highlighted their need to feel free to make choices and to be active participants on their doctoral journey. In this qualitative perspective, Devos et al. (2015) went a step further by reporting that doctoral students' motivation showed an intricate relationship with supervisors' provision of structure, involvement, and autonomy. From a quantitative perspective, Ivankova and Stick (2007) found that motivation was a significant predictor of doctoral persistence. These results were corroborated by Mason (2012), who demonstrated a positive effect of motivation on student persistence and satisfaction. From these findings, we can argue that motivational factors are critical for both starting and continuing doctoral studies. Yet, as asserted by Lynch et al. (2018), few quantitative studies have been conducted to support this claim.

### **The relevance of self-determination theory**

From a theoretical point of view, Self-Determination Theory (SDT) was identified by several studies as a particularly appropriate framework to investigate doctoral students' motivational process (Litalien & Guay, 2015; Litalien et al., 2015; Lynch et al., 2018; Mason, 2012; van Rooij et al., 2019). These authors claimed that SDT can provide a rich framework to identify the complex nature of motivation in doctoral studies and proximal correlates. SDT identifies three self-perceptions (also defined as fundamental psychological needs) of competence, autonomy and relatedness that will involve students' motivation, behavior, persistence, and well-being (Ryan & Deci, 2017).

A feeling of competence taps the need for the individual to feel able to deal with academic tasks (Wigfield et al., 2006). This variable comes near the conceptualization of self-efficacy beliefs widely studied in the context of higher education. A feeling of autonomy refers to the student's need for self-determined behavior initiated according to personal desires, rather than being controlled by others (Weinstein et al., 2012). According to SDT, this variable can be assessed through a feeling of self-determination or personal interest in learning tasks and academic courses (Weinstein et al., 2012). A feeling of relatedness encompasses the perception of closeness and friendships with peers (Vansteenkiste et al., 2009). It taps the basic need to be connected, accepted, and valued by others. The study done by Mason (2012) emphasized the relevance of these self-perceptions for the PhD student by highlighting that feelings of competence, autonomy and relatedness were related to persistence and well-being. The study done by Litalien and Guay (2015) also corroborated the impact of the feeling of competence and autonomous motivation on intention to persist and actual completion.

SDT also postulates that the experience of autonomy, competence and relatedness is linked to the contextual provision of structure, autonomy, and involvement. According to Devos et al. (2015), supervisors' provision of structure can be understood as the clarity of information provided to doctoral students about expectations of the doctoral process and the way of achieving it successfully. In the context of secondary education, the provision of structure was identified as the most effective support from the teacher to the student (Hospel & Galand, 2016). Autonomy support can be defined as the amount of freedom given by supervisors to doctoral students in order to determine their own doctoral thesis (Devos et al., 2015). Finally, involvement can be understood as the quality of the relationship with the supervisor and his/her ability to provide warmth and empathy to the doctoral student (Devos et al., 2015). The qualitative work of these authors highlighted the relevance of the three types of supervisor support for the PhD student: provision of structure, autonomy, and involvement. These results were supported by quantitative studies that compared different sources of support (supervisor, students, and family) on doctoral persistence (De Clercq et al., 2019; Litalien & Guay, 2015). This research demonstrated that supervisor support was the most important source of support for PhD student persistence.

The literature provides preliminary findings about the impact of doctoral motivation on completion. Yet several authors make a plea for a more thoughtful understanding of the role of motivation (De Clercq et al., 2019; Devos et al., 2017; Litalien & Guay, 2015). Two complementary perspectives can be then endorsed.

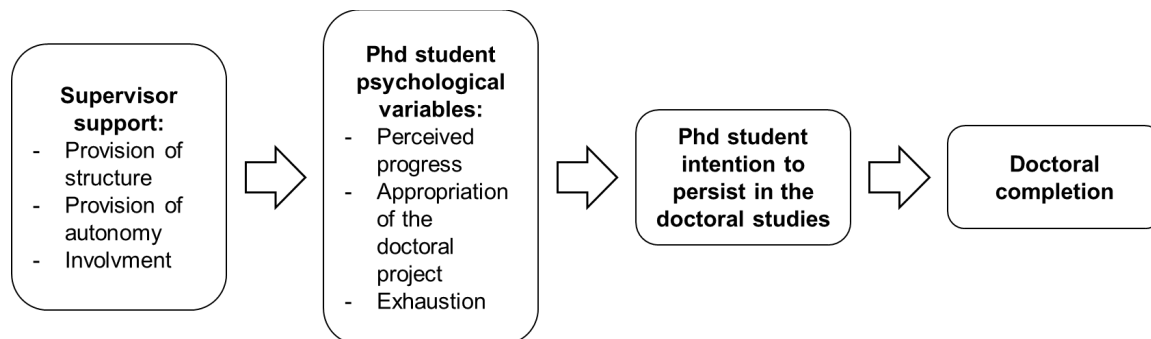
First, an interesting way of addressing motivation would be through the combined effects of autonomy, competence and relatedness needs satisfaction on doctoral completion (Gillet et al., 2019). This study endorses this perspective through a person-centered approach to these three self-perceptions. Second, there is a need for a more multivariate investigation of doctoral completion. For example, several authors underline the necessity to consider contextual variables, motivation and students' perceptions together when addressing their impact on doctoral completion (De Clercq et al., 2019; Peltonen et al., 2017). This study therefore endorses a multivariate framing of the doctoral completion process, encompassing contextual provision of structure, autonomy, and involvement.

