THE INDIVIDUAL AND SOCIAL COMPLEXITIES OF METACOGNITION IN EDUCATION-BASED LEARNING

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To Sylvia Lynch. Thank you.

'Never forget that you are absolutely unique. Just like everyone else'

- Margaret Mead

'Everybody is a genius. But if you judge a fish by its ability to climb a tree it will live its whole life believing that it is stupid'

'The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honours the servant and has forgotten the gift.'

-Albert Einstein

DECLARATION

This dissertation is the result of my own work and includes nothing, which is the outcome of work done in collaboration except where specifically indicated in the text. It has not been previously submitted, in part or whole, to any university of institution for any degree, diploma, or other qualification.

In accordance with the Division of Psychology guidelines, this thesis is does not exceed 80,000 words, and it contains less than 150 figures.

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THE INDIVIDUAL AND SOCIAL COMPLEXITIES OF METACOGNITION IN LEARNING

Metacognition, the knowledge and regulation of our cognitions, is an essential part of our learning. Metacognition has been linked to academic performance at all levels of education. Metacognitive skills, however, are likely to differ depending on that level. The current thesis aims to address four key questions. Firstly, how do metacognitive skills differ between undergraduate and postgraduate education? The metacognitive experiences and skills of 20 doctoral students were examined through semi-structured interviews. Thematic analysis indicated that, whilst doctoral students score above average on metacognitive skills questionnaires, doctoral students' metacognitive development is influenced by peer interaction and environment. Considering the findings presented at postgraduate level, the second question addressed was what role does social context play in metacognition at undergraduate level? The relationship was measured using both experimental and self-report measures in a first-year undergraduate population. The findings suggested that first year students are not capable of working effectively with others. The lack of capability stems, in part, from normative beliefs suggesting that the participants' peers think in a similar way to them. These relationships could also be due to individual differences, for example personality. The third question addressed, therefore, was do individual differences play a part in these relationships? Self-report measures of metacognition and personality were administered to undergraduates in all years of study. Correlational and moderation analyses indicated that conscientiousness plays a role in the implementation of metacognition in the later years of study. First-year performance, in comparison, was strongly related to extraversion, suggesting that the previous relationships found between social context and metacognition could potentially be impacted by a person's personality. Finally, can we implement the information achieved here into an intervention to improve the metacognitive skills of secondary school students? An intervention designed to promote metacognitive skills in group contexts was implemented in a secondary school classroom of 20. The intervention lasted

for 6 weeks. By the end of the intervention, analysis of Think Aloud Protocols indicated a marked difference in student's problem-solving ability and their communication skills. Overall, the findings support the idea that metacognitive skills differ between levels and years of study. Yet, the role of social context and individual differences in metacognition could be key to improving academic performance at all levels of education.

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LIST OF ABBREVIATIONS AND ACRONYMS

GPA: Grade Point Average

IPM- Interpersonal Perception Method

JOL- Judgement of Learning

LP-The Learning Process

MAI–Metacognitive Awareness Inventory

MSLQ- Motivated Strategies for Learning Questionnaire

NCE-National Curriculum for Excellence

NEO-FFI – NEO Five Factor Inventory

ToH-Tower of Hanoi

TSP- Travelling Salesman Problem

LIST OF APPENDICES

1. FOREWORD

Justification

We, as learners, have the capacity for immense knowledge. We learn through education, individual experience and social interaction. Yet, even though learning occurs in many ways, the educational literature has traditionally focused on intelligence as the main predictor of academic performance. Recently, however, the role of our ability to regulate our own knowledge has recognised as a key factor in determining academic success. Metacognition (the ability to regulate one's own thinking) is now, more than ever, at the forefront of educational and psychological research.

The cognitive processes supporting metacognition are well documented. Whilst understanding metacognition as a set of abstract, internal cognitive processes is important, as mentioned above learning is a much more complex process than consideration of just our cognitive functions would allow. The impact of environment, individual differences and social interactions must all be considered. Whilst all of these factors are known to impact on our ability to regulate our own knowledge, how these factors interact to support learning remains unknown.

The purpose of the current thesis is to address key limitations in current metacognitive research. Rather than focusing on identifying or characterising

the cognitive components of metacognitive development, the thesis aims to explore the relationships between metacognition, individual difference and social context in undergraduate and postgraduate education, with specific reference to peer learning and personality. The thesis does not aim to provide an in-depth analysis of every individual difference or type of social interaction, but rather aims to begin a discussion regarding the impact that different types of individual learning and educational environment have on metacognitive processes.

