The Association of Thinking Styles with Research Agendas among Academics in the Social Sciences

João M. Santos*[1], Hugo Horta[2], Li-fang Zhang[3]

[1] *Instituto Universitário de Lisboa (ISCTE-IUL), Centro de Investigação e Intervenção Social (CIS-IUL), Lisbon, Portugal*
[2] Social Contexts and Policies of Education, *Faculty of Education, The University of Hong Kong, Pokfulam, Hong Kong SAR, China;*
[3] Teaching Education and Learning Leadership, *Faculty of Education, The University of Hong Kong, Pokfulam, Hong Kong SAR, China.*
** Corresponding author. Tel:* (+351) 914728894*. E-mail address: joao_marques_santos@iscte.pt (João M. Santos).*

Funding

This work was supported by the Research Grants Council (Hong Kong) through the project titled "Characterizing researchers' research agenda-setting: an international perspective across fields of knowledge" (project number: 27608516), and also by doctoral grant PD/BD/113999/2015 from the Fundação para a Ciência e Tecnologia (FCT), co-funded by the European Social Fund (ESF) and the Portuguese Ministry of Science and Education.

Abstract

Research agendas are understudied, despite being key to academic knowledge creation. The literature suggests that the ways that academics determine their research agendas are conditioned by individual, organisational, and environmental characteristics. This study explores the cognitive aspects of academics' research agendas in the social sciences by using a theory on thinking styles as an analytical framework. The results suggest that the research agendas of academics in the social sciences are significantly associated with their thinking styles. These findings aid understanding of how academics set their research agendas. This study also represents an important landmark in research on thinking styles, focusing on academic research work as a potential venue for further studies. The findings are relevant for policymakers, research funding agencies, university administrators, and academics because they have implications for academic research development processes, outcomes, and for research and academic identity socialisation during doctoral studies.

Keywords: Thinking styles; research agendas; higher education research; science policy; academics

摘要

尽管研究计划是创造学术知识的关键，但是它还未得到充分的研究。以往研究表明，学者确定其研究计划的方式取决于个人、组织和环境特征。本研究以思维风格理论为分析框架，从认知层面探讨了社会科学领域学者的研究计划。结果表明，社会科学领域学者的研究计划与他们的思维风格有显著相关。这些发现有助于理解学者如何确定他们的研究计划。本研究也是思维风格研究的一个重要里程碑 –未来的思维风格研究可以将学术研究作为一个进一步研究的对象。这些发现与政策制定者、研究资助机构、大学管理人员和学者有关，因为研究结果对学术研究的发展过程、结果，以及博士学习期间的研究和学术身份社会化均具有现实意义。

1. Introduction

The processes of academic knowledge creation are undeniably complex, and studies focusing on these processes often underline issues of productivity or of macro-level factors related to policies, incentives, and resources (McGrail, Rickard, & Jones, 2006; Stephan, 2012). Individual academics (i.e., people involved in the production of knowledge) are usually analysed in terms of socio-demographic factors, which can include age (Bonaccorsi & Daraio, 2003), gender (Abramo, D'Angelo, & Caprasecca, 2009), number of children (Stack, 2004), education (Shin & Jung, 2014), or factors associated with the academic and research environments (Kim & Kim, 2017; Kwiek & Antonowicz, 2015; Leisyte, Enders, & De Boer, 2008). Although relevant, these analyses have generally been unconcerned with the processes through which academics define their individual research agendas.

The individual nature of social science research agendas, which is indirectly mentioned in the seminal work by Polanyi (2012), needs to be further explored. The few existing studies that have focused on this topic have taken a limited perspective, focusing mainly on the psychological traits of academics in particular disciplines. This approach is somewhat outdated, and is overly concerned with discerning general personality profiles for academics in specific disciplines (Helson & Crutchfield, 1970; Rushton, Murray, & Paunonen, 1983). Moreover, these studies do not account for the changes to the academic profession and work in recent decades, which have been strongly influenced by research assessments, institutional pressures towards performativity, 'publish or perish' dynamics, and demands that research impact is evidenced (Kenny, 2018; Chubb & Watermeyer, 2017; Martin-Sardesai et al., 2017). These changes to the current working environment in academia are bound to influence academics' behaviours and strategies

concerning their research agendas (e.g., Horta & Santos, 2019; Leisyte, 2016; Brew & Lucas, 2009). Considering this context, the present study sought to assess how psychological traits are associated with academics' research agendas. Furthermore, this was done while controlling for several variables that are known to influence research-related outcomes. Such variables included the participant's age, which is known to influence scientific outputs (Bonaccorsi & Daraio, 2003; Kwiek & Antonowicz, 2015); the amount of time passed since conclusion of the doctorate degree, which accounts for career stage (Jung, 2014); and gender, an equally important variable in scientific processes (Stack, 2004). The participant's country of work was also considered a fixed-effect control variable, as policies are not constant across countries, and higher education systems in some countries place greater emphasis on research competition, performativity, and evaluative mechanisms than others (Hicks, 2012; Auranen & Niemiren, 2010). Finally, the field of science in which the academic was educated was taken into account because research training tends to have a long-lasting influence on ways of thinking and often on social scientists' current research (Podlubny, 2005).

It is reasonable to assume that individual research agendas are situated at the behavioural end of the triadic reciprocity (Bandura, 1978). The exogenous factors associated with the environmental sector have been intensively researched in the literature, and previous studies have found that a range of incentives or motivations can stimulate academics to engage in research or expand the boundaries of knowledge (Allison & Stewart, 1974). The endogenous factors, however, have not been fully investigated. Although other psychological models such as vocational personality (Holland, 1997) might also be used to characterise individual research agendas, the construct of thinking styles (Sternberg, 1988; Sternberg & Grigorenko, 1997) seems to

be a more appropriate starting point, because the research tasks being investigated are largely intellectual by nature.

2. Literature Review

2.1. Thinking Styles

The concept of thinking styles was originally proposed by Sternberg in his theory on mental self-government (Sternberg & Grigorenko, 1997). Thinking styles are defined as individuals' preferred ways of using their abilities. Thinking styles are not abilities; rather, they relate to how people use the abilities they possess. As Sternberg (1999) explained, 'An ability refers to how well someone can do something. A style refers to how someone likes to do something'. Thinking styles have been found to be independent of personality or intelligence (Grigorenko, 2009). In addition to the factors of intelligence and personality, these style preferences make unique contributions to human performance (Zhang, 2017).

Sternberg (1988) initially proposed thirteen thinking styles, which Zhang (2002a) classified into three types. Type I styles tend to be more creativity-generating, and they require higher levels of cognitive complexity. These styles are deemed to carry more adaptive (i.e., desirable, positive) value because they are often found to be strongly associated with highly desirable human attributes and outcomes such as higher levels of creative thinking in approaching learning tasks (Davis, Kaufman, & McClure, 2011; Niu, 2007), teaching behaviours characterised by creativity (Dikici, 2014), and higher levels of emotional intelligence (Murphy & Janeke, 2009). Type II thinking styles denote a norm-favouring tendency, and they involve lower levels of cognitive complexity. These styles are considered to be more maladaptive because they have been empirically shown to display undesirable attributes and outcomes—ones that are the exact opposite of those

that have been found to be associated with Type I styles. These undesirable attributes and outcomes include lower levels of creative thinking in approaching learning tasks (Davis et al., 2011; Niu, 2007), teaching behaviours that lack creativity (Dikici, 2014), and lower levels of emotional intelligence (Murphy & Janeke, 2009; Zhang, 2017). Type III styles may manifest the characteristics of either Type I styles or Type II styles, chiefly depending on the stylistic demands of the specific situation or task at hand. Consider the internal style (a preference for working on one's own)—one of the Type III thinking styles. An individual could work on his/her own either creatively (i.e., manifesting the characteristics of Type I styles) or in a conforming manner (i.e., showing the features of Type II styles), depending on the specific tasks he/she is dealing with. Indeed, the literature has suggested that the ways in which Type III styles are related to other attributes and outcomes have been largely inconsistent (see Zhang, 2017 for a comprehensive review). Such inconsistency suggests that the adaptivity of Type III styles is variable.

