Development and validation of a mindset measurement scale for written expression

Authors : Emile Colin[1], Lucie Finez[2], Raphaël Laurin[3]

[1]Doctorant en psychologie sociale, Laboratoire PSY-DREPI, Université de Bourgogne, Dijon, France

[2] Maître de conférences en psychologie sociale et psychologie du sport et de la performance, Laboratoire PSY-DREPI, Université de Bourgogne, Dijon, France

[3] Maître de conférences HDR en psychologie du sport et de la performance, Laboratoire PSY-DREPI, Université de Bourgogne, Dijon, France

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Please address all correspondence concerning this manuscript to me at emile.colin@u-bourgogne.fr.

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Abstract

The aim of this article is to create and validate an implicit beliefs (mindset) scale in French. We have adopted a multidimensional approach, seeking to assess both growth and fixed mindset, but also the hypothesis of a threshold dimension, in which mindset become fixed beyond a certain point. The scale focuses on a specific domain: written expression. The study was carried out on three samples of French-speaking students, one for the exploratory analysis and two for the confirmatory analyses. Additional measures were also taken to support validity analyses, such as achievement goals and self-handicapping. Results showed satisfactory indicators, despite a fixed dimension with less robust markers than the growth dimension. The developed scale will be valuable for assessing the link between implicit beliefs, academic strategies and academic success in French students, in different fields.

Keywords : Scale validation, mindset, French students, academic achievement

Introduction

In France, spelling and written expression skills are very important and are high expectations on the part of school authorities. As in the case of mathematics (Carroll et al., 2023), we can assume that written expression can constitute a threat in an evaluation situation, provoking different learning strategies depending notably on the implicit beliefs of individuals. There are very few tools tool for measuring these beliefs in the field of written expression (Camacho et al., 2023; Limpo & Alves, 2014), and, to the best of our knowledge, the aim to propose the development and validation of a tool for measuring implicit beliefs in written expression on a French students sample is unprecedented.

Implicit theories, or implicit beliefs, postulate the existence of different distinct attitudes towards the malleability of abilities (Dweck & Leggett, 1988). These implicit beliefs are very strongly linked to school strategies in the field of academic success and performance psychology. Despite some still-debated characteristics, the majority of the literature seems to account for an indirect, sometimes weak, link between implicit beliefs and school and academic success (Sisk et al., 2018).

Behavioral patterns are distinguished by the tendency to adopt both growth and fixed mindset. An individual who holds growth mindset believes he has the power to develop his intelligence without limit. He will therefore be more inclined to train and make efforts to improve this characteristic than so-called "fixist" individuals. This behavioral pattern is clearly observed in the school environment. This willingness to progress can be measured by several factors: notably, a lower tendency to self-handicap (Midgley & Urdan, 2001), greater resilience in the face of failure (Erdley et al., 1997.; Yeager & Dweck, 2012), a

pursuit of mastery rather than performance goals (i.e., a tendency to seek to learn rather than to do better than others) (Dweck & Leggett, 1988; Rouch et al., 2022), and a greater search for challenge (Rhew et al., 2018). These more adaptive academic strategies are associated with greater academic success, as measured by grades. Conversely, fixist individuals perceive their level of intelligence as stable over time. Each evaluation test can therefore only be perceived as a reflection of their intelligence level. This way of thinking can make these individuals feel threatened in evaluation situations. They will therefore more readily adopt performance goals to do better than the others and thus reflect the highest possible level of intelligence.

Most studies about implicit beliefs focus on intelligence, as this theoretical framework has targeted so far. But there is one area of particular interest to us: spelling, for the reasons explained above. It is also easy to measure the concrete operationalization of spelling skills through dictation. Existing scales concerned with mindset about written expression skills focus on young children (Limpo & Alves, 2014). Considering the challenging transition period after high school (Annoot et al., 2019) we are interested in a more global context in implicit beliefs about higher education students. In addition, in this study, we tested a tool measuring mindset in French language on written expression. Preliminary work has been done by Da Fonseca et al. (2007), who validated a French-language mindset scale on children. That said, the theoretical and semantic rationale behind the creation of these items remains unclear, and the indicators of beliefs measurement obtained in the most recent study were unsatisfactory, helping to justify the need for us to validate a new scale for measuring implicit beliefs on a French student population.

Finally, theoretical debate persists as to whether implicit beliefs scales should consider two dimensions, or a single dimension perceived as a continuum. Several points of view suggest the possibility that the same individual may hold both growth and fixed mindset, depending on dispositional characteristics, but also on the context and domain under study (Dweck, 1999). The existence of a continuum was first argued by the strong link between mindset and achievement goals (Leggett, 1985, Dweck & Leggett, 1988), insofar as the authors observed a strong positive correlation between growth mindset and mastery goals, and between fixed mindset and performance goals. Consequently, the authors developed a single-dimension fixed mindset scale, constituting a "simple unit theme" (Dweck et al., 1995a). This choice was also justified after observing a strong desirability bias on incremental items. But according to the same author, knowing that incremental and entity theories are opposed does not mean an individual cannot hold both (Dweck et al., 1995b). People would not tend to finely examine their belief system in detail, and thus identify contradictions and inconsistencies. Even if one theory is dominant in an individual, the other may become accessible in particular circumstances. However, many mindset measurement scales have been based solely on fixed items, as suggested by Dweck (1999). We add to these contradictions that studies that use both dimensions find fairly low negative correlations between the two (Da Fonseca et al., 2007; Dupeyrat & Mariné, 2005; Karwowski, 2014), ranging from -.17 to -.55, which is an insufficient value to suggest that these two dimensions are two poles of the same continuum. Moreover, articles on interventions aimed at modifying beliefs focus on only one belief score or find a significant impact on only one of the two scores (Burnette et al., 2022; Rouch et al., 2022). One explanation for

this inconsistency might be the existence of a third dimension, which we call the threshold dimension, suggesting that beliefs become fixed after a certain point, from which they can no longer change. We have included this third dimension in our tool for exploratory purposes.

