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Global-local processing impacts academic risk taking

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ABSTRACT

Research has shown that academic risk taking—the selection of school tasks with varying difficulty levels—affords important implications for educational outcomes. In two experiments, we explored the role of cognitive processes—specifically, global versus local processing styles—in students' academic risk-taking tendencies. Participants first read a short passage, which provided the context for their subsequent academic risk-taking decisions. Following which, participants undertook the Navon's task and attended to either global letters or local letters only, i.e., were either globally or locally primed. The effects of priming on academic risk taking were then assessed using a perception-based measure (Experiment 1) and a task-based measure (Experiment 2). Experiment 1 provided preliminary evidence, which Experiment 2 confirmed, that globally focused individuals took more academic risk than did locally focused individuals after controlling for participants' need for cognition (how much they enjoy effortful cognitive activities). Additionally, the inclusion of and comparisons with a control group in Experiment 2 revealed that locally focused participants drove the observed effects. The theory of predictive and reactive control systems (PARCS) provides a cogent account of our findings. Future directions and practical applications in education are discussed.

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Academic risk taking; Global-local processing; Navon's task; Need for cognition (NFC); Theory of predictive and reactive control systems (PARCS)

In academic settings, students often have to decide between a harder or an easier assignment to work on, an unfamiliar or a familiar module to enrol in, or even sharing or not sharing one's tentative ideas in class. These decisions can be regarded as specific instances of academic risk taking. There are two broad ideas associated with academic risk taking. First, as with most types of risk taking (e.g., physical, economic), academic risk taking manifests when students can choose from a range of possible options. Second, these options are accompanied by undesirable consequences that are unique to the academic setting—e.g., students who choose to share their ideas in class may risk having their ideas dismissed or ridiculed by others (Beghetto, 2009). Clifford (1991) defines academic risk taking specifically as the selection of academic tasks that vary in their levels of difficulty. The view is that choosing a more difficult academic task reflects greater academic risk taking, as it increases one's likelihood of making mistakes, or obtaining a lower score, on the task.

Academic risk taking is important in education as it has implications for a range of learning processes and outcomes. In theory, the student who takes more academic risks may, in the longer term, benefit from greater self-efficacy (Bandura, 1977), heightened intrinsic motivation (Deci & Porac, 1978), an experience of "flow" or moment-to-moment task involvement (Csikszentmihalyi, 1990), as well as optimal cognitive development (e.g., Vygotsky, 1978). Such students are also likely to put more effort into performing their academic tasks (e.g., Clifford & Chou, 1991). Furthermore, students who participated in a risk-based vs. non risk-based learning game reported higher classroom engagement and demonstrated superior long-term retention of course material (Devonshire et al., 2014). In light of these potential advantages, researchers have sought to understand

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academic risk taking and explore the conditions under which it can be promoted (e.g., Beghetto, 2009; Clifford, 1991).

Past studies have largely investigated *external* (situational) factors that may influence student's academic risk taking. For example, students were found to take more academic risks when the academic tasks came with variable payoffs (i.e., higher points awarded for problems with increasing difficulty) and when the tasks were presented as a game rather than a test (e.g., Clifford & Chou, 1991). Fewer studies have, however, investigated *internal* factors that may influence students' academic risk taking–e.g., students with greater interest in science displayed greater academic risk-taking tendencies when learning science (Beghetto, 2009). Importantly, no study has explored the potentially interesting role of *internal* cognitive processes, such as global–local processing, in influencing students' academic risk taking. The present study aims to address that gap, thereby providing a new cognitive psychological perspective on the promotion of academic risk taking and sparking new ways of thinking about cognitive educational research and its applications. The theory of Predictive and Reactive Control Systems (PARCS), in particular, serves as a cogent framework for this research.

The theory of predictive and reactive control systems (PARCS)

The theory of PARCS (Tops, Boksem, Luu, & Tucker, 2010; Tops, Boksem, Quirin, IJzerman, & Koole, 2014) offers an evolutionary view of human cognition. Advancing Tucker's seminal work (e.g., Derryberry & Tucker, 1994; Tucker & Williamson, 1984), the theory of PARCS posits two distinct control systems—namely the "predictive control" and "reactive control" systems.[1] Importantly, the features within each control system have been organized and coordinated such that they, together, enact behaviours that are adaptive under different environmental circumstances (Tops et al., 2010, 2014). Under familiar, predictable circumstances, the predictive control system is dominant. One is likely to experience such features as low emotional intensity, extended temporal focus, and global processing, all of which support the goal of seeking and building resources over time. Conversely, under novel, unpredictable circumstances, such as when one faces an imminent threat from a predator, the reactive control system takes over. One is thereby likely to experience such features as high emotional intensity, immediate temporal focus, and local processing, all of which enable one to focus on the immediate threat and either fight or take flight. Global–local processing constitutes a specific feature of these broader control systems and is the variable of interest in this study.