Metacognition has most consistently been investigated from a cognitive perspective. The focus of the current thesis, however, is to examine other factors involved in our awareness and regulation of our cognitive abilities. The thesis addresses four key research questions:

1. How does metacognition differ between postgraduate and undergraduate environments?
2. What role does social context play in the relationship between metacognition and academic performance?
3. How do individual differences impact on the role between metacognition and academic performance?
4. Can metacognitive improvement programmes improve metacognition through collaborative contexts?

1.1.Chapter Outline

The thesis aims to determine how metacognition differs between undergraduate and postgraduate levels of education. The problem here is that relatively little is known about the process of metacognition in doctoral study. The first empirical chapter, Chapter Three, aims to address the gap in the literature by exploring metacognition in doctoral students, specifically determining what areas of metacognition can be improved at such a high level of education. The findings suggest that metacognitive development at doctoral level is influenced by social interaction, specifically with peers.

Despite the literature surrounding collaborative learning in university contexts, there is very little known about the awareness undergraduate students have regarding peer learning, and whether they will engage with peer learning without the input of authority figures. Chapter Four begins to explore the relationships between peer learning, metacognition and undergraduate students within their first year. The chapter examines how students work together, and whether the methods used are influenced by normative beliefs about peers or students' attitudes towards metacognition.

Any relationship between social context and metacognition could also, in part, be due to individual differences, considering the literature surrounding collaborative learning and personality. Chapter Five, therefore, examines the role of personality in the relationship between metacognition and academic performance. As the literature specifies that both conscientiousness and extraversion are known to affect academic performance, Chapter Five focuses specifically on whether these traits constrain the effect of metacognition on academic success.

The final empirical chapter, Chapter 6, explores how metacognition can be improved through social context using appropriate methods. The chapter explores how an intervention based on collaborative learning can have an impact on students' problem-solving ability and communication skills, providing them with key peer learning abilities, previously linked with improved academic performance.

The final chapter considers the theoretical and practical implications for the findings presented in the thesis. Considering the current understanding of individual and social metacognition, the data presented here suggest that a relationship exists between the two. Additionally, the relationship is subject to individual differences, perceptions and beliefs. All if the above factors are incorporated into one comprehensive model of metacognition, providing a novel understanding of the role of metacognition in academic performance. Additionally, the findings will be discussed in terms of recommendations for practice, offering solutions for how teachers can improve the academic

performance of each child both as an individual and using social learning methods.

1.2. Outcomes

The present thesis aims to produce both theoretical and practical outcomes. In theoretical terms, the thesis aims to contextualise metacognition in learning, incorporating individual and environmental factors into a novel metacognitive model. The theoretical expansion, however, can have no real impact without consideration of the implications that this information on educational practice. In addition, therefore, the potential practical outcomes of the research findings are of central concern. The experimental data presented within Chapters Three and Six reflect the outcomes of metacognitive improvement programmes. Most importantly, the findings from the thesis are incorporated into an intervention designed to promote metacognitive development before students reach university. Before these interventions are discussed, however, the next chapter presents an overview of previous and current metacognitive literature, providing a brief insight into the complexities of metacognition in education.

2. The Individual Complexities of Metacognition in Education

"Much of the time we are transfixed by all the ways we can reflect ourselves out into the world and barely find the time to reflect back deeply in on our own selves"
-Ariel Garten

2.1.Introduction

The role of the university student requires many different skills. Students must be able to learn independently, think critically and navigate the social environment of higher education (Briggs, Clark & Hall, 2012; Christie, Barron & D'Annunzio-Green, 2013). The theories of how students develop these skills are varied. Whilst intelligence has long been thought to be the key predictor of academic performance, recent evidence suggests that it is not the most important characteristic of a successful student. Rather, Wang, Haertel and Walberg's (1990) detailed content analysis of literature related to learning highlights a more significant factor in academic performance. From the 179 sources selected for the review, including handbooks, review chapters and papers, Wang and colleagues concluded that student's metacognitive ability has a more significant impact on academic success and is at least partially independent of their intelligence. The review also highlighted the importance of the peer group in learning, highlighting the impact of the environment in educational settings, an area not typically incorporated into metacognitive accounts of learning. This thesis aims to provide an understanding of

individual and social metacognition, merging these distinct factors into one coherent model. The initial chapter begins by providing an overview of metacognitive theory and the role of metacognition in education.