The aims of this work were therefore to propose a scale for measuring implicit beliefs on French students which also incorporated a third threshold dimension, i.e. that there is a threshold at which beliefs become fixed. Finally, the internal factor structure and consistency of the questionnaire were examined, through an exploratory factor analysis (Study 1A) and two confirmatory analyses (Studies 1B and 2).

Study 1

The aim of this study was to adapt and formulate items covering the measurement of implicit beliefs about written expression and spelling skills, hypothesizing the existence of three dimensions: an incremental dimension, a fixed dimension, and a threshold dimension. To test the validity of this model, we proceeded in two steps using the same sample of participants. After splitting the sample into two equivalent subgroups distributed randomly, we first conducted an exploratory factor analysis (EFA) on the first sample (Study 1A), and then, in a second step, performed a confirmatory factor analysis (CFA) on the second sample (Study 1B). All questionnaires were in French.

Study 1A

Participants

A total of 108 participants were recruited through social media, in different student communities from several French universities, for EFA subsample. They were invited to complete an online self-report questionnaire on the platform Qualtrics. Informed consent was obtained in the post prior to the survey. Participation in the questionnaire was voluntary. After completing the survey, they were thanked and rapidly briefed. Their field of study was heterogeneous. Among them, 85 were female, 21 were male and 2 non-binary. They were aged from 18 to 36 years old (M = 22.2 ± 2.34).

Formulating and adapting items

To date, the scientific literature on implicit beliefs heavily relies on the scale conceptualized by Dweck (1999) which comprises 4 incremental and 4 entity items to address the incremental bias which elicit acquiescent responses (Blackwell et al., 2007; De Castella & Byrne, 2015; Degol et al., 2018) including measurements in French (Da Fonseca et al., 2007). We relied on this scale to constitute a committee of 6 experts (i.e., researchers in the fields of social psychology and performance) to review, adapt, and formulate a new scale. Discussions highlighted the importance of adapting abilities (i.e., intelligence) to written expression and ensuring comprehensibility by higher education students. The formulation of threshold dimension items focused on the transition between high school and higher education (i.e., "When entering higher education with deficiencies in written expression, they cannot be fully compensated for"). All items were formulated in French. A final scale of 24 items (8 per dimension) was unanimously selected, combining various elements adapted from the literature (Q1, Q4, Q6, Q7, Q19, Dweck, 1999; Q15, Q16,

Karwowski, 2014 ; Q2, Q5, Claro et al., 2016 ; Q13, Q20, Da Fonseca et al., 2007) or entirely constructed, notably with the threshold dimension (see Table 1). The final survey included 24 items measuring implicit beliefs in the form of a 7-point Likert scale, from "Strongly disagree" to "Strongly agree".

[Insert Table 1]

Results and discussion

Exploratory analysis. All analyses were conducted using JAMOVI 2.2.5 or RStudio. The Bartlett's test of sphericity was highly significant ($\chi 2 = 1824$, $df = 276$, $p < 0.001$), rejecting the hypothesis of variable independence. Number of factors was based on parallel analysis. Oblimin rotation was selected. The exploratory factor analysis saturated the items into 3 dimensions corresponding to the theorized dimensions: incremental (Factor 1), entity (Factor 2), and threshold (Factor 3). The items corresponding to Factor 3 exhibited low saturation (all loadings are available in Table 1). The incremental dimension explains 19.7% of the observed variance in the sample, the entity dimension explains 19.2%, and the threshold dimension explains 5%, suggesting that Factor 3 only partially explains the observations. It was also observed that Factor 3 correlates very little with the other two (respectively -0.07 and 0.09), whereas Factors 1 and 2 correlate well with each other (-0.40). The Sampling Adequacy Measure (SAM) is overall 0.88, suggesting good sampling adequacy.

[Insert Table 2]

Exploratory Reliability Analysis. The exploratory reliability analysis allowed us to make an initial selection of the implicit beliefs scale. The observed results did not suggest the existence of a threshold dimension (Factor 3), so we decided to retain only two dimensions for further analysis. Therefore, items for which we expected saturation within Factor 3 were removed. Furthermore, for exploratory reliability analysis, we only retained items that saturated in the dimension we expected and in no other, even negatively. The saturation threshold we have selected was 0.3, in accordance with criteria of Howard (2016). This was done with the aim of creating two distinct dimensions that independently address incremental beliefs and entity beliefs.

In line with the saturations obtained in Table 1, we confined our reliability analysis to two dimensions, obtaining satisfactory Cronbach's alpha and good inter-item correlation values (Table 2; for more information see Appendix B). The initial analysis constituted a preliminary step in validating a tool for measuring implicit beliefs about written expression. This enabled us to select a 6-item scale, based on the following criteria: (i) minimum and unilateral item saturation of 0.3 (as mentioned previously), (ii) equal number of incremental and entity items, (iii) retention of a mix of items formulated by our team and items inherited from the literature (Dweck, 1999), (iv) removal of semantically redundant items. In the end, we retained a scale of 6 items comprising 2 dimensions with 3 items each (see Table 3). Further analyses of this tool were conducted on the two remaining dimensions.