For three reasons, the present study adopted only 6 of the 13 thinking styles (three Type I styles and three Type II styles). First, because this study is part of a larger research project, it was necessary to keep the length of the questionnaire short enough that the participants' concentration could be retained. Second, the selected Type I and Type II styles were anticipated to be more readily associated with the type of research agendas assessed. Third, similar segmentations of styles have been applied to good effect in other studies (Zhang, 2008).

The three Type I thinking styles assessed in this study included the *legislative* style (a preference for tasks that call for creative strategies), the *liberal* style (a preference for tasks involving ambiguity and novelty), and the *hierarchical* style (a preference for distributing attention among multiple tasks with differing priorities). The three Type II

thinking styles included the *executive* style (a preference for implementing tasks according to set guidelines), the *conservative* style (a preference for completing tasks based on existing procedures and rules), and the *monarchic* style (a preference for tasks that allow complete focus on one thing at a time).

The construct of thinking styles has rarely been applied in studies of academics, and to the best of our knowledge, this construct has never been used to investigate academic research agendas. Two previous studies have considered the relation between thinking styles and academic work: one that focused on the research-teaching nexus (Zhang & Shin, 2015), and the other that considered academics' organisational commitments (Jing & Zhang, 2014). However, thinking styles have been extensively studied at the student level (Zhang, 2010) in terms of how these styles influence academic achievement, cognitive development, personality, and career preparation (Fjell & Walhovd, 2004; Morgan, 1997; Tsagaris, 2006; Zhang, 2002a). These studies have shown that thinking styles influence students' self-efficacy and their career choices. It is also possible that thinking styles have even more profound but as yet unstudied implications for the students' professional lives, especially for those pursuing careers that require creativity (Fan, 2016).

One particularly important aspect of thinking styles is their relation to modes of thought, which represent the ways that information is processed at a cognitive level. Specifically, it has been determined that more complex and creativity-driven thinking styles are positively correlated with holistic modes of thinking (also known as right-brain dominance, which is characterised by processing information in a holistic manner), and that less complicated (and arguably more conservative) styles are correlated with the analytical mode of thinking (also known as left-brain dominance, which is characterised by processing information in a piecemeal fashion) (Zhang, 2002b). This pattern is further

explored in the following sections, as it helps to substantiate some of the expected relations between research agendas and thinking styles.

Because the existing literature on thinking styles is mostly student-centred, this literature was mainly used to propose potential associations between the thinking styles and research agendas of academics. Despite the fact that these studies do not tackle the issue of research agendas *per se*, they demonstrate the potentially impactful nature of thinking styles on the features of academic reasoning involved in setting research agendas. Even though the bulk of the literature focuses on students, it has been shown that thinking styles are equally important for academics, as different styles influence the pedagogical practice of these individuals (Emir, 2013). Thus, we considered it plausible that the effects of thinking styles on teaching could translate into similar effects on academics' research. Beyond this, as far as we are aware, very few previous studies were related to our investigation, which further highlights the need to pursue research in this direction.

2.2. Research Agendas

The research agendas of academics represent a combination of factors associated with social and individual interests and goals that are bound to influence the type of research engagement and topic choice (Santos and Horta, 2018). Research agendas are a personal choice (Polanyi, 2012), even though they are also influenced by the community of professionals in the field, and by other factors such as career considerations and organisational pressures (Kwiek & Antonowicz, 2015). Studies on academics' research agendas have begun to appear only recently, but a framework has been developed that characterises these agendas as having 8 dimensions, which are further divided into 12 sub-dimensions (Horta & Santos, 2016a), as summarised in Table 1.

<INSERT TABLE 1 HERE>

The first dimension in this framework is *scientific ambition*. This dimension represents the desire to acquire a position of authority in a field of knowledge but can also reflect the individual's socialisation into, or a response to, environmental pressures placed on academics to be more research-driven and research-active. This desire can be said to shape the tactics or even the explicit goals of an academic, as success in this endeavour allows access to further resources and greater academic freedom (Bourdieu, 1999). *Scientific ambition* is divided into the following two sub-dimensions: *prestige*, which reflects the explicit desire to obtain a position of research authority, and *drive to publish*, which reflects an interest in publishing, a goal that most academics involved in research processes wish to achieve (Latour & Woolgar, 2013). *Drive to publish* is arguably a requirement for obtaining or maintaining research authority in the field, especially given the current 'publish or perish' paradigm, and considering the well-known effects of cumulative advantage (Allison, Long, & Krauze, 1982; Dobele & Rundle-Theile, 2015; Merton, 1968). Publishing frequently and in high-ranked journals is also becoming a necessity in many countries to meet the conditions set by national research assessments, the results of which influence universities' levels of funding (Kelly & Burrows, 2011), and also to meet career progression criteria, which relies heavily on publication numbers and research profiles (Acker and Webber, 2017). Therefore, both sub-dimensions of scientific ambition are associated with success in today's academia. Since the *legislative* thinking style has been linked to academic success (Albaili, 2007), it was thought that this specific thinking style is likely to influence *scientific ambition* as well, as this dimension is among the most conceptually related to matters of success and achievement.

The next two dimensions, *convergence* and *divergence*, are somewhat intertwined, as they stand in concomitant opposition to one another. *Convergence* reflects a preference for single-discipline agendas. This approach can be considered desirable as a means to acquire research authority in a field, as this goal involves a process that takes a significant amount of time (Bourdieu, 1999). This consideration is reflected in the sub-dimensions of *convergence*, the first of which is *stability*, which indicates a preference for maintaining roots in a single discipline. The second sub-dimension, *mastery*, reflects the desire to obtain expertise in a single topic, rather than being a 'jack of all trades'. This tendency can also be advantageous, as shifting between topics and fields tends to incur hidden transaction costs (Leahey, 2007).

On the opposite side of the spectrum is *divergence*, which reflects a preference for multidisciplinary approaches. This pattern is also desirable, as many of the complex issues in modern science require such a strategy (Martimianakis & Muzzin, 2015; Schut, van Paassen, Leeuwis, & Klerkx, 2014). The *divergence* dimension is sub-divided into *branching out* (which reflects the desire to gain a foothold in differing topics and disciplines), and *multidisciplinarity* (which involves a preference for research agendas that require expertise in multiple subjects to address a multitude of research topics). These two competing dimensions are particularly sensitive to an academic's career stage, as it has been shown that academics tend to focus on singular topics early and late in their careers, and they often diverge into varied research topics and disciplines at the middle stages of their careers (Horlings & Gurney, 2013). In this sense, these dimensions also relate to the positioning of academics relative to sometimes paradoxical sets of environmental incentives that can determine strategic research and career choices. On the one hand, policymakers provide incentives (including research funding) towards fostering greater engagement of academics in interdisciplinary and multidisciplinary research, not

only to meet the increasingly complex challenges that research needs to tackle, but also to increase the potential to produce impactful research (de Raymond, 2018). On the other hand, these incentives tend to be counteracted by university structures that are rooted, and function, within mostly discipline-based organisational structures and mindsets (Leahey et al., 2019). These dimensions arguably have some degree of relation to the modes of thinking involved (Zhang, 2002b). It was therefore expected that Type I thinking styles (more adaptive) would be positive predictors of *divergence* agendas, and that the Type II styles (more normative) would be positive predictors of *convergence* agendas.