Global-local processing

People can attend to the same stimuli in different ways. For example, when looking at a scene, people can adopt a broad perceptual focus and take in the "big picture" or assume a narrow perceptual focus and attend to the individual elements. These are known as global and local processing styles, respectively. Processing styles can be experimentally manipulated—i.e., they can be induced in the course of a task and be carried over to subsequent tasks (Liberman, Förster, & Friedman, 2007). A key paradigm to induce global–local processing is the Navon's (1977) letter task (e.g., Dale & Arnell, 2013; Milne & Szczerbinski, 2009). A typical Navon stimulus comprises a larger letter that is built out of smaller letters of identical size (see Figure 1 for examples). In a typical priming task, individuals are presented with a series of Navon stimuli and instructed to repeatedly identify either the large letter or the small letter. Repeatedly identifying the large letter induces global processing, whereas repeatedly identifying the small letter induces local processing (see, also, Lim & Goh, 2013). Global versus local processing styles have been successfully induced in various studies via this approach and were found to differentially impact such subsequent tasks as face recognition (Macrae & Lewis, 2002), eyewitness identification (Perfect, Dennis, & Snell, 2007), and golf-putting performance (Lewis & Dawkins, 2015).

According to the theory of PARCS, processing styles do not exist solely as features on their own. Rather, they are situated within broader control systems and are coordinated with other features like affect and

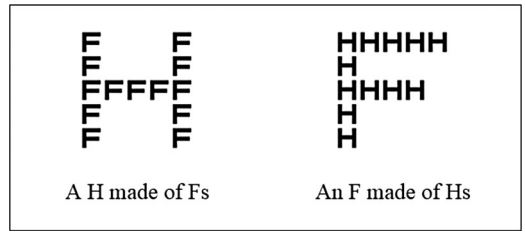

Figure 1. Examples of Navon stimuli.

motor control (Tops et al., 2014). Specifically, global processing is part of the predictive control system, which is concerned with growth and advancement, whereas local processing is part of the reactive control system, which is concerned with security and vigilance. This theoretical position is consistent with previous empirical reports—global processing has, for example, been associated with other growth-oriented features like positive affect and a promotion focus (e.g., Basso, Schefft, Ris, & Dember, 1996; Förster & Higgins, 2005; Fredrickson & Branigan, 2005), whereas local processing has been associated with other security-oriented features like anxiety and a prevention focus (e.g., Derryberry & Reed, 1998; Förster & Higgins, 2005).

On the basis of PARCS theory, one may also expect global versus local processing to be systematically associated with different manifest behaviours. In particular, global processing may favour growth-promoting behaviours, whereas local processing may favour vigilant behaviours. Lim, Yuen, and Tong (2015) directly tested this idea. Specifically, they investigated the influence of global–local processing on generic risk-taking behaviours assessed through the Balloon Analogue Risk Taking (BART) task. In the BART task, for each succeeding balloon pump that participants make, they would be able to increase their economic rewards but would, at the same time, inflate the risk of bursting the balloon (and hence not obtaining any reward at all). Thus, making more balloon pumps reflects a behavioural bias towards advancement over vigilance. Consistent with the theory of PARCS, Lim et al. (2015) found that globally focused participants, who likely prioritized growth and advancement through the activation of the predictive control system, made more balloon pumps—i.e., took more risks—than did locally focused participants. In light of the findings, that globally focused participants would presumably take more academic risk than would locally focused participants is a promising hypothesis.

Need for cognition

When faced with ambiguity, one's personality trait is also likely to influence one's risk-taking tendencies (e.g., Demaree, DeDonno, Burns, & Erik Everhart, 2008; Zuckerman & Kuhlman, 2000), although different personality traits may, of course, be involved in different domains of risk-taking (e.g., Weller & Tikir, 2011). In the context of academic risk, one's need for cognition (NFC) could potentially influence one's academic risk-taking tendencies. NFC is a stable personality trait defined as the extent to which an individual enjoys effortful cognitive activities (Cacioppo, Petty, Feinstein, & Jarvis, 1996). Of particular relevance to this study is the finding that individuals high in NFC reported higher intrinsic motivation to engage in effortful cognitive endeavours than did individuals low in NFC (Amabile, Hill, Hennessey, & Tighe, 1994). Furthermore, students high in NFC expressed significantly lower stress and anxiety insofar as academic challenges are concerned (e.g., Cacioppo & Petty, 1984; Jarvis & Petty, 1996). We expect, on the basis of these previous reports, one's NFC to influence one's academic risk-taking tendencies. Accordingly, NFC was measured as a potential covariate.