[Insert Table 3]

Study 1B

This study aimed to conduct confirmatory analyses to support the factorial validity of the 6-item scale we selected following the exploratory analysis.

Participants

Participants for this study came from the same sample that EFA. We split the original sample into 2 sub-samples, in which the latter was used for CFA. We have selected 106 participants (students from French universities) for this stage. Among them, 78 were female, 25 were male 3 non-binary. They were aged from 18 to 30 years old (M = 21.6 ± 2.18).

Results and discussion

Confirmatory and Reliability analysis. All analysis were conducted on the 6-item scale responses from previous study (see Table 3). The χ^2 value is low (9.31; $p > 0.3$), suggesting that the model fits data well. Other indicators confirm this (CFI = 0.99; TLI = 0.99; RMSEA < 0.04). Table 4 describes satisfactory Cronbach's alphas on a new-item based reliability analysis. More information about inter-item correlations is available in Appendix C.

[Insert Table 4]

To summarize, by chosing a French student sample on written expression, Study 1 indicated satisfactory psychometric properties of our final scale in terms of reliability and construct validity, with only two subscales. We aimed to propose additional predictive validity in the light of achievement goals on a new student sample, and an invariance analysis, to support the validity of the tool. Furthermore, we acknowledge that in our procedure, participants in the

confirmatory sample responded to all 24 items initially formulated, which is not in line with the practices of confirmatory validity analysis (Howard, 2016). It was therefore necessary to assess the quality of our model on a sample that only responded to the 6 items we selected.

Study 2

Study 2 aimed to increase the statistical power of our scale by conducting predictive and invariance analyses, because measurement of implicit beliefs about written expression abilities, is, to our knowledge, unprecedented. To do so, we needed to add other measures such as achievement goals and self-handicapping to our questionnaire. Once again, all questionnaires administered are in French.

Mindset & Achievement Goals

In school-aged children, two main types of cognition-affect-behavior patterns have already been identified, corresponding to "helpless" responses and "mastery-oriented" responses (Diener & Dweck, 1978). Helpless patterns correspond to performance goals, in which individuals seek to obtain favorable judgments of their abilities from others. Mastery-oriented patterns, on the other hand, correspond to mastery goals, in which individuals seek to improve their skills (Dweck & Leggett, 1988). The authors linked this with implicit beliefs, assuming that individuals who perceive their abilities as fixed tend to pursue performance goals, and individuals who perceive their abilities as improvable tend to pursue mastery goals. These two types of goals have been grouped under the term achievement goals, within which the scale proposes a 2*2 framework: a

mastery-performance dimension, and an approach-avoidance dimension (Elliot & McGregor, 2001). The literature suggests a causal link from implicit beliefs to achievement goals (Burnette et al., 2013 ; De Castella & Byrne, 2015). Considering beliefs at a higher cognitive level compared to attitudes, this justifies for us the choice to conduct a predictive analysis of achievement goals on our scale.

Mindset & Self-Handicap

Self-handicapping strategies have been identified in the literature for several decades (Berglas & Jones, 1978). They consist of emphasizing obstacles to one's own success before performing an evaluative task in a domain important for the self and where the outcome is uncertain (Berjot & Finez, 2011) with the aim of having an excuse in case of failure or being even more valued in case of success. The literature reports a positive correlation between entity beliefs and self-handicapping, or a negative correlation between incremental beliefs and self-handicapping (De Castella & Byrne, 2015) in both the academic and sports domains (Ommundsen, 2001).

We hypothesized that implicit beliefs about written expression also predicts achievement goals, which would demonstrate that constructs around implicit beliefs also apply to written expression. Also, the dichotomy between “self-handicappers” and “non-self-handicappers” allows us to divide our sample into two groups to use an invariance analysis of our mindset scale to show that the various scale indicators remain constant between groups. This kind of analysis is usually performed by splitting samples by gender (Teo, 2010), but as we

expected to have a predominantly female sample among psychology students, we chose a split by self-handicap to keep numerical equality between groups.

Participants

For this study, 416 participants were recruited in class from a course for first-year psychology students in France. They were invited to complete an online self-report questionnaire on the platform Qualtrics. Informed consent was obtained prior to the survey. Students ranged in age from 18 to 52 years (mean 18.83 ± 2.12 years). Participants included 359 women, 51 men, and 6 non-binary.

Measures

Mindset about written expression. We used the selected scale from the previous study to measure participants' implicit beliefs about written expression. This scale consists of two subscales, each with three items (see Table 3).

Achievement goals. We measured achievement goals in a 2*2 framework, comprising a mastery dimension and a performance dimension; the other dimension measures the tendency to approach or avoid. The original scale was proposed by Elliot and McGregor (2001), and validated in French by Schiano-Lomoriello et al. (2005). We focused the items on written expression skills.

Self-handicapping. To assess measures of self-handicapping (SH), we used Jones & Rhodewalt's 23-item Self-Handicapping Scale (SHS, 1982). The scale has three dimensions capable of measuring global SH, claimed SH, and behavioral SH. The scale also splits participants as "self-handicappers" or "non-self-handicappers" from to their overall behavioral SH score (Rouch et al., 2022). All items were translated into French using a back-to-back procedure.