The next two dimensions also stand in opposition to each other. *Discovery* and *conservative* reflect, respectively, a preference for cutting-edge research or for work in an established field (Horta & Santos, 2016a). The choice between these preferences is not necessarily based on an explicit preference *per se*, but may reflect more intrinsic risk-tolerance or risk-aversion tendencies, as the outcomes of research in new and emerging fields are less certain (Cummings & Kiesler, 2005). Similar to the dimensions above, the strategic choice or positioning of individual academics towards one or the other dimension may also be influenced by environmental pressures, including those related to funding, considering that academics are generally aware that funding research agencies tend to favour standard (safer) rather than transformative (riskier) research projects (Banal-Estañol et al., 2019). In terms of individual preferences, the *discovery* dimension can be argued to fit the holistic mode of thinking, with the *conservative* dimension more compatible with the analytic mode of thinking. Therefore, it was expected that the Type I thinking styles would positively predict a *discovery* agenda, and the Type II styles would positively predict a *conservative* agenda.

Related to these dimensions is the dimension *tolerance to low funding*, which is the degree of tolerance an academic has for doing research with limited funds. Clearly,

the lack of effective or potential resources may affect an academic's risk assessment when determining a choice of agenda (Ebadi & Schiffauerova, 2015b). This funding-related concern can be compounded by the fact that even if the academic does not require funding to undertake his research endeavours, he or she might be subject to institutional pressure to seek fundable projects anyway (Ion & Castro Ceacero, 2017).

The dimension of *collaboration* is sub-divided into *willingness to collaborate* (reflecting an academic's desire to engage in collaborative works) and *invited to collaborate* (which indicates an academic's willingness to integrate research agendas of others and thus be involved in collaboration). Collaborative research can be considered desirable for three reasons. First, collaborations expand an academic's access to knowledge and resources (Ebadi & Schiffauerova, 2015a). Second, collaborations often serve to boost publications and citations (Horta & Santos, 2016b; Mamun & Rahman, 2015) and to benefit career progression (Hoffman et al., 2014). Collaboration is particularly important when tackling multidisciplinary endeavours, as a single academic is unlikely to possess all of the skills required to tackle the complex problems of modern-day science (Wang, 2016). Third, due to institutional and systemic changes, engaging in research collaborations has become a 'must-do' in academia and is increasingly central in defining the research identity of most academics (Brew et al., 2016). Because collaboration can be done either creatively or in a more conforming manner, no specific hypothesis was made regarding the relationship between the collaboration research agenda and specific types of thinking styles.

The final dimension is *mentor influence*, which measures the degree to which an academic is influenced by his or her mentor (i.e., PhD supervisor). This influence is expected to be at its highest immediately after conclusion of the doctoral degree, and such influence has been shown to have beneficial effects on research output (Pinheiro,

Melkers, & Youtie, 2014). The degree of influence from the mentor is expected to diminish over the academic career (Platow, 2012). Type I styles were expected to be negative predictors of the *mentor influence* dimension.

The above exposition provides the substantiation for some expectations regarding the degrees and directions of influence that these thinking styles have on research agendas. To summarise briefly, Type I styles were expected to influence agendas that require more creative thinking and conceptual complexity. Type II styles were expected to predict agendas that are more related to norm-following and maintenance of the *status quo*. This assessment provided a key conceptual basis for responding to our main research questions: 1) Is there an association between thinking styles and academics' research agendas? and, if so, 2) How are thinking styles and the research agendas of academics connected? Our assessment allowed us to propose four hypotheses:

H1a: Type I thinking styles have a positive impact on the *divergence*, *scientific ambition*, and *discovery* agendas.

H1b: Type II styles have a negative impact on the *divergence*, *scientific ambition*, and *discovery* agendas.

H2a: Type II styles have a positive impact on the *convergence*, *conservative*, and *mentor influence* agendas.

H2b: Type I styles have a negative impact on the *convergence*, *conservative*, and *mentor influence* agendas.

The literature on thinking styles and the possible associations with *tolerance to low funding* and *collaborations* is inconclusive, as both thinking styles can have either a

positive or a negative association with both dimensions. As such, no specific hypothesis was established concerning these potential associations.

3. Method

3.1. Participants

The data for this study were obtained as part of a multi-study data-gathering exercise that took place between May and November of 2015. In the first step, we identified all corresponding authors who published in higher education journals indexed in Scopus between 2004 and 2014, which amounted to 6,086 potential participants distributed over 40 journals that matched our search criteria. The field of higher education studies is an appropriate field to examine for assessing the research agendas of academics engaged in the social sciences, because higher education journals receive contributions from academics with backgrounds in sociology, economics, psychology, political science, geography, management, history, education, linguistics, and anthropology. These disciplines apply a variety of theories and methodologies that encompass most (if not all) of the theories and methodologies used in the social sciences (Brennan & Teichler, 2008). Subsequently, invitations were sent to these corresponding authors to participate in an online survey. Those authors who accepted the invitation to participate were required to read and agree to an informed consent form before proceeding to the survey itself.

The survey contained questions of a demographic nature, and it used two validated instruments. The first instrument was the Multi-Dimensional Research Agendas Inventory (MDRAI), which includes 35 items. The MDRAI evaluates the characteristics of the participants' research agendas, and classifies them into 8 dimensions, which are further divided into 12 sub-dimensions (Horta & Santos, 2016a). The second instrument was the Thinking Styles Inventory–Revision II (TSI-R2) (Fan, 2016; Yuan, Zhang, & Fu,

2017), which takes an inventory to evaluate the thinking styles initially defined by Sternberg (Sternberg, 1988). For this exercise, we used an abridged version of the instrument, which included only those items pertaining to the aforementioned six styles of thinking (Types I and II; see Appendix A for sample items). We felt that the complete version would make the online survey too long, and thus reduce the rate of completion. This abridged version was previously validated by Zhang et al. (2019) for a population of PhD students, but considering that our population constituted academics, we conducted a confirmatory factor analysis to determine the factorial validity for this abridged version, as well as its reliability for academics. The results of this exercise can be found in Appendix B and demonstrate that the abridged version of TSI-R2 exhibits good psychometric properties in terms of both validity and reliability.

Of the 6,086 researchers who were invited to participate, a total of 1,348 agreed to complete the survey (response rate of 22.16%), but 416 of them were excluded from the analysis, as they failed to complete the MDRAI block. A further 403 participants were excluded for failing to complete the TSI-R2 section. The majority of drop-outs occurred at the second page of the survey, that is, at the beginning of the MDRAI block (and thus they never reached the TSI-R2 block), while some participants dropped out immediately at the demographics section, which followed the informed consent form. A possible reason for this could be that the participants, despite being informed of the length of the survey, experienced survey fatigue upon realising that the survey was multiple pages long and they therefore did not go beyond the initial sections of the MDRAI. The final sample size was 529 eligible participants. Of these, 281 (53.1%) were female, and the remaining 248 (46.9%) were male. Their ages ranged from 29 to 83 years (M = 51.36, SD = 10.82). In terms of geographical distribution, the most highly represented countries were the United States (N = 144; 27.2%), Australia (N = 83; 15.7%) and the United Kingdom (N

= 69; 13.0%). Considering the number of dropouts, we conducted an analysis to ascertain whether or not the participants who dropped out had different characteristics to those who completed the survey. Using a t-test and a chi-square test, we determined that both the final and drop-out groups of participants had no differences in terms of age, $t(1182,390) = 0.792$, $p = 0.429$, and gender, $\chi^2(1) = 0.134$, $p = 0.714$), thus mitigating the possibility of non-response bias in our sample.

3.2. Variables

The first set of variables used in this study was the 12 sub-dimensions assessed by the MDRAI (Horta & Santos, 2016a), as described above. The second set of variables included the Type I and Type II styles assessed by the TSI-R2 (Fan, 2016; Yuan et al., 2017), also as described above. Descriptive statistics for these scales are reported in Table 2.