### ***A PERSON-CENTERED APPROACH TO DOCTORAL STUDENT MOTIVATION***

Several authors endorsed a person-centered analysis of SDT among different groups. These include high school students (Vansteenkiste et al., 2009; Wormington et al., 2012), college students (Gillet et al., 2017; Gillet et al., 2019; Hayenga & Corpus, 2010; Litalien et al., 2019), teachers (Van den Berghe et al., 2014) or workers (Moran et al., 2012). These studies showed the relevance of investigating motivation profiles in order to better understand the complex combinations of motivations that can drive a person (Hayenga & Corpus, 2010). More precisely, the recent work of Gillet et al. (2019) highlighted the relevance of investigating the subpopulation of students characterized by a distinct configuration of needs satisfaction among undergraduate university students. This research highlighted five stable profiles among university students: (1) the *Globally Satisfied* with a high level of competence, autonomy, and relatedness; (2) the *Globally Satisfied and Highly Connected*; (3) the *Moderately Satisfied*; (4) the *Globally Dissatisfied and Relatedness Deficient*; and (5) the *Globally Dissatisfied, Highly Connected and Competent Deficient*. This variety of profiles highlighted the wide diversity of motivation profile. Yet it is still unclear today how these profiles relate to student perceptions, behaviors, and persistence. Moreover, no person-oriented approach to doctoral students has yet been endorsed. Such a SDT person-centered approach has been suggested by the qualitative study done by Devos et al. (2015), which described specific types of doctoral students having different perceptions of the relative importance of supervisory practices (in term of provision of structure, autonomy, and involvement).

### ***A CONCEPTUAL FRAMING OF THE DOCTORAL COMPLETION PROCESS***

To date, the doctoral completion process has not been clearly framed. This lack of clear modeling impedes understanding of the interplay between the most important factors in doctoral completion. However, based on the literature on doctoral completion and on SDT, conceptual framing can be proposed. This model is illustrated in Figure 1.



**Figure 1. Conceptual modeling of the doctoral completion process**

According to SDT, the three sources of support (structure, autonomy, and involvement) can be considered as contextual factors impacting on doctoral completion (Devos et al., 2015; Van der Linden et al., 2018). However, several authors have suggested that the impact of **supervisor support** on doctoral completion is not direct but rather mediated by student psychological variables (De Clercq et al., 2019; Litalien & Guay, 2015; Martinsuo & Turkulainen, 2011; van Rooij et al., 2019). Recent quantitative works (Corn er et al., 2017; Peltonen et al., 2017) corroborated this idea by highlighting a link between supervisor support and emotional distress indicators such as exhaustion. Exhaustion – defined as doctoral student feeling of being emotionally and psychologically drained by his/her work – was also found to be an important predictor of doctoral completion (Cohen, 2011; Hunter & Devine, 2016).

Recent works (Marais et al., 2018; van Rooij et al., 2019) also found that supervision was not the most proximal factor in the doctoral process. These authors instead highlighted the major importance of **perceived progress** in the thesis on the doctoral completion process (Marais et al., 2018). These results were in line with those of Cornwall et al. (2019) which highlighted the negative impact of uncertainty on the evolution of the project on PhD students' well-being. These results also agreed with the qualitative findings of Devos et al. (2017) who reported how important it is for doctoral students to feel that they are moving forward and making progress with their thesis in order to persist in the process of completion. These authors also highlighted another important factor, namely **appropriation of the doctoral project** (Devos et al., 2017). This factor can be defined as the student feeling that he/she owns, or is personally responsible for, his/her doctoral project. It comes close to Deci and Ryan's (2000) idea of "internalization", described as an active transformation of external requests into personal values and objectives. Recent research highlighted that this internalization can help the doctoral student to negotiate the complexity of the doctoral process and prevent dropout (Graham & Massyn, 2019).

Finally, several studies suggested that **intention to persist** is the most proximal predictor of doctoral student persistence and completion. (Ivankova & Stick, 2007, Litalien & Guay, 2015). This variable can be defined as the strength of the resolution to complete PhD studies. This proximal impact of the intention on actual persistence is also supported, from a theoretical point of view, by the model of student departure (Tinto, 1997, 2012) and planned behavior theory (Ajzen, 2011).

### *AIM OF THE STUDY*

This study attempted to overcome the limitations of existing studies by proposing a multivariate quantitative approach to the role of motivation in the doctoral completion process. Grounded in SDT and in empirical literature on doctoral completion, three main objectives were set.

First, the study aimed at identifying the motivation profiles of doctoral students. Drawing on previous findings on college students (Gillet et al., 2019; Hayenga and Corpus, 2010; Vansteenkiste et al., 2009; Wormington et al., 2012), we expected to find profiles combining high or low scores on the three self-perceptions of competence, relatedness, and autonomy. These profiles could be close to the "Globally Satisfied" and "Globally Dissatisfied" profiles identified by Gillet et al. (2019). Moreover, based on the relative independence of these three self-perceptions (Ryan & Deci, 2017), we also expected to find profiles with a specific lack of one of the three factors.

Second, the study aimed at assessing the relevance of the proposed conceptual framing of the doctoral completion process. We expected supervisor support to be the most distal determinant of doctoral completion (De Clercq et al., 2019; Martinsuo & Turkulainen, 2011). Conversely, we expected intention to persist to be the most proximal predictor of doctoral completion (Ivankova & Stick, 2007, Litalien & Guay, 2015).

Third, the study aimed at evaluating the moderating effects of the motivation profile on the doctoral completion process. The variations in the adjustment process from one profile to another were investigated. The context and psychological variables were expected to have a varied impact on doctoral

completion across student profiles. First, we expected profiles with a specific lack of self-perception to be particularly influenced by the related supervisor provision. Second, considering the link between appropriation of the project and internalization, we expected profiles with low autonomy to be particularly affected by appropriation of the project. Third, considering the proximal impact on intention to persist on actual completion, we expected to find a strong positive effect of intention to persist on completion for every profile identified.

## METHOD

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### *STUDY DESIGN*

Five waves of data collection were conducted in two Belgian universities (for more information about this national doctoral context, see Wollast et al., 2018). At Time 1 (T1), we measured motivational self-perceptions (autonomy, competence, and relatedness). At Time 2 (6 months after T1), we measured supervisor support (i.e., structure, autonomy, involvement). At Time 3 (1 year after T1), we measured the psychological variables (students' exhaustion, perceived progress, project appropriation). At Time 4 (18 months after T1) intention to persist was measured. At time 5 (2 years after T1) the actual completion of the doctoral degree was retrieved from administrative records from the two universities. The five-wave design was conceived in order to fit with the timeline depicted in our conceptual framing of the completion process. As motivational self-perception serves to generate the initial patterns of doctoral students, it was measured first (Litalien et al., 2019). The different categories of variables were then measured consecutively, starting from the more distal determinants (supervisor support) to actual completion.