Results and discussion

Confirmatory factor analysis. Here are the model fit indicators we observe: $\chi^2 = 48.0$ ($p < 0.001$); CFI = 0.95; TLI = 0.90; RMSEA = 0.107, suggesting a good model fit overall. We observed Cronbach's alpha of 0.79 on the incremental dimension and 0.66 on the fixed dimension, and good inter-item correlations (see Appendix D).

Predictive analysis. We hypothesized a causal relationship between mindset and achievement goals in our data. We obtained good indicators for all sub-dimensions of the achievement goals scale: performance approach (α = .85), performance avoidance (α = .93), mastery approach (α = .90), mastery avoidance (α = .97).

Table 5 shows the correlations between the study variables. In addition, all sub-dimensions of the achievement goals scale were independently regressed as dependent variables of implicit beliefs. Models incorporating both dimensions of the mindset scale predicted the mastery approach better than only one of the two ($F = 15.2$, $R2 = .07$, $p < .001$). The same model correctly predicts mastery avoidance goals ($F = 7.0$, $R2 = .03$, $p < .001$).

[Insert Table 5]

In line with literature, we observed a positive significant relationship between incremental beliefs and mastery approach goals (r = .23), and a negative one between fixed beliefs and mastery approach goals (r = -.21). An inverse relationship appeared to link implicit beliefs (incremental, r = -.10; fixed, r = .18) to mastery avoidance goals.

Invariance analysis. We also decided to perform an invariance analysis on this sample. As the aim of an invariance analysis is to gauge factorial invariance between several groups in the same sample, we decided to split our panel into two groups according to their behavioral self-handicap score. The self-behavioral handicap dimension of the Jones & Rhodewalt (1982) scale comprises 6 items. Using the same procedure as Rouch et al. (2022), we were able to categorize “self-handicappers” (N=159) and “non-self-handicappers” (N=257), from their scale total score (above or below 24 out of a possible value of 6 to 42). We performed three hierarchical levels of invariance models between these two groups, starting from a multigroup CFA and using a WLSMV estimator, which is better suited to categorical and ordinal data. Table 6 shows satisfactory model fit indices which are in line with Hu & Bentler's (1999) guidelines for good model fit.

[Insert Table 6]

Our results suggest remarkable consistency in the relationships between the items of the scale across the two groups studied. Configural invariance measurement allowed us to verify if the factorial structure of the scale was generally similar between the groups, regardless of the specific parameter values. Metric measurement of invariance highlighted the equivalence of regression coefficients between latent factors and scale items across our two groups. Finally, Equivalence between the groups remained stable when adding constrained intercepts.

General Discussion

Several scales for measuring implicit beliefs have already been developed, in English (Dweck, 1999) or French (Da Fonseca et al., 2007), but on young

populations, and the origin of the items was not made explicit. Furthermore, scales for measuring implicit beliefs in the context of written expression are, to our knowledge, new in the scientific literature. This area is of particular interest in a French-speaking environment, as this is a culture in which society places a certain importance on writing well. Our aim was to validate these measurement scales to be able to compare the impact of implicit beliefs in school strategies and academic results through the prism of written expression.

Implicit beliefs have been studied in a variety of domains, such as mathematics (Degol et al., 2018) or personality (Yeager & Dweck, 2012). We thus expected and obtained good indicators in exploratory analysis for the domain of written expression in view of the threat it may pose. Our choice to reduce each factor to 3 items was motivated solely by the desire to create a quick, inexpensive scale and equal in terms of dimensions. The confirmatory analyses then consolidated the results previously obtained with relatively similar indicators. This reflects the fact that our choice to lighten the implicit belief scale did not seem to have any impact on its factor structure.

The scarcity of the field of written expression in the literature made it difficult to compare our indicators with existing scales, which is the basis for convergent or discriminant validity analyses. This distance from the constructs established in the literature may explain some of the unclear results among our data with predictive models. For this reason, we also opted for an invariance analysis to support the robustness of our scale.

Limitations and future research

The tool we have developed allows for the measurement of students' implicit beliefs about their written expression abilities. However, despite a multitude of indicators reinforcing the stability of our scale, our approach is not without limitations. Consequently, as that we mentioned above, generalizing our results to cultures other than France must be done very cautiously. Without comparative studies, we cannot say that mastery of written expression is subject to similar requirements in other countries. Also, we were able to develop a predictive model of achievement goals, notably because we adapted these items to written expression. However, although the link between implicit beliefs and the mastery-performance dimension is well-established, the same link with the approach-avoidance dimension remains unclear. Our results suggest a positive link between growth mindset and approach (and conversely between fixed mindset and avoidance), but our aim was not to explain the configuration in a 2*2 interaction framework. This scenario needs to be investigated in future research, as also an explanation for the inconsistencies observed in the consideration of a fixed/growth mindset continuum (which is not the possibility of a threshold boundary).

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Table 1: Summary table of the 24 original items on mindset about written expression. The table includes factor loadings for each associated item by dimension. X indicates the dimension in which majority factor loadings were expected prior to exploratory factor analysis (Oblimin rotation). Scores (> .30) indicate actual factor loadings. Original French items are available in Appendix A.