Experiment 1

In the present experiment, we manipulated global or local processing using Navon's letter task and examined the impact of processing styles on participants' academic risk taking, operationalized as their preferred level of challenge across three academic scenarios (see Materials). We further included NFC as a potential covariate. In line with the theory of PARCS, we hypothesized that participants who attended to global letters would take more academic risk than would participants who attended to local letters, after controlling for NFC.

Method

Participants

In total, 69 undergraduate students (34 female) aged 19 to 27 ($M = 22.01$, $SD = 2.03$) from the National University of Singapore took part in the study for course credit or cash incentive. Participants were randomly assigned to either the global ($N = 34$) or the local ($N = 35$) processing condition.

Materials

Text. A science text entitled *Tropisms* was used (see Supplemental Material; Cook & Mayer, 1988). It contained 263 words, with a Flesch Reading Ease score of 62.4 (score ranges from 0 to 100, with 100 signifying complete reading ease) and a Flesch-Kincaid grade level of 8.3. Importantly, this text provided the context for which participants subsequently made their academic risk-taking decisions. In addition,

participants' memory of the text was assessed, and subsequently controlled for, via a free recall task.[2]

Meta-comprehension Questionnaire. A questionnaire comprising eight meta-comprehension items was administered (see Supplemental Material). These items measure various factors that may influence participants' academic risk taking, including judgments of text, as in (1) *how interesting the text was,* and (2) *how readable the text was*; judgments of learning, as in (3) *how confident participants were of the text,* and (4) *how well they thought they could remember the text*; motivation, as in (5) *how engrossed participants were in reading the text,* and (6) *how many times they read the text;* and, finally, prior knowledge, as in (7) *how much information in the text participants had prior to reading it*, and (8) *how well they knew the subject matter covered in the text prior to reading it*. Except for item (6), which documented simple frequency counts, participants rated all items on a 7-point Likert scale, with higher scores indicating more favourable attitudes.

Navon's Letter task. The Navon's task was administered on a colour monitor with 1920×1080 screen resolution, via the software *DirectRT* (Jarvis, 2004). Viewing distance ranged from 60 to 70 cm. Following Förster and Higgins (2005), each global letter was approximately 2.1 cm × 2.1 cm, while each local letter was approximately 0.4 cm × 0.4 cm. Local letters were arranged on an imaginary 5-letter × 5-letter grid. Across both the global and local conditions, the letters *H* and *L* were designated as targets. Participants were to press the *H* key on the keyboard if a composite stimulus contained the letter *H*, and the *L* key if it contained the letter *L*. In the global condition, participants saw composite stimuli in which the target letters always appeared at the global level (a *H* made of Fs, a *H* made of Ts, a *L* made of Fs, or a *L* made of Ts). Conversely, those in the local condition saw composite stimuli in which the target letters always appeared at the local level (a F made of *H*s, a F made of *L*s, a T made of *H*s, or a T made of *L*s). In both conditions, each of the four composite stimuli had an equal chance of being presented. These composite stimuli can be found in Figure 2.

In a typical trial, participants were first presented with a fixation cross at the centre of the screen for 500 ms, following which a composite stimulus appeared, substituting the cross. Participants were tasked to identify target letters within the composite stimulus as quickly and accurately as possible. Notably, participants in the global condition consistently identified global letters, whereas those in the local condition consistently identified local letters. Each participant completed 12 practice trials, followed by 120 test trials, which lasted 5 min altogether. This duration was consistent with that used in previous studies that successfully demonstrated global-local priming (e.g., Lewis & Dawkins, 2015; Perfect et al., 2007.)

Academic risk-taking scenarios. Research on academic risk taking dates back to the pioneering work of Clifford and colleagues (e.g., Clifford, 1991). To measure academic risk taking experimentally, these researchers created tasks like Academic Risk Taking (Clifford, 1988) and Cognitive Skills Risk Taking (Clifford, Lan, Chou, & Qi, 1989). In these tasks, participants—usually elementary or high school students—were presented with one set of multiple-choice questions for each of the various domains (e.g., mathematics, vocabulary). These questions were selected from retired standardized achievement tests and presented in order of increasing grades, i.e., difficulty. Participants were typically asked to choose and work on a portion (15–20%) of these questions. The average difficulty level of the chosen questions was then derived to reflect academic risk taking, with greater difficulty indicating higher risk taking. Crucially, these tasks utilized standardized achievement test questions which, while common at the elementary level, are rare at the college level—our level of interest.

To address this, we devised a scenario-based measure of academic risk taking that reflects students' academic experience in college and retains the essence of earlier measures. Specifically, participants were presented with three hypothetical academic scenarios that undergraduate students typically encounter: tutorial class discussion, group project, and individual assignment (see Supplemental Material). In the "individual assignment" scenario, for example, students were asked:

> Imagine you will be working on a piece of individual assignment. The assignment will be regarding the topic you read about a while ago. You can choose from one of seven assignment questions to work on. The assignment questions range from 1 (least challenging) to 7 (most challenging).