<INSERT TABLE 2 HERE>

The remaining variables were used as controls. *Age* refers to the age of the academics, which is a known predictor of scientific outputs, as noted above (Bonaccorsi & Daraio, 2003). Age also serves as a proxy for the effects of career stage (Jung, 2014). *Gender* is a binary variable, indicating whether the participant is male or female, which is also known to have profound impacts on scientific initiatives (Abramo et al., 2009; Stack, 2004); *Country* is a factor variable, indicating the country in which the academic is currently working, which controls for local differences in terms of the maturity of each country's higher education systems, local policies, and other regional aspects (Auranen & Niemiren, 2010). *Time since PhD* is a continuous variable, accounting for the years

that have passed since each academic concluded his or her PhD studies. This variable controls for the effects of research experience on output (Jung, 2014). Finally, *field of science* is a factor that indicates the participants' field of expertise—defined as the field in which they concluded their PhD degree—based on the OECD's aggregation scheme (OECD, 2002). Including this variable helps to account for inter-field differences that may derive from the field of the academics doctoral studies (Podlubny, 2005) as some academics doing research in the field of higher education and in the social sciences in general are known to have been initially trained in disciplines outside the social sciences (Tight, 2013).

3.3. Procedure

As the critical variables involved were of a continuous nature, a general linear model (GLM) was applied for this exercise. The specific variety of GLM used is commonly known as a MANCOVA, because it uses multiple dependent variables (the MDRAI scores), and both fixed factors and covariates are used as predictors (Hair, Black, Babin, Anderson, & Tatham, 2007). An initial model with only the control variables was specified. Following this, we estimated the model with the full set of variables, with the goal of determining the relative increase in model fit.

4. Results

The GLM model and its results are split across two tables (3 and 4) for readability, but all analyses were conducted concomitantly. The *country* variable was used as a control variable, but is not displayed in the tables, as it was not the focus of the analysis. Also, adding the numerous categories (i.e., countries) of this variable would significantly

expand the tables' size without adding relevant content. The *country* variable was found to have a significant effect only on the multivariate test ($F(240, 5928) = 1.182$; Pillai's $T = 0.548$; $p < 0.05$). At a univariate level, this variable's only direct effect was on *tolerance to low funding* ($F(20, 494) = 32.188$, $p < 0.05$), which highlighted the differences in availability of research funding between countries. Regarding the other control variables, at a multivariate level the *field of science* (FOS) was found to be significant ($F(60, 2435) = 1.366$, Pillai's $T = 0.163$, $p < 0.05$). Other significant variables were *age* ($F(12, 483) = 3.483$, Pillai's $T = 0.080$, $p < 0.01$) and *time since PhD,* ($F(12, 483) = 3.800$, Pillai's $T = 0.086$, $p < 0.01$). *Gender* was not found to be significant at the multivariate level ($F(12, 483) = 1.525$, Pillais' $T = 0.036$, $p = 0.111$).

All of the thinking style variables were highly significant at the multivariate level ($p < 0.001$) except for the *executive* style, which was found to have no multivariate significance $F(12, 483) = 1.303$, Pillai's $T = 0.031$, $p = 0.213$). The analysis given below focuses exclusively on the thinking style variables, as these are the focus of this study. The control variables are of interest in themselves, but they fall outside the scope of this analysis, and thus are mentioned only briefly.

<INSERT TABLE 3 HERE>

We begin by evaluating Hypothesis 1a, which states that Type I styles (*legislative, hierarchical,* and *liberal*) would have a positive influence on the *divergence, scientific ambition,* and *discovery* agendas. First, we can observe that the *legislative* style (preference for tasks that call for creative strategies) is a positive and significant predictor of *prestige* ($b = 0.308$, $p < 0.001$) and *drive to publish* ($b = 0.196$, $p < 0.01$), both of which are sub-dimensions of the *scientific ambition* dimension. As the *legislative* thinking style

is related to creativity and autonomy, which are critical predictors of research productivity (see Enders, De Boer & Weyer, 2013), it can be argued that this style also leads to enhanced ambition to pursue scientific endeavours. *Legislative*-oriented academics have a preference for choosing their own topics, and as they stress autonomy and creativity above anything else, it is not surprising that the *legislative* style is found to be a positive and significant predictor of *discovery* ($b = 0.196$, $p < 0.01$).

The *liberal* style (a preference for tasks involving ambiguity and novelty) is shown to be a positive predictor of *multidisciplinarity* ($b = 0.227$, $p < 0.001$) and *branching out* ($b = 0.205$, $p < 0.001$), both of which are components of the *divergence* dimension. This style is also a significant and positive predictor of *discovery* ($b = 0.224$, $p < 0.001$), as *liberal*-oriented individuals are commonly attracted to agendas in which the effective *discovery* of truly novel knowledge is possible. As such, the results of the surveys largely confirm Hypothesis 1a.

Next, we evaluate Hypothesis 1b, which posits that Type II styles have a negative impact on the *divergence*, *scientific ambition*, and *discovery* agendas. The *monarchic* style (a preference for tasks that allow complete focus on one thing at a time) has a pattern of effects that to a large extent are the exact contrary of those found for the *liberal* style. The *monarchic* style is a negative predictor of the *divergence* sub-dimensions of *multidisciplinarity* ($b = -0.137$, $p < 0.01$) and *branching out* ($b = -0.102$, $p < 0.01$). The other two Type II styles have no significant effect. This set of results partially confirms Hypothesis 1b, which is only confirmed for the effects of the *monarchic* style on the *divergence* sub-dimensions.

Table 4 reports the next set of dependent variables, which associate the various thinking styles and research agendas in relation to Hypotheses 2a and 2b.

<INSERT TABLE 4 HERE>

We proceed with our analysis by testing Hypothesis 2a, which states that Type II styles will have a positive impact on the *convergence*, *conservative*, and *mentor influence* dimensions of the research agendas. We begin by observing that the *conservative* style (a preference for completing tasks based on existing procedures and rules) is a positive predictor of the *convergence* sub-dimensions, namely *stability* ($b = 0.150$, $p < 0.01$) and *mastery* ($b = 0.146$, $p < 0.01$). The *conservative* style reflects a preference for *status quo* research, and thus it is understandable that this style translates into a preference for agendas focused on fields where the individual academic already has a foothold. This style is also a significant and positive predictor of *conservative* agendas ($b = 0.255$, $p < 0.001$), a finding which is self-explanatory due to the nature of both variables.

The *monarchic* style is found to be a positive predictor of the *convergence* sub-dimensions, namely *stability* ($b = 0.099$, $p < 0.001$) and *mastery* ($b = 0.128$, $p < 0.001$). The *monarchic* style is related to a preference for single-tasking (in opposition to multi-tasking). Thus, it is evident that juggling a variety of disciplinary fields can be anathema to a *monarchic*-oriented individual, who manifests preference for single-discipline endeavours. Finally, the *monarchic* style is a positive and significant predictor of *mentor influence* ($b = 0.103$, $p < 0.01$). Academics who score high on *mentor influence* tend to be more focused on single tasks, which are likely to be determined or heavily influenced by their mentors. These findings largely confirm Hypothesis 2a, as only the *executive* style (a preference for implementing tasks according to set guidelines) is found to have no significant effect on the expected variables.

Finally, we evaluate Hypothesis 2b, which proposes that Type I styles have a negative impact on the *convergence*, *conservative*, and *mentor influence* agendas. We begin by analysing the *legislative* style. This style is found to be a negative and significant

predictor of *mentor influence* (b = -0.205, p < 0.01), which is expected, as this style is linked to a preference for autonomous activities, which are curtailed by operating largely under a mentor's instructions. Additionally, the *legislative* style is a negative and significant predictor of *conservative* agendas (b = -0.216, p < 0.01). This finding is expected, as the *legislative* style is also linked with creativity, and thus it stands to reason that *legislative*-oriented academics would prefer to work on agendas that require more creative thinking rather than agendas that aim to reinforce established paradigms. The *liberal* style is a negative predictor of *convergence*, which includes the sub-dimensions of *stability* (b = -0.103, p < 0.01) and *mastery* (b = -0.109, p < 0.01). This set of findings resonates with past findings, which have positioned *convergence* and *divergence* as competing dimensions (Santos & Horta, 2018). However, the hierarchical style has no statistically significant associations with the *convergence*, *conservative*, and *mentor influence* dimensions of the research agendas. In summary, Hypothesis 2b is partly supported, as the *legislative* and *liberal* styles behave as predicted, but the *hierarchical* style evidences no significant effects.