Question	Content	Incremental dim.	Fixed dim.	Threshold dim.
Q1	No matter who you are, you can always significantly change your level of written expression.	X 0.771		
Q2	The level of written expression is something you can't change very much.	-0.526	X 0.306	
Q3	By the time you reach the end of high school, it's too late to improve your written expression.		0.630	X
Q4	You can always substantially change your written expression skills.	X 0.711		
Q5	You can learn new things, but you can't really change someone's written expression skills.		X 0.463	
Q6	Even your basic level of written expression can change considerably.	X 0.538		
Q7	You have a certain basic level of written expression and there's not much you can do to change it.		X 0.577	
Q8	When you arrive at university with a lack of written expression, there's no catching up.		0.686	X
Q9	You can overcome your difficulties in written expression to reach a high level.	X 0.617		
Q10	You're either good at written expression or you're not - and nothing can change that.		X 0.507	
Q11	After a certain age, there's no room for improvement in		0.483	X

	written expression.			
Q12	It's possible for anyone to become good at written expression, even if they have a lot of catching up to do.	X 0.789		
Q13	Excellence in written expression is determined from an early age.		X 0.428	
Q14	There's a point at which it's hard to really improve your written expression.		0.449	X
Q15	The quality of written expression is something that develops from an early age and is long-lasting.		X 0.513	0.359
Q16	Excellence in written expression only takes effort and hard work.	X 0.591		
Q17	Willingness makes it difficult to compensate for a lack of written expression.	-0.341	X	
Q18	Difficulties with written expression can't be overcome once you've left high school behind.		0.734	X
Q19	No matter what your level of written expression is, you can always change it significantly.	X 0.597		
Q20	To be good at written expression, you need to have certain qualities from birth.		X	0.640
Q21	You can achieve an excellent level of written expression through perseverance.	X 0.712		-0.327
Q22	If you start from too far back, you'll never be able to excel at written expression.			X
Q23	Once you're an adult, the opportunities to become excellent at written expression disappear.		0.608	X
Q24	Some people are naturally good at written expression, and others aren't; that can't really change.		X 0.547	0.417

Table 2: Descriptive statistical analyses of the exploratory sample (Study 1).

Factor	M	SD	Possible observed ranking	Cronbach alpha
Growth mindset	4.97	1.12	1-7	.86
Fixed mindset	2.33	0.98	1-7	.72

Table 3: Final scale of mindset about written expression.

Question	Contenu
Q1 (1)	Peu importe qui on est, on peut toujours changer significativement son niveau en expression écrite.
Q2 (4)	On peut changer énormément ses capacités en expression écrite.
Q3 (19)	Peu importe le niveau en expression écrite que l'on a, on peut toujours le changer de façon consistante.
Q1 (5)	On peut apprendre de nouvelles choses, mais on ne peut pas changer véritablement les capacités d'une personne en expression écrite.
Q2 (7)	On a un certain niveau de base en expression écrite et on ne peut pas faire grand-chose pour le changer.
Q3 (10)	On est bon en expression écrite ou on ne l'est pas - et rien ne pourra changer ça.

*Note. *In blue: items in the incremental dimension. In red: items in the fixed dimension.*

Table 4: Descriptive statistical analyses of the confirmatory sample (Study 1 bis).

Factor	M	SD	Possible observed ranking	Cronbach alpha
Growth mindset	5.07	1.36	1-7	.87

Fixed mindset	2.12	0.91	1-7	.74

Table 5: Descriptive statistics, psychometric properties, and latent correlations among variables (Study 2).

Factor	**M**	**SD**	**Possible observed ranking**	**Cronbach alpha**	**1**	**2**	**3**	**4**	**5**
(1) Growth mindset	4.97	1.12	1-7	.86	/				
(2) Fixed mindset	2.33	0.98	1-7	.72	**-.48****	/			
(3) Performance approach	3.31	1.47	1-7	.85	.08	.03	/		
(4) Performance avoidance	3.64	1.81	1-7	.93	.02	.02	**.32****	/	
(5) Mastery approach	5.65	1.20	1-7	.90	**.23*****	**-.20****	**.24****	**.17****	/
(6) Mastery avoidance	3.27	1.89	1-7	.97	**-.10***	**.18*****	-.04	**.38****	**.13****

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

Table 6: Model indicators for three types of invariance models between self-handicappers and non-self-handicappers.

Group split	**Invariance models**	**Chi-square difference test**	**Model fit indices**

“Self-handicappers” (N=159) vs. “Non-self-handicappers” (N=257)	Configurational invariance model	/	CFI= .99, TLI = .98, RMSEA = .042
	Metric invariance model	$\Delta\chi^2$ = 1.49, df = 4, p = .83	CFI = .98, TLI = .97, RMSEA = .057
	Scalar invariance model	$\Delta\chi^2$ = 1.55, df = 4, p = 0.82	CFI = .98, TLI = .98, RMSEA = .049).