All the participants registered in the two universities received the online questionnaires (programmed in LimeSurvey) via their university e-mail address, which was also used for the matching of the three questionnaires. Participants were assured of data confidentiality and the research design was approved by our National Commission for Protection of Privacy.

### *MEASURES*

**Motivational Self-Perceptions** were assessed through 12 items retrieved from the **Doctorate-related Need Support and Satisfaction (DN-2S)** short scales (Van der Linden et al., 2018). Four items measured the feeling of competence (e.g., "I have confidence in my ability to finish my PhD";  $\alpha = .79$ ) Four items evaluated the feeling of autonomy (e.g., "I can influence the development of my thesis project"  $\alpha = .72$ ). The last four items tap the feeling of relatedness (e.g., "I get along well with the members of my team";  $\alpha = .77$ ).

**Supervisor Support** was evaluated with the validated scale of D-N2S (Van der Linden et al., 2018) from which 21 items captured doctoral supervisor support. (Because supervision situations differ from one another (e.g., one or several supervisors, formal or informal supervision, by another member of the lab), we first asked the participants from whom they received most supervision.) This person was thereafter called the "mentor" and the supervision items were completed in relation to him/her. Seven items measured supervisors' provision of structure (e.g., "My mentor defines clear objectives for me";  $\alpha = .88$ ). Seven items measured supervisors' provision of autonomy (e.g., "My mentor directs my work a lot, without really asking for my opinion" – reverse item;  $\alpha = .71$ ). Seven items measured supervisor involvement (e.g., "My mentor shows that he/she respects me and values me";  $\alpha = .89$ ).

**Perceived Progress** (3 items,  $\alpha = .81$ ) deals with doctoral students' feeling of moving forward and progressing in their doctoral work. It addresses the perceived speed of this progress in itself, with regard to what was planned and in comparison to other PhD students' progress (e.g., "I have the feeling that I am not moving forward" – reverse item). Items were inspired by Devos et al.'s (2017) qualitative findings.

**Exhaustion** reflected the extent to which doctoral students feel emotionally and psychologically drained by their work. This scale of 10 items was inspired by the measure adapted from Hunter and Devine (2016) in their work on doctoral completion (e.g., “When I think about my thesis, I feel in despair”,  $\alpha = .89$ ).

**Appropriation of the Project** referred to the idea of ownership of the thesis project by the doctoral student. This scale was inspired by Devos et al.’s (2017) qualitative findings and measured by six items (e.g., “I feel personally responsible for my doctoral project”;  $\alpha = .86$ ).

**Intention to Persist** (6 items,  $\alpha = .82$ ) assessed the strength of participants’ intention to persist in their PhD and complete it (e.g., “No matter what happens, I intend to finish my PhD”). The items are based on Galand and Hospel (2015) and Litalien and Guay (2015).

## ***PARTICIPANTS***

A T1 questionnaire was sent to 3,230 doctoral students registered in the two universities and was completed by 945 of them. Of those, 612 of them also answered the T2 questionnaire and 461 completed the three waves of questionnaire (T1, T2 and T3). This last sample ( $N = 461$ ) is therefore the sample considered in the present study, composed of 61.4% of women (mean age = 28.2). Most of them were funded by a research grant (64.6%) (i.e., four-year full-time funding for their doctoral research), 28.4% had research assistant status (i.e., a six-year contract in the university with part-time teaching and part-time research) and 7% had other types of funding or no funding. The participants were distributed across the four academic fields as follows: 15.2% in human sciences, 22.6% in health sciences, 27.4% in science and technology and 34.8% in social sciences.

In order to assess the representativeness of our final sample of 461 doctoral students, we compared it to the 2,769 participants who only completed the T1 with independent t-tests. These two sub-groups did not display any statistical differences in age, highest qualification of parents, Master’s grade, marital status or motivational self-perceptions.

In order to assess context differences, the university and academic fields were compared on age, highest qualification of parents, Master’s grade, marital status, and self-perceptions, supervisor support, perceived progress, exhaustion, appropriation of the doctoral project and intention to persist. While there was no significant difference between the universities, significant differences among motivational self-perceptions, supervisor support and appropriation of the project can be identified. More precisely, PhD students from human and social sciences reported a lower level of autonomy ( $F_{(3,457)}=4.935$ ;  $p=.002$ ), a higher level of relatedness ( $F_{(3,457)}=6.412$ ;  $p<.001$ ), a lower level of supervisors’ provision of autonomy ( $F_{(3,457)}=6.172$ ;  $p<.001$ ) and more difficulty in appropriating their doctoral project ( $F_{(3,457)}=7.323$ ;  $p<.001$ ) than students from health sciences and science and technology. These differences in context will be discussed later.

## ***ANALYTICAL PROCEDURE***

First, a person-centered approach was used in order to identify the motivation profile of doctoral students. More precisely, k-means cluster analyses were run with regard to basic need satisfaction in order to identify profiles of students most similar and most dissimilar between profiles (Daniels et al., 2008; Peck & Roeser, 2003; Phinney et al., 2005; Valle et al., 2008). To steer the cluster selection several indicators were considered: the number of iterations to run the analyses, the distribution of students in each profile, the explained variance in the self-perceptions explained by the profile solution and the interpretability of the final profile solution.