With a more exploratory focus, we find that the *legislative* thinking style is positively related with *tolerance to low funding* (b = 0.171, p < 0.05), but the *executive* style has a negative relationship to this dimension (b = -0.139, p < 0.05). These findings are somewhat expected, in that starting a research agenda with low funding requires some degree of creative strategising to do things with little or no resources, and research funding typically comes with conditions that establish the rules of action. Without funding, there is no strict sense of guidelines to follow, and unfunded initiatives assume a more randomised dynamic.

The *liberal* style is also a significant and positive predictor of both *collaboration* dimensions: *invited to collaborate* (b = 0.140, p < 0.05) and *willingness to collaborate* (*b*

= 0.147, $p < 0.01$). It can be argued that *liberal*-oriented academics, which have a preference for tasks involving ambiguity and novelty, are more receptive to outside ideas, and they are thus more willing and available to engage in collaborative work.

The *hierarchical* style is a significant and positive predictor of the *invited to collaborate* ($b = 0.179$, $p < 0.01$) and *willingness to collaborate* ($b = 0.222$, $p < 0.001$) dimensions. This style relates to a preference for triaging various tasks according to their relative importance. It can be argued that this tendency can lead to a preference for collaborative endeavours, as collaboration allows an academic team to make a more effective allocation of resources by assigning specific tasks to various academics. At the same time, academics who lean toward this thinking style feel comfortable working in teams, as they are able to allocate priorities to different tasks and minimise the potential transaction costs of research collaborations.

Additionally, the *monarchic* style is a significant and negative predictor of both the *invited to collaborate* ($b = -0.157$, $p < 0.001$) and the *willingness to collaborate* ($b = -0.191$, $p < 0.001$) sub-dimensions of *collaboration*. This effect can be interpreted as the opposite of the *hierarchical* style's effect (preference for distributing attention among multiple tasks with differing priorities). As the *monarchic* style is more oriented toward focusing on single tasks, it finds collaborations less useful, and it is more likely to treat tasks as indivisible.

5. Conclusion

This study identifies the associations between individual academics' thinking styles and their research agendas in the social sciences. Our results show that research agendas are indeed associated with the academics' thinking styles. Our findings suggest that Type I styles are particularly associated with research agendas characterised as scientifically

ambitious, multidisciplinary, collaborative, and riskier, as these styles of thinking are associated with values that may be conducive to a more disruptive advancement of knowledge (Zhang, 2000) and to holistic modes of thinking (Zhang, 2002c). Type II styles, in contrast, are more associated with research agendas characterised by disciplinary norms and research on well-established topics, and which are therefore safer in terms of reaching findings acceptable by the scholarly community. This set of findings on the dual nature of thinking styles resonates with past findings that have suggested the existence of two major archetypes of academics based on their research agendas, with their characteristics being quite similar to those identified in this study (Santos & Horta, 2018). That previous study found that both research agenda archetypes played key roles in both stabilising and in creating new knowledge. Because thinking styles are attuned respectively with each archetype, our study suggests that thinking styles play a decisive role in this process as well.

Overall, these findings have several implications for both research and practice in the social sciences. First, this study expands the literature on thinking styles, which in the past was mainly focused at the student level, and it does so by demonstrating that thinking styles can also have significant relevance for academics and their work. In this context, environmental conditions given to academics to develop their work are important. Governments, research funding agencies and universities should be aware of this and support academics to pursue research agendas that are most in consonance with their thinking styles (and in so doing, also nurture academics' research autonomy). Studies have demonstrated that organisations nurturing the research autonomy of academics not only promote the development of innovative and transformative findings, but also assure a stable conceptual and methodological development of fields of knowledge and

disciplines by means of a mix of incremental and disruptive knowledge advancements (Santos and Horta, 2018; Hollingsworth and Hollingsworth, 2000).

However, current performativity, indicators craze, research assessments, and research projects' limited duration and expected deliverables, may be driving for publications *en masse* with short-term focuses, rather than fomenting research programmes that are longer-term, stable, and focused on innovative and transformative research (Horta and Santos, 2019; Young, 2015). This means that some academics with specific thinking styles are likely to be at a disadvantage in the current academic environment, and also that some research agendas associated with these thinking styles may not reach the potential that they could possibly achieve, with potential detrimental consequences for knowledge advancement. In a world characterised by a multitude of complex challenges, a diverse body of academics involved in research may achieve better results than one that is more homogeneous, and in this the role of organisational policies and incentives is key (Saá-Pérez et al., 2017).

Second, it is relevant to consider that thinking styles come to fruition during a long development process partly informed by formal education throughout the years, and in this process, training that emphasises and stimulates the further development of desirable thinking styles may be critical (Goodwin & Miller, 2013). As thinking styles are changeable and can be learned, they are influenced by the processes of socialisation during formal education, and in this context, the socialisation during doctoral studies may have a very important role, for it is the socialisation during the PhD that informs the research and field identity of academics, influencing their thinking and behaviours throughout their careers (Brew et al., 2016). Considering the association of thinking styles with research agendas and the research environment that academics from the social sciences may find when starting their research careers in the future may be important in

the design of doctoral education and in informing best practices on supervisory orientation.

6. References

Abramo, G., D'Angelo, C. A., & Caprasecca, A. (2009). Gender differences in research productivity: A bibliometric analysis of the Italian academic system. *Scientometrics 79*(3): 517–539. https://doi.org/10.1007/s11192-007-2046-8

Acker, S. and Webber, M. (2017). Made to measure: early career academics in the Canadian university workplace. *Higher Education Research and Development 36*(3): 541-554.

Albaili, M. A. (2007). *Differences in Thinking Styles among Low-; Average-; and High-Achieving College Students*. 5–10. Linköping University Electronic Press.

Allison, P. D., Long, J. S., & Krauze, T. K. (1982). Cumulative advantage and inequality in science. *American Sociological Review 47:* 615–625.

Allison, P. D., & Stewart, J. A. (1974). Productivity differences among scientists: Evidence for accumulative advantage. *American Sociological Review 39*(4): 596–606.

Auranen, O., & Niemiren, M. (2010). University research funding and publication performance - an international comparison. *Research Policy 39*(6): 822-834.

Banal-Estañol, A., Macho-Stadler, I., & Pérez-Castrillo, D. (2019). Evaluation in research funding agencies: are structurally diverse teams biased against? *Research Policy 48*(7): 1823-1840.

Bandura, A. (1978). The self system in reciprocal determinism. *American Psychologist 33*(4): 344.

Becher, T., & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines*. McGraw-Hill International.

Bonaccorsi, A., & Daraio, C. (2003). Age effects in scientific productivity. *Scientometrics 58*(1): 49–90.

Bourdieu, P. (1999). The specificity of the scientific field. *The Science Studies Reader.* Ed. Biagioli M. New York: Routledge, 31–50.

Brew, A., and L. Lucas. (2009). *Academic Research and Researchers*. Maidenhead: Open University Press.

Brew, A., Boud, D., Namgung, S.U., Lucas, L., & Crawford, K. (2016). Research productivity and academics' conceptions of research. *Higher Education 71*(5): 681-697.

Chubb, J., and Watermeyer, R. (2017). Artifice or integrity in the marketization of research impact? Investigating the moral economy of (pathways to) impact statements within research funding proposals in the UK and Australia. *Studies in Higher Education 42*(12): 2360-2372.

Cummings, J. N., & Kiesler, S. (2005). Collaborative research across disciplinary and organizational boundaries. *Social Studies of Science 35*(5): 703–722.

Davis, C. D., Kaufman, J. C., & McClure, F. H. (2011). Non-Cognitive Constructs and Self-Reported Creativity by Domain. *The Journal of Creative Behavior 45*(3): 188–202.

de Raymond, A.B. (2018). 'Aligning activities': coordination, boundary activities, and agenda setting in interdisciplinary research. *Science and Public Policy 45*(5): 621-633.