For each of these scenarios, participants were required to choose their preferred level of challenge

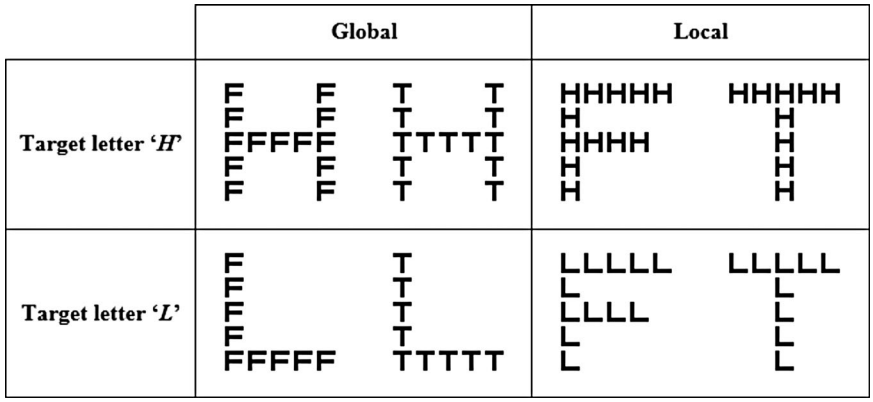

Figure 2. Composite stimuli used in the global and local conditions.

on a 7-point Likert scale (1 = "least challenging"; 7 = "most challenging"). Participants' preferred level of challenge across the three academic scenarios significantly correlated, *rs* = .58 to .61, *ps* < .001, indicating considerable consistency. An academic risk-taking score, *ART*, was hence derived for each participant by averaging their responses across all three scenarios.

NFC scale. NFC was assessed using the well-established 18-item short NFC scale (see Supplemental Material; Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984). Participants rated all items on a 7-point Likert scale (1 = "strongly disagree"; 7 = "strongly agree"). Example items include "*I find satisfaction in deliberating hard and for long hours*" and "*thinking is not my idea of fun*". Nine of the items were negatively worded and were reverse-coded prior to any analysis, such that higher scores indicated higher NFC for all items. The NFC scale was subjected to a principal component analysis that resulted in the extraction of one factor. This single NFC factor yielded a coefficient alpha of .89 and accounted for 34% of the variance in the NFC items. A *NFC* score was then computed for each participant by averaging their responses across all 18 items.

Procedure

Participants underwent the experiment either individually or in groups of no more than five. When in groups, participants were seated separately so that they could not communicate with, nor monitor the activities of, other participants. Each session lasted about 30 min. Participants first read a short text *Tropisms* for 4 min, after which they filled out the meta-comprehension Questionnaire. Next, participants undertook either the global or the local priming task, before they responded to the three hypothetical academic scenarios. Participants then recalled freely (i.e., without any cues) the text *Tropisms* in 8 min. Finally, participants completed the NFC scale. They were then debriefed and thanked for their participation.

Results and discussion

Preliminary analyses

The descriptive statistics of the main measures are summarized in Table 1. Participants' *ART* scores ranged from 1 to 7 (*M* = 4.77, *SD* = 1.36), and their *NFC* scores ranged from 2.83 to 6.50 (*M* = 4.65, *SD* = 0.82). Importantly, participants' *ART* scores significantly correlated with their *NFC* scores (*r* = .62, *p* < .001), confirming that *NFC* was a covariate. Participants' *ART* scores also correlated with 5 of the 8 meta-comprehension items, namely, *interest*, *readability*, *confidence*, *memory*, and *engrossment* (*rs* = .24 to .53, *ps* < .05). These items were subsequently controlled for in our main analyses. Notably, the kurtosis and skewness values of the main measures all fell within the range of ±2 (see Table 1), wherein normality is assumed (George & Mallery, 2010). This provided the justification to proceed with our main analyses.

Main analyses

The dataset was submitted to a one-way Analysis of Covariance (ANCOVA) with *ART* as the dependent variable, *Group* (global or local) as the independent variable, and *NFC* as the covariate. The interaction

Table 1. Descriptive statistics of main measures in Experiment 1.