Second, a variable-centered approach was used in order to investigate individual students’ variation in their adjustment process with regard to their motivation profile. Such an investigation was carried out through multi-group modeling in several steps. *In the first stage*, an overall model was drawn up to find out the dynamic that governs the academic doctoral completion process. This model (see Figure 1) was built on self-determination theory and the literature on completion which shows intention to

persist as the most proximal predictor of actual retention (Miller, 2013; Spaulding & Rockinson-Szapkiw, 2012). This model was compared with an alternative model with only direct paths to doctoral completion. *In the second stage*, measurement invariance across profiles was investigated. First, a full constrained model was analyzed. The fit of the model that emerged from the first stage was analyzed for all profiles constraining all parameters to be equal between the profiles. Then, parameters constraints were progressively released. Paths between endogenous variables were released if significant improvement in the model fit (significant Chi<sup>2</sup> difference) was implied. Otherwise, parameters were kept constrained (De Clercq et al., 2020). The best fitting multi-group modeling was determined at the end of this procedure. *In the third stage*, the specific moderating effect of the profiles on the doctoral completion process was assessed. Using critical ratio for the difference test, pairwise comparisons were performed between profiles present on each pathway (Byrne, 2016). Significant differences in the pathways between the variables across the groups were identified.

This combination of a person and a variable-centered approach provides more detailed examination of doctoral completion. A person-centered approach identifies particular combinations of variables as they exist within individuals. Multigroup path analyses then allow us to understand the moderating effects of these combinations on a complex modeling of doctoral completion.

### ***FIT INDICES***

The multigroup analyses were conducted with AMOS20. The parameters of the models were estimated using the maximum likelihood. It is worth noting that in structural equation modeling, the chi square compares the sample covariance matrix with the theoretical model covariance matrix. Therefore, a non-significant chi square is evidence of a good fit of the sample to the theoretical model. Beyond the chi-square, numerous goodness-of-fit indicators are used in educational literature and there is no consensus on what the best indicators are. In line with several authors, we decided to use four frequently used indicators (Schreiber et al., 2006). The goodness of fit was evaluated using the comparative fit index (CFI), the root mean square error of approximation (RMSEA), P for the test of close fit (PCLOSE) and standardized root mean square residual (SRMR). A good fit is generally indicated by a CFI close to 0.95, an RMSEA less than 0.08, a PCLOSE higher than 0.05 and a SRMR lower than 0.05 (Schreiber et al., 2006). Finally, chi-square difference was used to compare the models tested. The chi-square difference statistic is used in nested models comparison to test the statistical significance of the improvement in fit when parameters are added (Kline, 2011). In this study, standardized path coefficients are reported and  $p < .05$  was used as a criterion of statistical significance.

## **RESULTS**

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### ***PRELIMINARY ANALYSIS***

The correlation table showed several important links (Table 1). First, relatedness and competence are related to actual completion of the doctoral studies two years later. Second, intention to persist is strongly related to exhaustion, sense of progress and appropriation of the thesis. Third, the strongest correlate of doctoral completion is intention to persist.



Table 1. Correlations of the study variables

	1	2	3	4	5	6	7	8	9	10	11
1. Autonomy (t1)	–										
2. Relatedness (t1)	.22***	–									
3. Competence (t1)	.24***	.14**	–								
4. Supervisor involvement (t2)	.37***	.23***	.17***	–							
5. Supervisor autonomy (t2)	.47***	.04	.14**	.40***	–						
6. Supervisor structure (t2)	.25***	.22***	.30***	.60***	.13**	–					
7. Exhaustion (t3)	-.26***	-.17**	-.54***	-.25***	-.23***	-.33***	–				
8. Appropriation of the project (t3)	.47***	.08	.24***	.27***	.38***	.20***	-.29***	–			
9. Perceived progress (t3)	.15**	.06	.49***	.18**	.20***	.29***	-.52***	.32***	–		
10. Intention to persist (t3)	.29***	.12*	.41***	.25***	.28***	.30***	-.46***	.44***	.52***	–	
11. Completion (t4)	.04	.10**	.16**	.05	.05	.04	-.19**	.17**	.30***	.41***	–

Note: \*p<.05; \*\*p<.01; \*\*\*p<.001

## CLUSTER ANALYSIS

### Determination of the number of profiles

Before being entered in the cluster analysis, motivational self-perceptions were standardized through Z-transformations. Five k-means cluster analyses were run separately specifying three, four, five, six and seven cluster solutions. Based on several indices (e.g., number of iterations, sample sizes and interpretability) the five-cluster solution was identified as the most meaningful distinction.

The univariate test of variance for each cluster variables was also operated and depicted significant differences across the clusters. These results showed that cluster membership as an explanation of the variance of the four variables under investigation ranged from 28 to 66 %. This lends credence to the cluster solution as a meaningful depiction of the distribution of entrance students. The final cluster centroids are illustrated in Figure 2 and ANOVAs on the composition variables are described in Table 2.

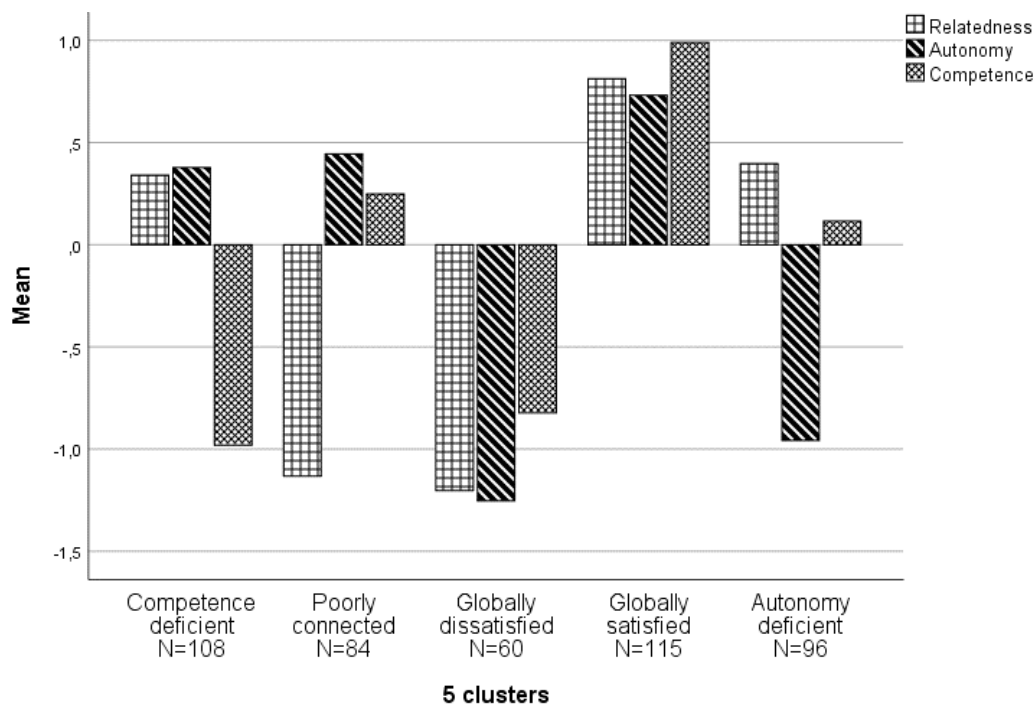


Figure 2. Final cluster solution

Table 2. Analysis of variance of the self-perceptions across the 5 motivational profiles