Appendices

Appendix A

Question	Contenu	Dim. Incrémentielle	Dim. Fixe	Dim. Seuil
Q1	Peu importe qui on est, on peut toujours changer significativement son niveau en expression écrite.	X 0.771		
Q2	Le niveau en expression écrite est quelque chose que l'on ne peut pas beaucoup changer.	-0.526	X 0.306	
Q3	Quand on arrive en fin de lycée, il est trop tard pour s’améliorer en expression écrite.		0.630	X
Q4	On peut changer énormément ses capacités en expression écrite.	X 0.711		
Q5	On peut apprendre de nouvelles choses, mais on ne peut pas changer véritablement les capacités d'une personne en expression écrite.		X 0.463	
Q6	Même son niveau de base en expression écrite, on peut le changer considérablement.	X 0.538		
Q7	On a un certain niveau de base en expression écrite et on ne peut pas faire grand-chose pour le changer.		X 0.577	
Q8	Quand on arrive dans le supérieur avec des lacunes en		0.686	X

	expression écrite, on ne peut plus les rattraper.			
Q9	On peut compenser ses difficultés en expression écrite jusqu'à atteindre un haut niveau.	X 0.617		
Q10	On est bon en expression écrite ou on ne l'est pas - et rien ne pourra changer ça.		X 0.507	
Q11	Après un certain âge, on ne peut plus s'améliorer en expression écrite.		0.483	X
Q12	C'est possible pour tout le monde de devenir bon en expression écrite, même en ayant beaucoup de lacunes à rattraper.	X 0.789		
Q13	L'excellence en expression écrite est déterminée dès le plus jeune âge.		X 0.428	
Q14	Il y a un moment à partir duquel il est difficile de vraiment s'améliorer en expression écrite.		0.449	X
Q15	La qualité de l'expression écrite est quelque chose qui se développe dès le plus jeune âge et qui est durable.		X 0.513	0.359
Q16	L'excellence en expression écrite ne demande que des efforts et du travail.	X 0.591		
Q17	La volonté permet difficilement de compenser ses lacunes en expression écrite.	-0.341	X	
Q18	Les difficultés en expression		0.734	X

	écrite ne peuvent plus être surmontées une fois que le lycée est derrière nous.			
Q19	Peu importe le niveau en expression écrite que l'on a, on peut toujours le changer de façon conséquente.	X 0.597		
Q20	Pour être bon en expression écrite, il faut avoir certaines qualités dès la naissance.		X	0.640
Q21	On peut acquérir un excellent niveau en expression écrite grâce à la persévérance.	X 0.712		-0.327
Q22	Si on part de trop loin, on ne pourra jamais exceller en expression écrite.			X
Q23	Une fois adulte, les opportunités de devenir excellent en expression écrite disparaissent.		0.608	X
Q24	Certaines personnes sont naturellement douées en expression écrite, et d'autres non; cela ne peut pas réellement changer.		X 0.547	0.417

*Note. * The table includes factor loadings for each associated item by dimension. X indicates the dimension in which majority factor loadings were expected prior to exploratory factor analysis (Oblimin rotation). Scores (> .30) indicate actual factor loadings.*

Appendix B

Reliability Analysis – Incremental dimension

Scale Reliability Statistics

	mean	sd	Cronbach's α
scale	4.97	1.12	0.856

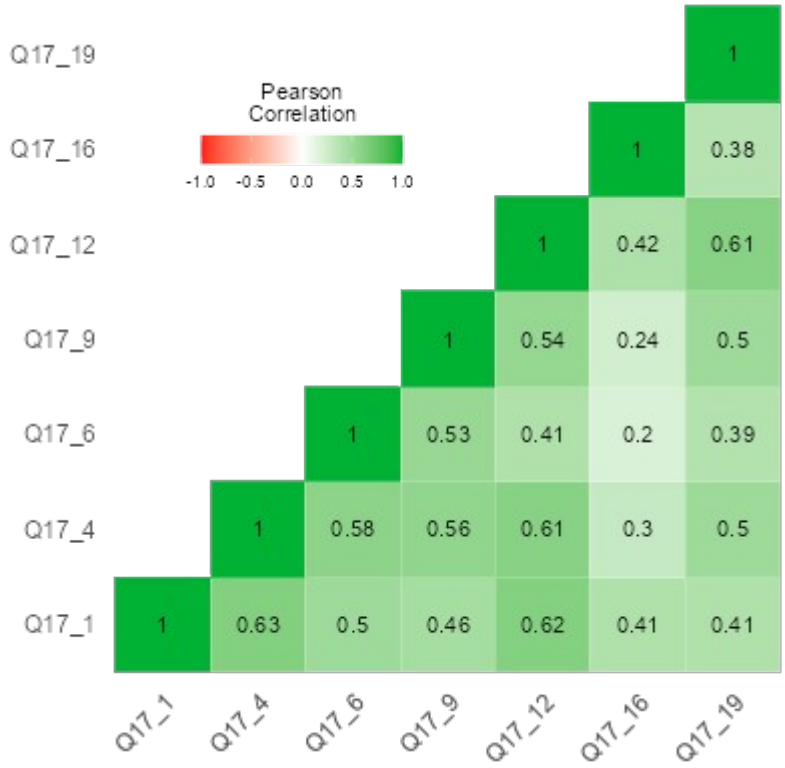
Item Reliability Statistics

	mean	sd	item-rest correlation	if item dropped Cronbach's α
Q17_1	5.08	1.55	0.685	0.827
Q17_4	5.15	1.51	0.719	0.822
Q17_6	4.96	1.56	0.573	0.843
Q17_9	5.12	1.40	0.632	0.835

Item Reliability Statistics

	mean	sd	item-rest correlation	if item dropped Cronbach's α
Q17_12	5.22	1.49	0.732	0.820
Q17_16	4.20	1.68	0.419	0.867
Q17_19	5.07	1.49	0.620	0.836