Variables	Global Mean (*SD*)	Local Mean (*SD*)	Overall Mean (*SD*)	Range	Skewness	Kurtosis	Corr. (ART)
ART	4.71 (1.41)	4.84 (1.33)	4.77 (1.36)	1–7	−0.67	0.49	1.00
NFC	4.42 (0.82)	4.88 (0.76)	4.65 (0.82)	2.83–6.50	−0.15	−0.52	.62***
Interest	5.09 (1.00)	5.20 (1.35)	5.14 (1.18)	2–7	−0.44	−0.27	.34**
Readability	5.68 (0.84)	5.66 (1.21)	5.67 (1.04)	2–7	−0.87	1.06	.28*
Confidence	5.68 (0.91)	5.69 (1.18)	5.68 (1.05)	3–7	−0.63	−0.33	.34**
Memory	5.38 (0.99)	5.49 (1.09)	5.43 (1.04)	3–7	−0.38	−0.09	.24*
Engrossment	4.76 (1.18)	4.91 (1.31)	4.84 (1.24)	2–7	−0.06	−0.59	.53***
Times read	3.35 (1.18)	3.11 (1.13)	3.23 (1.15)	1.5–7	1.13	1.63	.19
Text knowledge	2.50 (1.44)	1.94 (1.14)	2.22 (1.32)	1–6	1.13	0.27	.069
Subject knowledge	2.71 (1.70)	2.29 (1.41)	2.49 (1.56)	1–7	1.02	0.06	.058
Free recall performance	13.26 (3.13)	12.80 (3.45)	13.03 (3.28)	6–21	0.30	−0.36	.13

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

term NFC × Group was not statistically significant, $F(1, 65) = .11$, $p = .75$, fulfilling the *homogeneity of slopes* assumption. In other words, the relationship between *NFC* and *ART* does not differ between the global and local groups. This in turn allows us to adjust, and subsequently compare, the mean *ART* for each group according to their respective mean *NFC* scores. Controlling for *NFC*, globally focused individuals did not differ from locally focused individuals in terms of their academic risk taking ($Ms_{adj} = 4.97$ vs. 4.59, respectively), $F(1, 66) = 2.0$, $p = .16$, $\eta_p^2 = .029$. Including the five covariates of non-interest (i.e., *interest*, *readability*, *confidence*, *memory*, and *engrossment*) in the existing ANCOVA model yielded a similar result ($Ms_{adj} = 4.93$ vs. 4.62 respectively), $F(1, 61) = 1.46$, $p = .23$, $\eta_p^2 = .023$.

Our initial findings, while in the predicted direction, revealed a small effect size. A possible reason for this observation relates to the presence of outliers, which can markedly influence and distort a study's true results (e.g., Aguinis, Gottfredson, & Joo, 2013; Bollen & Jackman, 1990). Following Bollen and Jackmans' (1990) recommendation on outlier diagnostics (e.g., Cook's distance) and cut-off criterion, we subsequently identified and excluded five outlying observations from our dataset.[3] The trimmed dataset ($N = 64$; global = 32; local = 32) was then re-submitted to the same ANCOVA. The interaction term NFC × Group was not significant, $F(1, 60) = .88$, $p = .35$, fulfilling the *homogeneity of slopes* assumption. Controlling for participants' *NFC,* globally focused individuals took significantly more academic risk than did locally focused individuals ($Ms_{adj} = 5.19$ vs. 4.63, respectively), $F(1, 61) = 5.73$, $p = .020$, $\eta_p^2 = .086$. This observation persisted even after controlling for the five covariates of non-interest ($Ms_{adj} = 5.13$ vs. 4.68, respectively), $F(1, 56) = 4.82$, $p = .032$, $\eta_p^2 = .079$.

In this experiment, we tested the hypothesis that globally focused individuals would take more academic risk than would locally focused individuals. The data provided preliminary support for our hypothesis, following the exclusion of five influential outliers. The existing literature on priming, which suggests that the effects may manifest in such various forms as one's perception, behaviours, and/ or goals (see Loersch & Payne, 2011), offers a possible interpretation. In our current measure of academic risk taking, participants made choices based on hypothetical scenarios but did not actually act on their choices. Research has shown that hypothetical choices may differ from choices that entail real actions and consequences, both behaviourally (e.g., Lafferty & Higbee, 1974) and at the neuronal activation level (e.g., Kang, Rangel, Camus, & Camerer, 2011). This could have underpinned the present preliminary findings. To ascertain whether this was the case, we designed a second experiment in which a task-based measure (involving participants' actual behavioural responses) was administered.

Experiment 2

In this experiment, we adopted the same paradigm from Experiment 1, but with two key revisions. First, an ecologically relevant task-based (vs. perception-based) measure of academic risk taking, which entailed real actions and consequences for participants, was employed. We hypothesized that globally focused individuals would take more academic risk than would locally focused individuals, while controlling for NFC. Second, a control condition was now included, in order to ascertain whether the priming effects, if any, were driven by globally or locally focused individuals, or both.

Method

Participants

A total of 116 undergraduate students (71 female) aged 18 to 26 ($M = 21.99$, $SD = 1.65$) from the National University of Singapore took part in the study for cash incentive. Participants were randomly assigned to one of the three conditions: global ($N = 38$), local ($N = 38$), or control ($N = 40$).