2.2.Early Conceptualisations of Metacognition

For the purposes of the current thesis, it is important to understand the development and conceptualisations of metacognition. The earliest conceptualisation of metacognition focused entirely on metamemory. Metamemory focuses on the knowledge and regulation of our memory behaviour. The original contribution to understanding metamemory was theorised by Brown (1975). The theory highlighted three categories of metamemory: knowing, knowing about knowing, and knowing how to know. Knowing refers to the systems we have in place to understand our cognitions (Brown, 1975; Flavell, 1979). Knowing about knowing suggests a conscious awareness of our memory processes (Brown, 1975; Flavell, 1971; Tarricone, 2011). Knowing how to know includes strategies and actions designed to encourage improved memory (Brown, 1975; Flavell, 1979; Tarricone, 2011).

In comparison to Brown's three level taxonomy, Flavell and Wellman (1975) suggested that memory processes could be divided into four distinct categories incorporating both memory and metamemory. A review of relevant metamemory literature highlighted four key categories of memory. The first category focuses on the basic processes of memory at an unconscious level, including retrieval and cueing. The second, third and fourth categories reflect the categories presented by Brown (1975). The second category also focuses on unconscious and involuntary processes and highlights the impact of general cognitive activity on memory behaviour. Within this category, specific reference is made to advances in semantic knowledge that occur with age, making content more familiar and, therefore, memorable.

The third category in Flavell and Wellman's model marks a step towards more conscious memory processing. The category begins to incorporate strategies which could be used to improve memory function. The rehearsal of

information, conscious reconstruction of events, or 'retracing your steps' to find mislaid objects, are all described as voluntary processes attempting to influence our unconscious processes. Finally, the fourth category is labelled 'metamemory', the knowledge and awareness of memory. This ability refers to our awareness of what we might have problems remembering, understanding that some information is irretrievable, or being consciously aware that we have memorised information that is difficult to recall.

Flavell's original research into metamemory was succeeded by research that extends the early models into the area of cognitive monitoring. The change in focus stemmed from Flavell's research into the metamemory of schoolchildren. Flavell, Friedrichs and Hoyt (1970), for example, measured children's metamemory through two procedures. The first procedure assessed the child's ability to predict their memory span using familiar objects such as toys. The second procedure aimed to determine whether children could identify when they had sufficiently memorised information for perfect recall. Children were given a series of pictures which they could only see when holding a button. The participants were advised that they could hold the button for as long as they wanted, until they had memorised the information. The procedure was carried out on four age groups; nursery school children, kindergartners, second graders and fourth graders. Analysis of variance between the age groups demonstrated that, whilst older schoolchildren could identify when they had memorised information correctly and demonstrated perfect recall (Flavell, Friedrichs & Hoyt, 1970), younger children often mistook their readiness to recall items, resulting in flawed recall of items.

From these findings, Flavell suggested that children struggled to monitor or understand their own memory. Furthermore, Flavell suggested that the deficiencies were not limited to a child's memory, but rather there was a global deficiency in their metacognition i.e. the ability to understand and regulate one's own cognitions. Flavell concluded that children had limitations in their metacognitive ability. In other words, the children lacked accurate cognition about their cognitions. The model of cognitive-monitoring was therefore an attempt to address the question of the developmental targets

of a child's metacognitive progression, leading to "adultlike knowledge and behaviour" (Flavell, 1979, p.906). The new, revised model was comprised of four different phenomena that influence cognitions: metacognitive knowledge, metacognitive experiences, goals and actions.

Each of the sub-components have a specific purpose in metacognition. Metacognitive knowledge refers to an individual's knowledge considering their own cognitive processes. The facet of knowledge refers to active monitoring of an individual's cognition and evaluating their knowledge accordingly. Metacognitive experience refers to any conscious or emotional experience in a person's learning. Flavell suggests that these experiences are normally highly conscious and are often a product of situations that require a higher order of thinking. Metacognitive goals and tasks, put simply, refer to the goals set in place to achieve, and the behaviours or strategies employed to achieve them.