Correlation Heatmap



Reliability Analysis – Fixed dimension

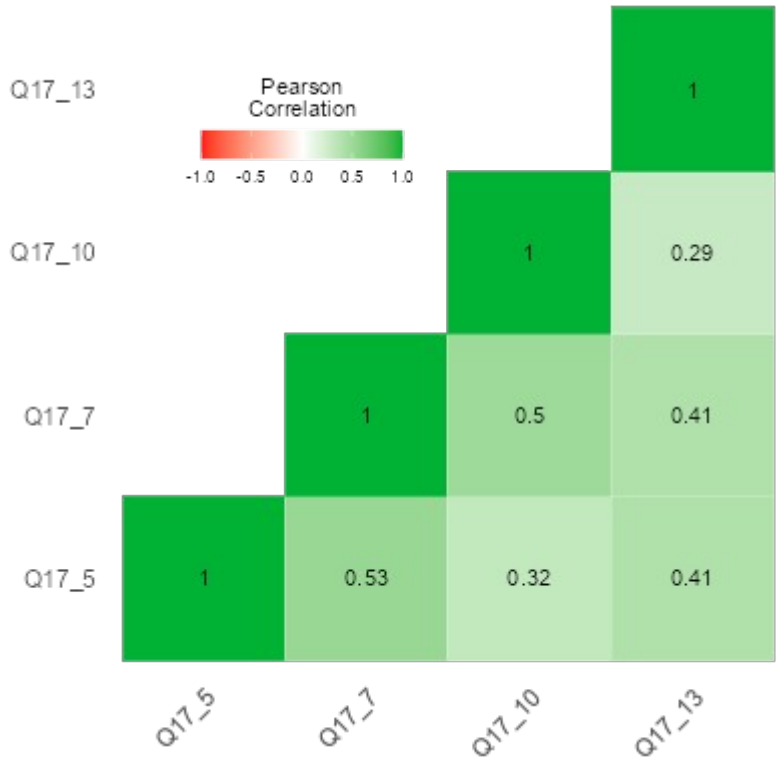
Scale Reliability Statistics

	mean	sd	Cronbach's α
scale	2.33	0.982	0.719

Item Reliability Statistics

	mean	sd	item-rest correlation	if item dropped Cronbach's α
Q17_5	2.65	1.42	0.546	0.633
Q17_7	2.13	1.17	0.624	0.599
Q17_10	1.73	1.03	0.451	0.694
Q17_13	2.82	1.64	0.468	0.702

Correlation Heatmap



Appendix C

Reliability Analysis – Incremental dimension

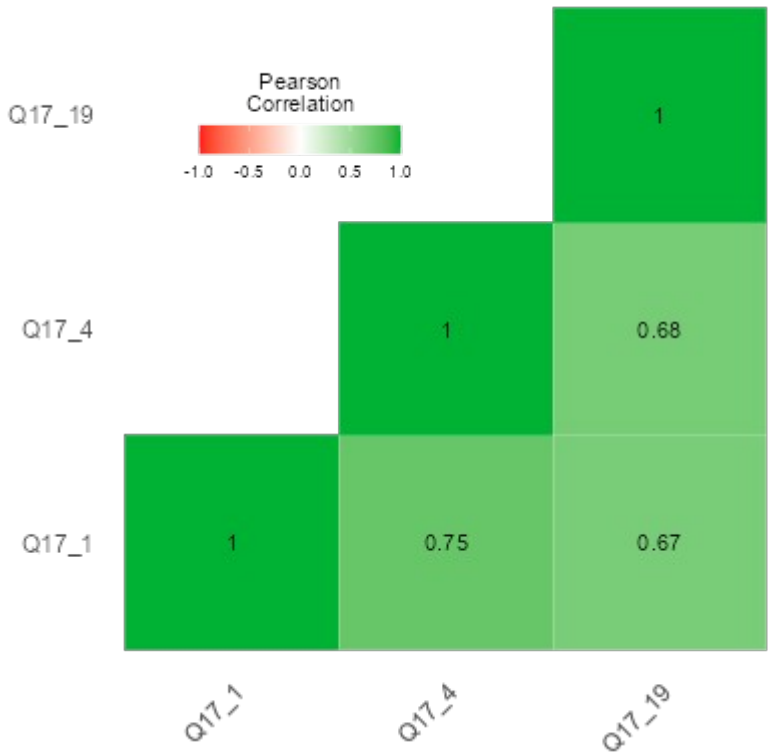
Scale Reliability Statistics

	mean	sd	Cronbach's α
scale	5.07	1.36	0.872

Item Reliability Statistics

	mean	sd	item-rest correlation	if item dropped Cronbach's α
Q17_1	5.03	1.61	0.773	0.806
Q17_4	5.03	1.50	0.781	0.796
Q17_19	5.16	1.44	0.717	0.854