Dikici, A. (2014). Relationships between thinking styles and behaviors fostering creativity: An exploratory study for the mediating role of certain demographic traits. *Educational Sciences: Theory and Practice*, *14*(1): 179–201.

Dobele, A. R., & Rundle-Theile, S. (2015). Progression through academic ranks: A Longitudinal Examination of Internal Promotion Drivers. *Higher Education Quarterly 69*(4): 410–429.

Ebadi, A., & Schiffauerova, A. (2015a). How to become an important player in scientific collaboration networks? *Journal of Informetrics 9*(4): 809–825.

Ebadi, A., & Schiffauerova, A. (2015b). How to receive more funding for your research? Get connected to the right people! *PloS One 10*(7): e0133061.

Emir, S. (2013). Contributions of teachers' thinking styles to critical thinking dispositions (Istanbul-Fatih sample). *Educational Sciences: Theory and Practice 13*(1): 337–347.

Fan, J. (2016). The role of thinking styles in career decision-making self-efficacy among university students. *Thinking Skills and Creativity 20*: 63–73.

Fjell, A. M., & Walhovd, K. B. (2004). Thinking styles in relation to personality traits: An investigation of the Thinking Styles Inventory and NEO-PI-R. *Scandinavian Journal of Psychology 45*(4): 293–300.

Goodwin B. & Miller, K. (2013). Research says/Evidence on flipped classrooms is still coming in. *Technology Rich Learning 70*(6): 78-80

Grigorenko, E. L. (2009). What is so stylish about styles? Comments on the genetic etiology of intellectual styles. *Perspectives on the Nature of Intellectual Styles*, 233–251.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2007). *Multivariate data analysis*. Bookman.

Helson, R., & Crutchfield, R. S. (1970). Mathematicians: The creative researcher and the average PhD. *Journal of Consulting and Clinical Psychology 34*(2): 250.

Hicks, D. (2012) Performance-based university research funding systems. *Research Policy 41*(2): 251-261.

Hoffman, D. M., Blasi, B., Ćulum, B., Dragšić, Ž., Ewen, A., Horta, H., … Rios-Aguilar, C. (2014). The methodological illumination of a blind spot: Information and communication technology and international research team dynamics in a higher education research program. *Higher Education 67*(4): 473–495.

Hollingsworth, R. & Hollingsworth, E.J. (2000). Major discoveries and biomedical research organizations: perspectives on interdisciplinarity, nurturing leadership, and integrated structure and cultures. In Weingart, P. & Stehr, N. (Eds.) *Practising interdisciplinarity*. Toronto: Toronto University Press.

Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments.* Psychological Assessment Resources.

Horlings, E., & Gurney, T. (2013). Search strategies along the academic lifecycle. *Scientometrics 94*(3): 1137–1160. https://doi.org/10.1007/s11192-012-0789-3

Horta, H. & Santos, J.M. (2019). Organisational factors and academic research agendas: an analysis of academics in the social sciences. *Studies in Higher Education*, DOI: 10.1080/03075079.2019.1612351

Horta, H., & Santos, J. M. (2016a). An instrument to measure individuals' research agenda setting: the multi-dimensional research agendas inventory. *Scientometrics 108*(3): 1243–1265. https://doi.org/10.1007/s11192-016-2012-4

Horta, H., & Santos, J. M. (2016b). The impact of publishing during PhD studies on career research publication, visibility, and collaborations. *Research in Higher Education*, 1–23. https://doi.org/10.1007/s11162-015-9380-0

Ion, G., & Castro Ceacero, D. (2017). Transitions in the manifestations of the research culture of Spanish universities. *Higher Education Research & Development, 36*(2): 311–324.

Jing, L., & Zhang, D. (2014). Does organizational commitment help to promote university faculty's performance and effectiveness? *The Asia-Pacific Education Researcher 23*(2): 201–212.

Jung, J. (2014). Research productivity by career stage among Korean academics. *Tertiary Education and Management 20*(2): 85–105.

Kelly, A., & Burrows, R. (2011) Measuring the value of sociology? Some notes on performative metricization in the contemporary academy. *Sociological Review 59*(SUPPL. 2): 130-150.

Kenny, J. (2018). Re-empowering academics in a corporate culture: an exploration of workload and performativity in a university. *Higher Education 75*(2): 365-380.

Kim, K., & Kim, J.-K. (2017). Inequality in the scientific community: the effects of cumulative advantage among social scientists and humanities scholars in Korea. *Higher Education 73*(1): 61–77.

Kwiek, M., & Antonowicz, D. (2015). The changing paths in academic careers in European universities: Minor steps and major milestones. In *Academic work and careers in Europe: Trends, challenges, perspectives* (pp. 41–68). Springer.

Latour, B., & Woolgar, S. (2013). *Laboratory life: The construction of scientific facts*. Princeton University Press.

Leahey, E. (2007). Not by productivity alone: How visibility and specialization contribute to academic earnings. *American Sociological Review 72*(4): 533–561.

Leahey, E., Barringer, S.N., & Ring-Ramirez, M. (2019). Universities' structural commitment to interdisciplinary research. *Scientometrics 118*(3): 891-919.

Leisyte, L. (2016). New public management and research productivity – a precarious state of affairs of academic work in the Netherlands. *Studies in Higher Education 41* (5): 828–846.

Leisyte, L., Enders, J., & De Boer, H. (2008). The freedom to set research agendas—illusion and reality of the research units in the Dutch universities. *Higher Education Policy 21*(3): 377–391.

Mamun, S. A. K., & Rahman, M. M. (2015). Is there any feedback effect between academic research publication and research collaboration? Evidence from an Australian university. *Scientometrics 105*(3): 2179–2196.

Martimianakis, M. A., & Muzzin, L. (2015). Discourses of interdisciplinarity and the shifting topography of academic work: generational perspectives on facilitating and resisting neoliberalism. *Studies in Higher Education 40*(8): 1454–1470.

Martin-Sardesai, A., Irvine, H., Tooley, S., & Guthrie, J. (2017). Government research evaluations and academic freedom: a UK and Australian comparison. *Higher Education Research and Development 36*(2): 372-385.

McGrail, M. R., Rickard, C. M., & Jones, R. (2006). Publish or perish: A systematic review of interventions to increase academic publication rates. *Higher Education Research & Development 25*(1): 19–35.

Merton, R. K. (1968). The Matthew effect in science. *Science 159*(3810): 56–63.

Morgan, H. (1997). *Cognitive styles and classroom learning*. Praeger Publishers.

Murphy, A., & Janeke, H. (2009). The relationship between thinking styles and emotional intelligence: an exploratory study. *South African Journal of Psychology 39*(3): 357–375.

Niu, W. (2007). Individual and environmental influences on Chinese student creativity. *The Journal of Creative Behavior 41*(3): 151–175.

OECD. (2002). *Frascati Manual - Proposed standard practice for surveys on research and experimental development*. Retrieved from http://dx.doi.org/10.1787/9789264239012-en

Pinheiro, D., Melkers, J., & Youtie, J. (2014). Learning to play the game: Student publishing as an indicator of future scholarly success. *Technological Forecasting and Social Change 81*: 56–66. https://doi.org/10.1016/j.techfore.2012.09.008

Platow, M. J. (2012). PhD experience and subsequent outcomes: a look at self-perceptions of acquired graduate attributes and supervisor support. *Studies in Higher Education 37*(1): 103–118.

Podlubny, I. (2005). Comparison of scientific impact expressed by the number of citations in different fields of science. *Scientometrics 64*(1): 95–99.

Polanyi, M. (2012). *Personal knowledge: Towards a post-critical philosophy*. University of Chicago Press.

Rushton, J. P., Murray, H. G., & Paunonen, S. V. (1983). Personality, research creativity, and teaching effectiveness in university professors. *Scientometrics 5*(2): 93–116.