	F	D <sup>2</sup>
Relatedness	484.60***	.66
Autonomy	378.22***	.60
Competence	361.54***	.28

\*p<.05;\*\*p<.01;\*\*\*p<.001

### Interpretation of the final profile solution

The titles of the profiles were inspired by Gillet et al. (2019). First, a profile with above average scores on the three needs satisfaction was entitled “*Globally Satisfied*”. These PhD Students can be depicted as those with the strongest perceptions that their needs of competence, autonomy and relatedness are fulfilled. Second, the opposite pattern was identified and labelled “*Globally Dissatisfied*”. The

PhD students in this profile reported the weakest levels of competence, autonomy, and relatedness. Third, three profiles presenting specific weaknesses were identified, namely “*Competence deficient*”, “*Poorly connected*” and “*Autonomy deficient*”. The *Competence deficient* profile is defined by a particularly above average score on perception of competence, but with slightly above average perception of autonomy and relatedness. *Autonomy deficient* describes students who expressed under average perception of being able to influence the development of their thesis project, even though they also expressed slightly above average relatedness. Finally, the *poorly connected* profile groups together students with the lowest perception of belonging and being integrated in their research teams, despite an above average sense of competence and autonomy.

### Main differences among the profiles

ANOVAs were also performed on the three sources of support and showed significant differences across profiles. Perception of structure support was significantly lower for the *Globally Dissatisfied* and *Poorly Connected* profiles ( $F_{(4,456)} = 16.88$ ;  $p < .001$ ). Support for autonomy was significantly lower for the *Globally Dissatisfied* and *Autonomy deficient* profiles ( $F_{(4,456)} = 18.63$ ;  $p < .001$ ). Finally, involvement was the lowest for the *Globally Dissatisfied* profile and the highest for the *Globally Satisfied* profile ( $F_{(4,456)} = 16.17$ ;  $p < .001$ ).

ANOVAs were finally performed on the four components of the doctoral process: perceived progress, appropriation of the doctoral project, exhaustion, and intention to persist. *Globally Dissatisfied* and *Competence deficient* were found to have the lowest level of perceived progress ( $F_{(4,456)} = 22.30$ ;  $p < .001$ ). These two profiles also expressed the highest levels of exhaustion ( $F_{(4,456)} = 22.12$ ;  $p < .001$ ). Appropriation of the doctoral project was significantly lower for *Globally Dissatisfied* and *Poorly connected* profiles ( $F_{(4,456)} = 18.27$ ;  $p < .001$ ). Finally, intention to persist was lowest for the *Globally Dissatisfied* profile and highest for the *Globally Satisfied* profile ( $F_{(4,456)} = 18.23$ ;  $p < .001$ ).

### MULTI-GROUP MODELING

Grounded in the literature, the adjustment of our theoretical model of doctoral process (illustrated in Figure 3) was investigated. The different indices highlighted a good overall fit of the data to the theoretical model (see Table 3). Nevertheless, the paths from (1) autonomy support and involvement to perceived progress with the thesis and (2) from involvement to exhaustion were removed because they were non-significant. These modifications are also theoretically and empirically consistent with previous research which highlights a weaker impact of autonomy support and involvement when considered together with provision of structure (Dupont et al., 2016; Hospel & Galand, 2016; van Rooij et al., 2019). This model was compared to an alternative model assuming (1) a direct path from a supervisor's support to intention to persist, perceived progress, exhaustion, and appropriation of the doctoral project and (2) direct paths from intention to persist, perceived thesis's progress, exhaustion, and appropriation of the doctoral project to doctoral completion. This alternative model yielded a poor model fit. Moreover, the model comparison highlighted the theoretical model without the two non-significant paths mentioned above as the best fitted model. The AIC was lower than the alternative model and the Chi-square was significantly better ( $\chi^2_{d(3)} = 74.8$ ;  $p < .001$ ).

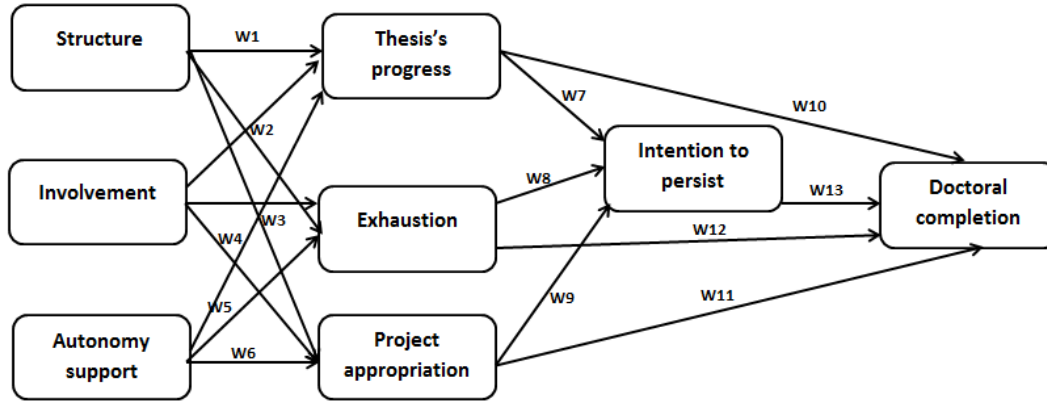


Figure 3. Initial theoretical model of doctoral completion process

Table 3. Path analysis results – overall model comparison

	$\chi^2$	df	AIC	RMSEA	CFI	PCFI	SRMR	P- Close
<b>Theoretical model</b>	382.34***	11	448.34	.058	.978	.384	.033	.004
<b>Alternative model</b>	3354.65***	9	3424.65	.194	.805	.259	.090	.000

\*p<.05;\*\*p<.01;\*\*\*p<.001

### MEASUREMENT INVARIANCE ACROSS GROUPS

In order to test the variation of the adjustment process across the different profiles, measurement invariance was initiated. The theoretical model was initially fully constrained to be equal across the groups. Then, a progressive relief of the parameters was operated. Model fit indices of the models can be consulted in Table 4.