Materials

Text. A sample reading comprehension text from the International English Language Test System was used (IELTS, 2015). Titled *Is Science Dangerous*, the text is an excerpt from a scientific article (see Supplemental Material; Wolpert, 2002). It contained 800 words, with a Flesch Reading Ease score of 46.8 and a Flesch-Kincaid grade level of 11.0. As in Experiment 1, this text provided the context for which participants subsequently make their academic risk-taking decisions. Furthermore, this text was accompanied by a common set of 12 comprehension questions (see Supplemental Material), which all participants were assigned regardless of their personal decisions.

Navon's Letter task. Both the global and local processing conditions were identical to those in Experiment 1. For the control condition, all parameters (e.g., number of trials, duration, target letters) were identical to the other two conditions, except for the neutral stimuli presented, which comprised only single-level *H*s and *L*s, without any global or local elements. Each single-level letter was 1.2 cm × 1.2 cm, averaging between the sizes of a global letter and a local letter (see Figure 3).

Academic risk-taking task. Participants were first informed that they would be working on a set of text-relevant questions in the next 10 min. They were then tasked to choose one out of seven sets of questions to work on. Participants were led to believe that these seven sets of questions differed in their level of challenge on a 7-point Likert scale (1 = "least challenging"; 7 = "most challenging"), when, in fact, all participants were eventually assigned the same set of questions, regardless of their decisions. The levels of challenge that participants selected constituted their respective *ART* scores.

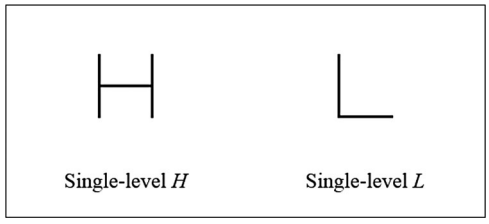

Figure 3. Single-level stimuli used in the neutral condition.

NFC scale. The NFC scale was subjected to a principal component analysis, resulting in the extraction of one factor (α = .89), which accounted for 33% of the variance in the NFC items. A *NFC* score was then computed for each participant by averaging his or her responses across all 18 items.

School Failure Tolerance (SFT) scale. The 36-item SFT scale measures, through self-report, the extent to which an individual responds to failures in a school context (see Supplemental Material; Clifford, 1988). It comprises three subscales—namely, *affect* (α = .87), *action* (α = .75), and *preferred difficulty* (α = .87), each with 12 items. Importantly, the *preferred difficulty* subscale, in particular, demonstrated modest correlations with the previously established Academic Risk Taking measure (Clifford, 1988). Here, the SFT was administered for the purpose of validating the academic risk taking measures employed in the present study.

Procedure

Participants first read the text *Is Science Dangerous* for 5 min, after which they filled out the meta-comprehension questionnaire. Next, participants underwent one of three conditions: global priming, local priming, or the control condition. Immediately after that, participants responded to the new academic risk taking task. Finally, participants completed the NFC scale, with participants in the control condition additionally completing the SFT scale as well as the academic risk-taking scenarios used in Experiment 1. All participants were then debriefed and thanked for their participation. In particular, participants were probed during debrief, and none of them suspected, at the point of their decision making, that there was only one common set of questions assigned to all participants regardless of their personal decisions. We checked that no one was dismayed by the deception.

Results and discussion

Preliminary analyses

The inclusion of a control condition in the present experiment allows us to collect data to preliminarily assess the consistency and validity of our current measures of academic risk taking.[4] The task-based and perception-based measures were significantly correlated ($r = .68$, $p < .001$), indicating high consistency. In addition, the *preferred difficulty* score in SFT correlated with the task-based and perception-based measures ($r = .28$, $p = .077$; $r = .48$, $p = .0018$, respectively). Taken together, the validation results suggest that our existing measures are not only internally consistent, but also exhibit partial consistency with previous measures of academic risk taking.

The descriptive statistics of the main measures are summarized in Table 2. Participants' *ART* scores ranged from 1 to 7 ($M = 4.84$, $SD = 1.54$), and their *NFC* scores ranged from 1.50 to 6.50 ($M = 4.36$, $SD = 0.75$). Importantly, participants' *ART* scores correlated significantly with their *NFC* scores ($r = .39$, $p < .001$). Participants' *ART* scores also correlated with six of the eight metacomprehension items—namely, *interest*, *readability*, *confidence*, *memory*, *engrossment*, and *prior text knowledge* ($rs = .21$ to $.42$, $ps < .05$). The kurtosis and skewness values of the main measures were all within the range of ±2 (see Table 2), indicating normality (George & Mallery, 2010) and providing the justification to proceed with our main analyses.