Saá-Pérez, P.D., Díaz-Díaz, N.L., Aguiar-Díaz, I., & Ballesteros-Rodríguez (2017) How diversity contributes to academic research teams performance. *R&D Management 47*(2): 165-179.

Santos, J. M., & Horta, H. (2018). The research agenda setting of higher education researchers. *Higher Education 76*(4): 649–668. https://doi.org/10.1007/s10734-018-0230-9

Schut, M., van Paassen, A., Leeuwis, C., & Klerkx, L. (2014). Towards dynamic research configurations: A framework for reflection on the contribution of

research to policy and innovation processes. *Science and Public Policy 41*(2): 207–218.

Shin, J. C., & Jung, J. (2014). Academics' job satisfaction and job stress across countries in the changing academic environments. *Higher Education 67*(5): 603–620.

Stack, S. (2004). Gender, children and research productivity. *Research in Higher Education 45*(8): 891–920.

Stephan, P. (2012). *How economics shapes science* (Vol. 1). Harvard University Press Cambridge, MA.

Sternberg, R. J. (1988). Mental self-government: A theory of intellectual styles and their development. *Human Development 31*(4): 197–224.

Sternberg, R. J. (1999). *Thinking styles*. Cambridge University Press.

Sternberg, R. J., & Grigorenko, E. L. (1997). Are cognitive styles still in style? *American Psychologist 52*(7): 700.

Tight, M. (2013). Discipline and methodology in higher education research. *Higher Education Research & Development 32*(1): 136–151.

Tsagaris, G. S. (2006). *The relationships between thinking style preferences, cultural orientations and academic achievement*. ProQuest.

Wang, J. (2016). Knowledge creation in collaboration networks: Effects of tie configuration. *Research Policy 45*(1): 68–80.

Young, M. (2015). Competitive funding, citation regimes, and the diminishment of breakthrough research. *Higher Education 69*: 421–434.

Yuan, W., Zhang, L.-F., & Fu, M. (2017). Thinking styles and academic stress coping among Chinese secondary school students. *Educational Psychology 37*(8): 1015–1025.

Zhang, L. F. (2000). Relationship between thinking styles inventory and study process questionnaire. *Personality and Individual Differences 29*(5): 841–856.

Zhang, L.-F. (2002a). Thinking styles and cognitive development. *The Journal of Genetic Psychology 163*(2): 179–195.

Zhang, L.-F. (2002b). Thinking styles and modes of thinking: Implications for education and research. *The Journal of Psychology 136*(3): 245–261.

Zhang, L.-F. (2002c). Thinking styles: Their relationships with modes of thinking and academic performance. *Educational Psychology 22*(3): 331–348.

Zhang, L.-F. (2008). Teachers' styles of thinking: An exploratory study. *The Journal of Psychology 142*(1): 37–55.

Zhang, L.-F. (2010). Further investigating thinking styles and psychosocial development in the Chinese higher education context. *Learning and Individual Differences 20*(6): 593–603. https://doi.org/10.1016/j.lindif.2010.04.011

Zhang, L.-F. (2017). *The Value of Intellectual Styles*. https://doi.org/10.1017/9781316014561

Zhang, L.F., Horta, H., Jung, J., Chen, G., & Postiglione, G.A. (2019) The role of thinking styles in program satisfaction and perceived intellectual competence among STEM doctoral students. *Journal of Educational Psychology 111*(4): 573-589.

Zhang, L.-F., & Shin, J.-C. (2015). The research–teaching nexus among academics from 15 institutions in Beijing, Mainland China. *Higher Education 70*(3): 375–394.

Table 1: Dimensions and sub-dimensions of the Multi-Dimensional Research Agendas Inventory

Dimension	*Sub-dimension*	*Definition*
Scientific ambition	Prestige	The desire to acquire recognition and academic prestige in a given field (Brew et al., 2016; Bourdieu, 1999).
	Drive to publish	Being motivated and driven towards the publication of research results (Horodnic and Zait, 2015; Allison et al., 1982).
Convergence	Mastery	Specializing into a single field or topic (Leahey, 2007).
	Stability	Preference for focusing on a single field or topic and avoiding shifts of research focus (Bourdieu, 1999).
Divergence	Branching out	Desire to expand into other fields of study or topics (Geschwind & Melin, 2016).
	Multidisciplinarity	Preference for working in multidisciplinary research ventures (Horlings & Gurney, 2013).
Discovery	Discovery	Preference for working in fields or topics with the potential to lead to discovery (Popper, 2005; Merton, 1957).
Conservative	Conservative	Preference for working in mature and more stable fields or topics (Rzhetsky, Foster, Foster & Evants, 2015; Klavans, Boyack & Sorensen, 2013).
Tolerance to low funding	Tolerance to low funding	Willingness to develop research on fields or topics even if research funding for them is scarce (Ebady & Schiffauerova, 2015b).
Collaboration	Willingness to collaborate	Desire to engage in collaborative research endeavors (Uddin, Hossain, Rasmussen, 2013; Katz & Martin, 1997).
	Invited to collaborate	Invited to participate in collaborative research ventures (Uddin, Hossain, Rasmussen, 2013; Katz & Martin, 1997).
Mentor influence	Mentor influence	The PhD mentor holds a degree of influence over his or her research plans (Pinheiro, Melkers & Youtie, 2013).

Notes: Adapted from Santos and Horta (2018)

Table 2: Descriptive statistics for the MDRAI and TSI-R2

Variables	*Mean*	*Std. Dev.*	*Min.*	*Max.*	*Sk.*	*Ku.*
Discovery	4.493	1.133	1.00	7.00	0.165	-0.167
Conservative	2.986	1.082	1.00	7.00	0.206	0.251
Tolerance to Low Funding	4.619	1.290	1.00	7.00	-0.151	-0.200
Mentor Influence	2.584	1.261	1.00	6.67	0.537	-0.460
Prestige	4.984	1.135	1.25	7.00	-0.268	0.086
Drive to Publish	5.345	1.150	1.00	7.00	-0.540	0.325
Mastery	3.456	1.138	1.00	7.00	0.192	-0.243
Stability	3.490	1.027	1.00	7.00	0.025	0.077
Branching Out	4.764	1.075	1.00	7.00	-0.279	0.501
Multidisciplinarity	5.209	1.198	1.00	7.00	-0.432	-0.021
Willingness to Collaborate	5.523	0.994	1.00	7.00	-0.944	2.062
Invited to Collaborate	5.145	1.161	1.00	7.00	-0.703	0.859
TS Legislative	5.305	0.914	2.40	7.00	-0.188	-0.286
TS Executive	4.016	1.187	1.20	7.00	0.044	-0.399
TS Liberal	4.809	1.090	1.00	7.00	-0.161	-0.170
TS Conservative	3.515	1.267	1.00	7.00	0.221	-0.629
TS Hierarchical	5.142	0.910	2.60	7.00	-0.162	-0.367
TS Monarchic	3.842	1.276	1.00	7.00	0.076	-0.696