Table 4. Path analysis results – multigroup model comparisons

	$\chi^2$	df	$\chi^2_{diff}$	RMSEA	CFI	PCFI	SRMR	P- Close
<b>Fully constrained model</b>	829.57***	111	.	.025	.957	.759	.058	1
<b>W2 free</b>	818.13***	107	11.4*	.026	.957	.732	.051	1
<b>W2+W3 free</b>	781.87***	103	36.3***	.026	.959	.706	.054	1
<b>W2+W3+W6 free</b>	743.52***	99	38.35***	.026	.961	.680	.050	1
<b>W2+W3+W6+W7 free</b>	718.19***	95	25.33***	.026	.962	.653	.051	1
<b>W2+W3+W6+W7+W9 free</b>	682.22***	91	35.97***	.025	.964	.627	.048	1
<b>W2+W3+...+W9+W11 free</b>	627.47***	87	54.75***	.024	.967	.601	.034	1
<b>W2+W3+...+W11+W13 free</b>	574.42***	83	53.05***	.024	.970	.575	.033	1

\*p<.05;\*\*p<.01;\*\*\*p<.001

The different paths between endogenous variables were progressively released. The analysis showed a significant improvement in the fit when releasing the path between structure and exhaustion (W2), structure and appropriation of the doctoral project (W3), autonomy support and appropriation of the doctoral project (W6). Then, the results highlighted a significant improvement in the fit when relieving the weight between perceived progress and intention to persist (W7), appropriation of the doctoral project and intention to persist (W9) and appropriation of the doctoral project and doctoral completion (W11). Finally, the release of the weight between intention to persist and doctoral completion provided a significant improvement in the model fit (W13). No improvement in the fit was

observed for other paths, showing that the weight of these paths was the same for each profile. Fit indices provided evidence of an excellent fit of the data to this final model (the structural model – W13). Hence, this model was retained as the best fitting to the data (see Figure 4).

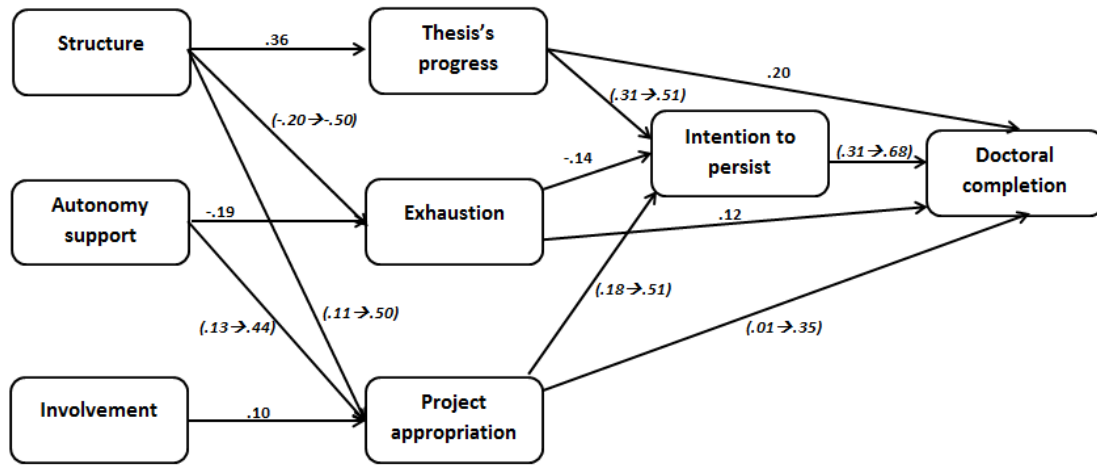


Figure 4. Final model of doctoral completion process

### *CRITICAL RATIO OF DIFFERENCE TEST*

In order to provide a pairwise comparison of the weights' variation in paths from one motivation profile to another (P1 to P4), critical ratio of differences tests was generated. The results of these analyses can be found in Table 5.

Table 5. Critical ratio of differences test – paths' weight pairwise comparisons across the profiles

	W2	W3	W6	W7	W9	W11	W13
1. Globally dissatisfied (N= 60)	-.50 <sup>***a</sup>	.50 <sup>***b</sup>	.41 <sup>***a</sup>	.51 <sup>***b</sup>	.18 <sup>a</sup>	n.s.	.51 <sup>***a</sup>
2. Poorly Connected (N= 84)	-.39 <sup>***ab</sup>	n.s.	.32 <sup>***a</sup>	.50 <sup>***b</sup>	.24 <sup>***a</sup>	n.s.	.68 <sup>***b</sup>
3. Competence deficient (N= 108)	-.20 <sup>***b</sup>	.24 <sup>***ab</sup>	.43 <sup>***a</sup>	.48 <sup>***b</sup>	.20 <sup>***a</sup>	n.s.	.41 <sup>***a</sup>
4. Autonomy deficient (N= 96)	-.24 <sup>***b</sup>	.36 <sup>***b</sup>	.44 <sup>***a</sup>	.31 <sup>***a</sup>	.51 <sup>***b</sup>	.35 <sup>***</sup>	.67 <sup>***b</sup>
5. Globally satisfied (N= 115)	-.23 <sup>***b</sup>	.22 <sup>**a</sup>	n.s.	.31 <sup>***a</sup>	.24 <sup>***a</sup>	n.s.	.31 <sup>***a</sup>

\*p<.05;\*\*p<.01;\*\*\*p<.001.