Main analyses[5]

The dataset was submitted to a one-way ANCOVA with *ART* as the dependent variable, *Group* (global, local or control) as the independent variable, and *NFC* as the covariate. The interaction term *NFC* × *Group* was not statistically significant, $F(2, 110) = 0.65$, $p = .53$, fulfilling the *homogeneity of slopes* assumption. *Group* was found to be significant, $F(2, 112) = 4.53$, $p = .013$, suggesting that some groups differed in terms of their academic risk taking. We then proceeded to conduct three sets of planned comparisons.

We first compared the global and local groups. Consistent with our prediction, globally focused individuals took significantly more academic risk than did locally focused individuals after controlling for *NFC* ($Ms_{adj} = 5.28$ vs. 4.30, respectively), $F(1, 73) = 8.86$, $p = .0039$, $\eta_p^2 = .11$, and after controlling for *NFC* and the six covariates of non-interest (i.e., *interest*, *readability*, *confidence*, *memory*, *engrossment*, and *prior text knowledge*) ($Ms_{adj} = 5.14$ vs. 4.44, respectively), $F(1, 67) = 4.69$, $p = .034$, $\eta_p^2 = .065$.

To ascertain which condition(s) may be driving the observed effect, we conducted two additional planned comparisons, one comparing the global with control group, and another comparing the local with control group. Controlling for *NFC*, globally focused participants did not differ from participants in the control group in terms of academic risk taking ($Ms_{adj} = 5.21$ vs. 4.88, respectively), $F(1, 75) = 1.03$, $p = .31$, $\eta_p^2 = .014$. This outcome remained the same after controlling for the six covariates of non-interest ($Ms_{adj} = 5.13$ vs. 4.95, respectively), $F(1, 69) = 0.30$, $p = .59$, $\eta_p^2 = .0043$. In contrast, locally focused participants took significantly less academic risk than did participants in the control group after controlling for *NFC* ($Ms_{adj} = 4.37$ vs. 4.98, respectively), $F(1, 75) = 4.20$, $p = .044$, $\eta_p^2 = .053$. This effect persisted even after controlling for the six covariates of non-interest ($Ms_{adj} = 4.36$ vs. 4.99, respectively), $F(1, 69) = 4.29$, $p = .042$, $\eta_p^2 = .058$.

The present experiment is an extension of Experiment 1, wherein a task-based measure of academic risk taking was employed, in order that effects of the global-local processing manipulation, if any, may be more readily observable. Consistent with our hypothesis, our findings corroborated those from Experiment 1: globally focused individuals took more academic risk relative to locally focused individuals, after controlling for their NFC. Additionally, comparisons with the control group revealed that locally focused participants drove the observed effects.

General discussion

In two experiments, we investigated the influence of global–local processing styles on students' academic risk taking. Preliminary effects that obtained using a perception-based measure (Experiment 1) were confirmed via the use of a task-based measure of academic risk taking (Experiment 2). Consistent with our hypothesis, globally focused individuals took more academic risk than did locally focused individuals, after taking into account their NFC.

The theory of PARCS (Tops et al., 2010, 2014; see introduction) provides a cogent account of the present findings. Recapitulating, our brain comprises two broad control systems. The predictive control system is dominant under benign circumstances and is concerned with growth and advancement. On the

Table 2. Descriptive statistics of main measures in Experiment 2.

Variables	Global Mean (*SD*)	Control Mean (*SD*)	Local Mean (*SD*)	Overall Mean (*SD*)	Range	Skewness	Kurtosis	Corr. (ART)
ART	5.16 (1.65)	4.92 (1.44)	4.42 (1.48)	4.84 (1.54)	1–7	−0.47	−0.28	1.00
NFC	4.23 (0.72)	4.36 (0.85)	4.48 (0.69)	4.36 (0.75)	1.5–6.5	−0.33	1.34	.39***
Interest	4.63 (1.32)	4.68 (1.16)	4.55 (1.25)	4.62 (1.23)	1–7	−0.55	0.25	.21*
Readability	5.00 (1.27)	4.40 (1.15)	4.68 (1.16)	4.69 (1.21)	2–7	−0.24	−0.47	.27**
Confidence	4.55 (0.95)	4.25 (1.24)	4.37 (1.05)	4.39 (1.09)	1–6	−0.93	0.96	.42***
Memory	4.21 (0.87)	4.05 (1.24)	3.95 (1.04)	4.07 (1.06)	1–6	−0.40	−0.40	.39***
Engrossment	4.47 (1.31)	4.80 (1.16)	4.34 (1.32)	4.54 (1.27)	1–7	−0.55	−0.08	.22*
Times read	1.74 (0.65)	1.68 (0.76)	1.76 (0.66)	1.73 (0.69)	1–4	0.92	0.70	.069
Text knowledge	3.61 (1.33)	3.45 (1.57)	3.61 (1.28)	3.55 (1.39)	1–7	−0.04	−0.77	.22*
Subject knowledge	3.66 (1.44)	3.40 (1.41)	3.58 (1.29)	3.54 (1.37)	1–7	0.01	−0.74	.12

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

other hand, the reactive control system prevails under threatening circumstances and is concerned with security and vigilance. Global processing is associated with the predictive control system and is likely to favour growth-promoting behaviours. Conversely, local processing is associated with the reactive control system and is likely to favour vigilant behaviours. In accordance with the PARCS theory, the present study demonstrated that globally focused individuals did indeed take more academic risk than did locally focused individuals, while controlling for NFC.