Table 3: Determinant effects on research agendas

Dimensions	*Divergence*		*Collaboration*		*Scientific Ambition*		*Discovery*
Variables	*Multidisc.*	*Branching Out*	*Invited to Collab.*	*Will to Collab.*	*Prestige*	*Drive to Publish*	
Gender (Female)	-0.016 (0.092)	-0.147 * (0.071)	0.055 (0.089)	0.091 (0.081)	-0.093 (0.107)	-0.022 (0.086)	-0.148 (0.079)
FOS (NS)	0.312 (0.209)	0.031 (0.162)	0.301 (0.202)	0.519 ** (0.185)	-0.128 (0.244)	-0.013 (0.195)	-0.193 (0.179)
FOS (E&T)	0.622 (0.374)	0.056 (0.290)	0.543 (0.362)	0.747 * (0.332)	-0.063 (0.437)	0.105 (0.350)	-0.121 (0.322)
FOS (M&HS)	0.472 (0.326)	0.179 (0.253)	0.556 (0.316)	0.560 (0.289)	-0.658 * (0.381)	-0.349 (0.305)	-0.156 (0.280)
FOS (AS)	0.527 (0.508)	0.161 (0.394)	0.097 (0.491)	0.279 (0.450)	-0.610 (0.593)	0.480 (0.475)	-0.468 (0.437)
FOS (SS)	0.093 (0.147)	-0.136 (0.114)	0.271 (0.142)	0.413 ** (0.130)	-0.032 (0.171)	0.099 (0.137)	-0.072 (0.126)
Age	-0.002 (0.006)	-0.015 ** (0.005)	-0.007 (0.006)	-0.013 * (0.005)	-0.017 * (0.007)	-0.022 *** (0.006)	-0.011 * (0.005)
TS Legislative	0.075 (0.073)	0.055 (0.057)	0.057 (0.071)	-0.046 (0.065)	0.308 *** (0.086)	0.196 ** (0.069)	0.196 ** (0.063)
TS Hierarchical	0.031 (0.065)	-0.035 (0.050)	0.179 ** (0.063)	0.222 *** (0.057)	-0.015 (0.075)	-0.025 (0.060)	-0.071 (0.056)
TS Liberal	0.227 *** (0.057)	0.205 *** (0.044)	0.140 * (0.055)	0.147 ** (0.050)	0.036 (0.067)	0.058 (0.053)	0.224 *** (0.049)
TS Executive	-0.009 (0.075)	0.026 (0.058)	0.031 (0.072)	0.069 (0.066)	0.097 (0.087)	0.064 (0.070)	-0.041 (0.064)
TS Conservative	0.021 (0.069)	-0.019 (0.053)	0.077 (0.067)	0.015 (0.061)	0.078 (0.080)	0.063 (0.064)	-0.081 (0.059)
TS Monarchic	-0.137 ** (0.041)	-0.102 ** (0.031)	-0.157 *** (0.039)	-0.191 *** (0.036)	-0.028 (0.047)	-0.036 (0.038)	0.009 (0.035)
Time Since Ph.D.	0.005 (0.006)	0.005 (0.005)	0.017 ** (0.006)	0.017 ** (0.006)	0.016 * (0.007)	0.012 * (0.006)	0.010 (0.005)

Notes. A general linear model (MANCOVA) with fixed factors (coded as dummies) and covariates is shown. Standard errors are in parenthesis. The *country* fixed factor is omitted from this table. FOS (NS): Natural Sciences; FOS (E&T): Engineering and Technology; FOS (M&HS): Medical and Health Sciences; FOS (AS): Agricultural Sciences; and FOS (SS): Social Sciences; FOS (H): Humanities (baseline).

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4: Determinant effects on research agendas

Dimensions	*Mentor Influence*	*Tolerance to Low Funding*	*Conservative*	*Convergence*	
Variables				*Stability*	*Mastery*
Gender (Female)	-0.127 (0.078)	-0.180 * (0.083)	0.022 (0.082)	0.065 (0.062)	0.064 (0.071)
FOS (NS)	0.055 (0.178)	-0.543 ** (0.189)	0.375 * (0.186)	0.010 (0.141)	0.065 (0.161)
FOS (E&T)	-0.203 (0.319)	-0.685 * (0.338)	0.483 (0.333)	-0.036 (0.252)	-0.061 (0.289)
FOS (M&HS)	0.109 (0.278)	-0.694 * (0.295)	0.061 (0.290)	-0.067 (0.220)	-0.031 (0.252)
FOS (AS)	-0.040 (0.433)	-1.134 * (0.459)	0.166 (0.452)	-0.016 (0.342)	0.223 (0.392)
FOS (SS)	0.007 (0.125)	-0.187 (0.133)	0.056 (0.131)	0.140 (0.099)	0.184 (0.113)
Age	0.006 (0.005)	-0.002 (0.005)	0.006 (0.005)	0.008 * (0.004)	0.009 * (0.005)
TS Legislative	-0.205 ** (0.063)	0.171 ** (0.066)	-0.216 ** (0.065)	-0.004 (0.049)	-0.008 (0.057)
TS Hierarchical	0.012 (0.055)	-0.011 (0.058)	-0.055 (0.058)	-0.067 (0.044)	-0.098 (0.050)
TS Liberal	0.088 (0.049)	-0.002 (0.051)	-0.060 (0.051)	-0.103 ** (0.038)	-0.109 ** (0.044)
TS Executive	0.069 (0.064)	-0.139 * (0.067)	-0.039 (0.066)	-0.041 (0.050)	-0.019 (0.058)
TS Conservative	0.102 (0.059)	0.061 (0.062)	0.255 *** (0.061)	0.150 ** (0.046)	0.146 ** (0.053)
TS Monarchic	0.103 ** (0.035)	-0.042 (0.037)	0.048 (0.036)	0.099 *** (0.027)	0.128 *** (0.031)
Time Since Ph.D.	-0.024 *** (0.005)	0.004 (0.006)	-0.017 ** (0.006)	-0.007 (0.004)	-0.011 * (0.005)

Notes. A general linear model (MANCOVA) with fixed factors (coded as dummies) and covariates is shown. Standard errors are in parenthesis. The *country* fixed factor is omitted from this table. FOS (NS): Natural Sciences; FOS (E&T): Engineering and Technology; FOS (M&HS): Medical and Health Sciences; FOS (AS): Agricultural Sciences; and FOS (SS): Social Sciences; FOS (H): Humanities (baseline).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Appendix A

Six Thinking Styles in the Thinking Styles Inventory – Revised II

Style Type	*Thinking Style*	*Key Characteristics*
I	Legislative	When faced with a problem, I use my own ideas and strategies to solve it.
	Liberal	I like to take old problems and find new methods to solve them.
	Hierarchical	I like to set priorities for the things I need to do before I start doing them.
II	Executive	I like to follow definite rules or directions when solving a problem or doing a task.
	Monarchic	I tend to give full attention to one thing at a time.
	Conservative	I like tasks and problems that have fixed rules to follow in order to complete them.

Appendix B – Validation of the abridged version of the TSI-R2

TSI-R2 Reliability	
Sub-scale	*Composite Reliability*
Monarchic	0.873
Conservative	0.915
Hierarchical	0.767
Liberal	0.878
Executive	0.824
Legislative	0.833

TSI-R2 Validity		
Sub-scale	*Item*	*Factorial loadings*
Monarchic	When talking or writing about ideas, I prefer to focus on one idea at a time.	0.72
	I tend to give full attention to one thing at a time.	0.88
	If there are several important things to do, I focus on the one most important to me and disregard the rest.	0.58
	I like to concentrate on one task at a time.	0.91
	I have to finish one project before starting another one.	0.68
Legislative	When faced with a problem, I use my own ideas and strategies to solve it.	0.55
	I like to play with my ideas and see how far they go.	0.67
	I like problems where I can try my own way of solving them.	0.81
	When working on a task, I like to start with my own ideas.	0.62
	I like situations where I can use my own ideas and ways of doing things.	0.86
Executive	I like to figure out how to solve a problem following certain rules.	0.57
	I am careful to use the proper method to solve any problem.	0.53
	I enjoy working on things that I can do by following directions.	0.81
	I like projects that have a clear structure and a set plan and goal.	0.67
	I like to follow definite rules or directions when solving a problem or doing a task.	0.87
Liberal	I like to challenge old ideas or ways of doing things and to seek better ones.	0.79
	When faced with a problem, I prefer to try new strategies or methods to solve it.	0.87
	I like to do things in new ways not used by others in the past.	0.79
	I like to change routines in order to improve the way tasks are done.	0.67
	I like to take old problems and find new methods to solve them.	0.72
Conservative	I stick to standard rules or ways of doing things.	0.86
	When I'm in charge of something, I like to follow methods and ideas used in the past.	0.73
	I like situations where I can follow a set routine.	0.83