Notes: Subscripts letters indicate grouping based on pairwise comparisons, paths with different subscripts differ significantly; W2= path between structure and exhaustion ; W3= path between structure and project appropriation; W6= path between autonomy support and appropriation; W7= path between thesis' progress and intention to persist; W9= path between project appropriation and intention to persist; W11= path between project appropriation and doctoral completion; W13= path between intention to persist and doctoral completion

The results provided a detailed depiction of weight variation in paths according to student profile.

- First, a significant negative effect of supervisors' provision of structure on exhaustion (W2) was demonstrated. But this effect was stronger for the *Globally Dissatisfied* profile. The perception of supervisors' provision of structure proved to be particularly helpful for *Globally Dissatisfied* doctoral students.
- Supervisors' provision of structure also revealed a positive effect on project appropriation (W3) for all profiles except for *Poorly connected*. Moreover, this effect was stronger for the *Autonomy deficient* and *Globally Dissatisfied* profiles.

- The positive effect of supervisors' provision of autonomy on appropriation of the project (W6) was also significant for all profiles except for *Globally Satisfied*; this adapted profile has no need of supervisors' provision of autonomy to appropriate his/her doctoral project.
- The importance of perceived progress in the thesis was really important for every doctoral student (W7), although it was less important than enhanced intention to persist in the *Autonomy deficient* and *Globally Satisfied* profiles.
- Appropriation of the doctoral project also showed a positive effect on intention to persist for every student (W9). Appropriation was, however, particularly more important to enhance intention to persist in *Autonomy deficient* students. In this connexion, appropriation of the doctoral project was also directly predictive of actual completion for the *Autonomy deficient* profile.
- Finally, intention to persist showed a positive impact on doctoral completion for all students. This impact was more important for *Poorly connected* and *Autonomy deficient* profiles.

## DISCUSSION

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The purpose of this prospective study was to extend previous research on the motivational determinants of the doctoral completion process through sound multivariate quantitative design. To do so, the study tested, in a five-stage and large-scale study, (1) the motivation profiles of doctoral students; (2) a multifactorial modelling of the doctoral completion process; and (3) whether this process varies according to the motivation profile of the doctoral student.

The results from the present study (1) identified particular motivation profiles among doctoral students; (2) revealed important variation in the doctoral process across the profiles; (3) confirmed the direct effect of intention to persist on doctoral completion; and (4) partially provided evidence that a supervisor's support does not have the same effect on every PhD student.

### *MOTIVATION PROFILES UNDER INVESTIGATION*

The first main result of this study was the depiction of motivation profiles among doctoral students. Such profiles have been identified in other contexts (i.e., Hayenga & Corpus, 2010) but not among doctoral students. This finding corroborated the assumption of Devos et al. (2015) about the diversity of doctoral students. More precisely, two main categories of profiles were identified.

Two profiles, *Globally Dissatisfied* and *Globally Satisfied*, endorsed cumulative strengths or weaknesses which are close to the conception of self-determined and hetero-determined students in SDT theory (Deci & Ryan, 2000). The results showed that *Globally Dissatisfied* students systematically reported the lowest levels on variables embedded in the doctoral process which makes them particularly at risk of dropout and in need of specific attention. The identification of these students at the beginning of the doctoral process could help supervisors to prevent them from dropping out before being left too far behind to be able to catch up. Conversely, the *Globally Satisfied* profile covers students with the highest levels on the variables included in the doctoral process and is close to the profile drawn by Gillet and colleagues (2019); this profile can be characterized as the thriving profile with low motivational issues in the doctoral completion process.

Three other profiles emerged from the analyses expressing specific motivational weaknesses. Considering the relative independence between the three needs of SDT (Ryan & Deci, 2017) such profiles were expected. Among these profiles, *Competence deficient* seems to be particularly of concern. Together with the *Globally Dissatisfied* profile, it was found to have the lowest level of perceived progress and the highest level of exhaustion. This result is consistent with the social cognitive theory of Bandura (1997) which identified a feeling of competence as a main driver of student well-being and achievement. This assumption is also corroborated by the literature in HE which has identified a feeling of competence as one of the main predictors of persistence and achievement (Elias & MacDonald, 2007; Richardson et al., 2012). Litalien and Guay (2015) also found competence to be one of the

main predictors of doctoral completion. *Autonomy deficient* profiles were also identified as having specific difficulties in their appropriation of the doctoral project which is coherent with their weaknesses and substantiated the validity of the cluster and our hypothesis.

### ***FRAMING THE DOCTORAL COMPLETION PROCESS***

This study substantiates the relevance of SDT as a relevant framework of investigation for doctoral completion (De Clercq et al., 2019; Devos et al., 2017; Litalien et al., 2015). More precisely, the three types of supervisor support were found to have an impact on more proximal determinants of doctoral completion for all students. This result supports the assumed theoretical importance of contextual provision of structure, autonomy and involvement for students' further behavior and well-being (Ryan & Deci, 2017).

Beyond the distal impact of supervisor support, the model also substantiates the direct and indirect impact of perceived progress, exhaustion, and appropriation of the doctoral project on doctoral completion. This result is coherent with previous literature (Cornér et al., 2017; Cornwall et al., 2019; Devos et al., 2017, Graham & Massyn, 2019; Marais et al., 2018) and demonstrates the necessity to consider these three determinants.

The findings also demonstrate the strong impact of intention to persist on doctoral completion. The analyses corroborate our hypothesis and the assumption of planned behavior theory (Ajzen, 2011) and the model of student departure (Tinto, 1997) that intention to persist is the most proximal predictor of completion. This finding also supports the results of other studies carried out on persistence in the HE context (Litalien & Guay, 2015; Morrow & Ackermann, 2012).

### ***A CHANGING COMPLETION PROCESS***

The third main result addressed the moderating effect of the motivation profiles on the doctoral completion process. The findings found several main effects of doctoral completion determinants and several significant variations in the effects across motivation profiles.