The exact mechanism underpinning the observed effects deserves further attention. In particular, global processing has been associated with a promotion focus, whereas local processing has been associated with a prevention focus (Förster & Higgins, 2005). Global (vs. local) processing may have induced a promotion (vs. prevention) focus, which may, in turn, lead to differential academic risk-taking behaviours (see, also, Lim et al., 2015). Alternatively, it is plausible that global and local processing may have activated distinct goal pursuits (e.g., goal to explore vs. goal to conserve; see Liberman et al., 2007), which translate as differences in academic risk-taking behaviours. Future studies should directly investigate these hypotheses, in order to elucidate more fully the nature of relationship between processing styles and academic risk taking. Other related variables (e.g., emotions, temporal focus) can also be investigated in conjunction with academic risk taking, in order to give a better understanding of how risk taking can be encouraged in an academic setting.

A peripheral observation is that the effects in Experiment 1 ($\eta_p^2 = .029$ before outlier exclusion; $\eta_p^2 = .086$ after outlier exclusion) were relatively weaker than were those in Experiment 2 ($\eta_p^2 = .11$), which may shed new light on the existing priming literature (see Loersch & Payne, 2011; Wheeler, DeMarree, & Petty, 2014 for reviews). There is preliminary evidence to suggest that the effects of priming may be more robust and observable in a task involving real actions and consequences (Experiment 2) than in one involving merely hypothetical choices (Experiment 1). Future priming studies may expound on task type as a potential moderator.

Implications for education

The present study is among the first to investigate academic risk taking in college students. Based on our measures, college students tended to express *above-average* academic risk-taking tendencies (Experiment 1: $M = 4.77$, $SD = 1.36$; Experiment 2: $M = 4.84$, $SD = 1.54$). Our findings contrast with those documented in previous studies, which often reported *below-average* academic risk taking among elementary students (see Clifford, 1991). One interpretation for the relatively high academic risk taking in our sample relates to the ecological validity of the current academic risk-taking measures (e.g., participants might have been more willing to take academic risks when there were no real consequences involved), although this explanation is problematic given that the current measures were similar to those used in previous studies (e.g., Clifford, 1991). A second interpretation relates to the nature of our sample—students who eventually made it to college could be higher academic risk takers. Future research should test the latter possibility in particular.

Notably, in Experiment 2, only locally focused, but not globally focused, individuals differed from the control group in terms of academic risk taking. This finding is consistent with Lim et al.'s (2015) observation suggesting that global focus may be the default mode of focus. The insight is that college students' default academic predisposition may well be an

adventurous one. The question may, then, relate not so much to how to promote academic risk-taking tendencies as such but, instead, to how *not* to stifle these default tendencies to take healthy academic risks. This has critical implications for the ways in which educators and stakeholders ought to rethink and refine extant educational systems and pedagogies.

Author contributions

The initial study concept came from S. W. H. Lim and was developed by all authors. E. W. S. Tan performed the testing and data collection. E. W. S. Tan performed the data analysis and interpretation under the supervision of S. W. H. Lim. E. W. S. Tan drafted the manuscript, and S. W. H. Lim and E. Manalo provided critical revisions. All authors approved the final version of the manuscript for submission.

Notes

1. Following Tops et al. (2010, 2014), we wish to emphasize that the two distinct control systems are not organized around the concepts "predictive" or "reactive". Rather, the terms "predictive" and "reactive" are used as labels for functional systems that are organized, really, on the basis of their controlling behaviours that are adaptive under different circumstances.
2. Individuals who remembered more information from the text may, as a result of greater confidence or familiarity, take more academic risk. We wanted to rule out this possibility.
3. Influential outliers were identified based on Cook's distance, with a recommended cutoff value of $4/N = 0.058$. We wish to refer readers to the Supplemental Material for more specific details of the outlier diagnostics.
4. Validation data was not collected from participants assigned to either the global or local condition because their *ART* scores, under the influence of priming, would likely not constitute "true" scores.
5. Here, we applied the same outlier exclusion criteria as those used in Experiment 1. We did not, however, exclude any outliers eventually, as the conclusions before and after exclusion remained the same. We thus reported the results of the complete dataset.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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