Correlation Heatmap



Reliability Analysis – Fixed dimension

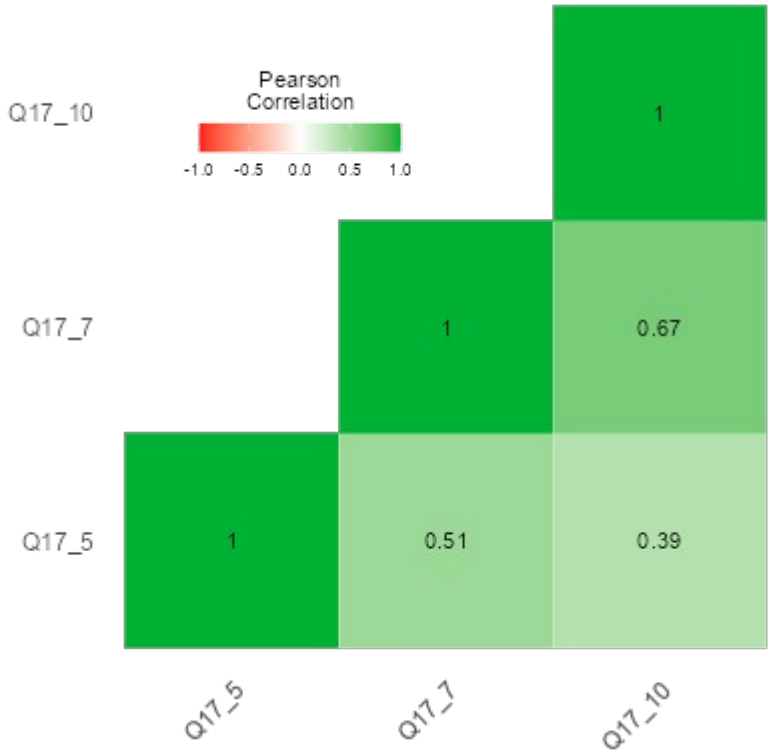
Scale Reliability Statistics

	mean	sd	Cronbach's α
scale	2.12	0.906	0.741

Item Reliability Statistics

	mean	sd	item-rest correlation	if item dropped Cronbach's α
Q17_5	2.59	1.358	0.501	0.792
Q17_7	2.11	1.063	0.682	0.524
Q17_10	1.64	0.875	0.587	0.666

Correlation Heatmap



Appendix D

Factors contribution

Factor	Indicator	Estimation	Standard error	Z	p	Standard estimation
Incremental dimension	Q3_1	1.037	0.0601	17.3	< .001	0.771
	Q3_2	1.066	0.0563	18.9	< .001	0.842
	Q3_6	0.773	0.0585	13.2	< .001	0.633

Factors contribution

Factor	Indicator	Estimation	Standard error	Z	p	Standard estimation
Fixed dimension	Q3_3	0.761	0.0723	10.5	< .001	0.545
	Q3_4	0.816	0.0541	15.1	< .001	0.778
	Q3_5	0.634	0.0488	13.0	< .001	0.659

Reliability Analysis – Incremental dimension

Statistiques de fidélité de l'objet

	Moyenne	Ecart-type	α de Cronbach
échelle	5.38	1.07	0.786

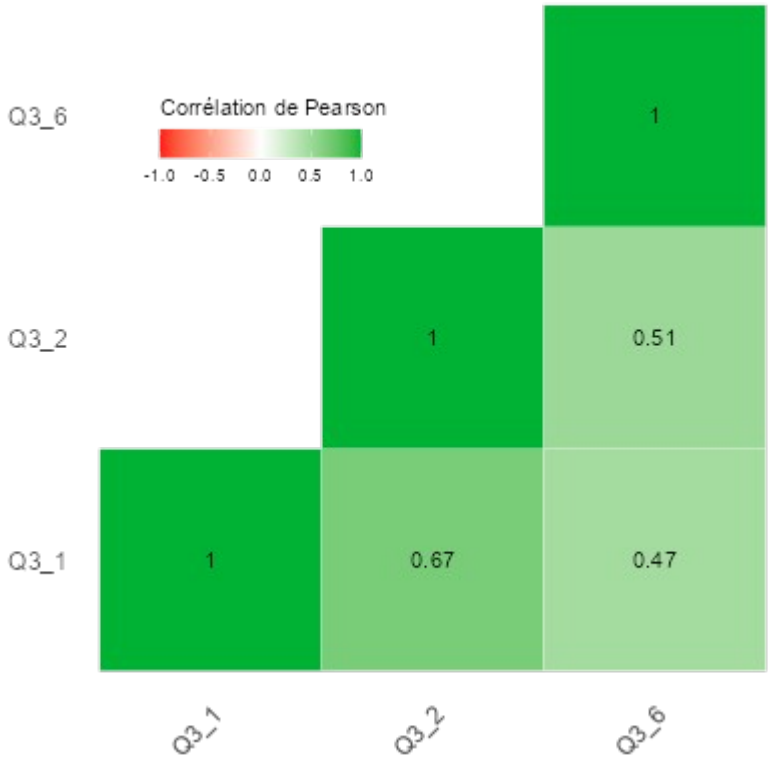
Statistiques de fidélité de l'objet

				If item dropped
	Moyenne	Ecart-type	Corrélation objet-reste	α de Cronbach

Statistiques de fidélité de l'objet

	Moyenne	Ecart-type	α de Cronbach	
Q3_1	5.45	1.35	0.657	0.675
Q3_2	5.43	1.27	0.693	0.635
Q3_6	5.26	1.22	0.534	0.801

Correlation Heatmap



Reliability Analysis – Fixed dimension

Statistiques de fidélité de l'objet

	Moyenne	Ecart-type	α de Cronbach
échelle	2.21	0.891	0.663

Statistiques de fidélité de l'objet

	Moyenne	Ecart-type	Corrélation objet-reste	If item dropped α de Cronbach
Q3_3	2.89	1.398	0.425	0.689
Q3_4	2.06	1.051	0.582	0.439
Q3_5	1.67	0.963	0.468	0.591

Correlation Heatmap