Supervisors' provision of structure was found to have a significant impact on perceived progress which, in turn, has a major impact on doctoral completion, regardless of student profiles. This finding corroborates the vital importance of provision of structure highlighted in the literature (Hospel & Galand, 2016). This idea is also in line with the strong impact of supervisors' provision of structure on exhaustion and appropriation of the doctoral project for *Globally Dissatisfied* profiles. This source of support seems the most important for doctoral students, especially for struggling ones.

Supervisors' provision of autonomy was also identified as a main buffer of emotional exhaustion for each profile, although the identified relation was quite low. Supervisors' provision of autonomy also showed a significant average impact on appropriation of the doctoral project, except for the *Globally Satisfied* profile. As supported by the self-process model of motivation development (Appleton et al., 2008), autonomy support from teachers is decisive for students to take ownership of their action in a specific learning context.

The results identified supervisor involvement as the least important source of supervisor support with only a weak impact on appropriation of the doctoral project. This result is in line with other studies in the HE context which showed no remaining effect of involvement when considered together with provision of structure or autonomy (Dupont et al., 2016).

Surprisingly, the profile characterized by a specific lack did not benefit the most from the corresponding source of support. This finding contradicts our initial hypothesis and suggests that supervisors' support mainly has a general positive impact on all patterns of PhD students.

The findings also showed the importance of the appropriation of the doctoral project for the *Autonomy deficient* profile. Beyond a weak effect for other profiles, appropriation of the doctoral project was found to have a strong effect on intention to persist for the *Autonomy deficient* profile. Furthermore,

appropriation of the doctoral project was also a moderate direct predictor of doctoral completion for this profile. Such findings show the important variations that could occur when considering the motivational diversity of doctoral students.

A final main result showed that intention to persist was found to be particularly important for both *Autonomy deficient* and *Poorly connected* profiles. Such results provide another lever to promote completion of these specific profiles.

### ***IMPLICATIONS***

The combination of student self-perceptions provided complex motivation profiles expressing different needs for supervision. These results allow for the identification of specific levers of action that can be considered as a step towards better supervision of doctoral students. Supervision could shift to differentiated types of support, tailor-made to students' specific needs (De Clercq et al., 2019). Such improvement in the supervision would increase doctoral students' well-being and their persistence. Moreover, the findings also suggested that some positive psychological intervention (i.e. Marais et al., 2018) based on emotional regulation could have a general positive effect on all PhD students. In this context, we can assume that these findings could have an effect on the efficiency of faculty teaching and research by preventing important members of the workforce from dropout and exhaustion.

### ***LIMITATIONS AND FUTURES PERSPECTIVES***

Among the limitations of this study, three are particularly noteworthy. First, despite a five-wave design and a large sample for the domain, the sample size is quite low to address the complex model under investigation in this study. This low sample size could have hindered the reliability of our results and therefore deserve to be replicated with a larger database (Kline, 2011).

Second, several confounding variables were not considered in our approach such as gender, age, and more importantly context characteristics. Our preliminary analysis revealed significant variations between the academic fields among the factors embedded in the doctoral completion process. These findings highlight that the doctoral completion process is not only person-specific but might be context-specific. This context diversity could be further developed by replicating the study in another educational context. A future study could explore the motivation profiles across the academic fields of research in order to assess differences from one field to another.

Third, our analyses specifically focused on doctoral completion. This specific lens left several important questions out of the picture. For example, the effect of motivation and context on student satisfaction and professional efficiency could have been further explored. In this context, a relevant future perspective could be to investigate the impact of the motivation profile on doctoral student fulfillment together with the impact on research and teaching efficacy. Such a perspective could provide interesting information to better understand the motivation of a higher education faculty and could shed light on another important issue, namely the efficiency of the faculty workforce (Perkmann et al., 2013).

Another future perspective going beyond the limitations of this study could be to interview students from different profiles in order to have a more in depth understanding of their experience.

Finally, stages of advancement could also be considered in the investigation. Recent studies (McAlpine & McKinnon, 2013; Wollast et al., 2018) assume that the doctoral attrition issue is specific to the different stages of the doctoral process. With this idea in mind, it could be important to consider the model investigated in this study at different stages of advancement.

In conclusion, this study aimed at proposing an innovative approach to further investigate the underdeveloped understanding of the motivational layer of the doctoral process (Lynch et al., 2018). More precisely, the study investigated multifactorial modeling of the doctoral completion process through



sound quantitative and longitudinal design. The results also identified five motivation profiles demonstrating specific combinations of self-perceptions and specific doctoral completion processes. This approach provides interesting first results to grasp the importance of motivational patterns in the understanding of the doctoral completion process.

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## AUTHORS

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**Mikaël De Clercq** PhD, is a post-doctoral researcher in educational psychology at the Université catholique de Louvain, Belgium. His research interests focus on student's experience of academic transition in the first year at the university and in the doctoral studies. More information about her can be found on <https://www.uclouvain.be/mikael.declercq>



**Mariane Frenay**, PhD, is a Professor at the Université catholique de Louvain, Belgium. Her research interests include students' persistence and academic achievement, learning and professional development in higher education. More information about her can be found on <http://www.uclouvain.be/mariane.frenay>



**Asaad Azzi**, PhD, is a Professor and Head of the Social psychology unit at the Université Libre de Bruxelles, Belgium. His research interests include intergroup relations, acculturation, discrimination, and perception of justice. More information about him can be found on <http://www.psychopsysoc.site.ulb.ac.be/equipe/assaad-azzi>



**Olivier Klein**, PhD, is a Professor and head of the Center for Social and Cultural Psychology at the Université Libre de Bruxelles, Belgium. His research interests concern social stereotypes, objectivation and dehumanization, and social influences on memory. More information about him can be found on <http://www.psychopsysoc.site.ulb.ac.be/equipe/olivier-klein>



**Benoît Galand**, PhD, is a Professor at the Université catholique de Louvain, Belgium. His research interests include motivation and engagement in learning, violence and bullying in schools, and teachers' professional practices. More information about him can be found on <http://www.uclouvain.be/benoit.galand>