Flavell specifies that each of the components detailed above interact with each other. Moreover, some metacognitive experiences are described as aspects of metacognitive knowledge that make their way into consciousness, related to Flavell's previous models' ideas of memory recall. Flavell also specifies that metacognitive experiences can influence your metacognitive knowledge, through adding information, changing the information already held, or removing information completely. Metacognitive experiences and knowledge also have an impact on an individual's goals, activating the most effective strategies at the time, depending on the action required.

There are two facets commonly discussed in more modern metacognitive models, in comparison to Flavell's original conceptualisation. Currently, metacognition is divided into two main sub-components: metacognitive knowledge (as identified by Flavell, 1979) and metacognitive regulation. Metacognitive regulation incorporates the sub-component of metacognitive strategies and goal orientation as previously discussed by Flavell.

Within the thesis, the sub-components of metacognitive knowledge, regulation and experiences will be referred to frequently. Table 2.1 highlights the numerous facets within these components that are discussed within the literature. The subsequent sections discuss the sub-components of metacognition and the further sub-divisions within each of them, providing an overview of the concepts used here.

2.3. Metacognitive Knowledge

Metacognitive knowledge, as introduced above, refers to our ability to understand our knowledge and evaluate it accordingly. Jacobs and Paris (1987) suggested that the understanding and evaluation of information could be attributed to three key sub-facets of metacognitive knowledge: conditional, procedural and declarative knowledge. The importance of including declarative knowledge was supported by research into children's cognitive processes, demonstrated that good learners demonstrated a better understanding of their own memory, including the limitations of their own memory capacity and their ability to rehearse and retain information (Garner, 1987; Schneider & Pressley, 1989). The inclusion of procedural knowledge was supported by research demonstrating that higher levels of procedural knowledge facilitated automatic task performance and was related to retaining a higher number of strategies (Pressley, Borkowski & Schneider, 1987). Conditional knowledge was related to improved adaptation of strategies and flexibility of learning (Reynolds, 1992).

In comparison, Flavell further divides metacognitive knowledge into person, task and strategy. The person category refers to an understanding of yourself and others as "cognitive processors" (Flavell, 1990, p.907). The second category, task, refers to the understanding of the best strategy to use to achieve your goals, and how likely you are to be successful in achieving said goal. The strategy category of metacognitive knowledge focuses on the knowledge obtained about certain strategies, and which of these strategies are most effective in certain situations.

Table 2.1: Demonstrating Common Sub-Components of Metacognition (Sections within the current chapter noted beside each facet).

Metacognition	Component	Sub - Component	Citation
Metacognitive Knowledge (2.3)			Brown, 1978; Flavell, 1979; Jacobs & Paris, 1987; Kluwe, 1982; Schraw & Dennison, 1994
	Declarative Procedural Conditional	Person, task, strategy knowledge	Tarricone, 2011
	Tacit theories Informal Theories Formal Theories		Schraw and Moshman, 1993
Metacognitive Regulation (2.4)			Brown, 1978; Miller, 1991; Paris et al., 1984; Schraw and Dennison, 1994
	Self-Regulation (2.4.1)	Monitoring/Control (2.4.2)	Nelson, 1990; Newell, 1990; Schraw, 2009; Pieschl, 2009
	Strategy (2.4.3)		Borkowski, Carr & Pressley, 1987; Brown, 1978; Flavell, 1979; Pintrich, 2002
	Metacognitive Experience (2.4.4)		Flavell, 1979; Efklides, 2008
	Planning Monitoring Evaluation		Miller, 1991; Paris et al., 1984; Schraw & Dennison, 1994; Schraw and Moshman, 1993;

Deviating from the definitions of metacognitive knowledge as suggested by Flavell (1979), Schraw and Moshman's model of metacognition (1995) consisted of three different metacognitive theories: tacit, informal and formal. *Tacit theories* are gradually constructed or acquired frameworks that help organise metacognitive knowledge. The person is not aware of this knowledge. *Informal theories* refer to theories that one is aware of to a certain extent. They have some of the knowledge or assumptions regarding a theory but have not yet made that theory concrete. *Formal theories* consist of highly thought out and well-constructed theories.

The important difference between tacit and informal knowledge is that informal knowledge tends to have a degree of explicit metacognition. Schraw and Moshman highlight that, whilst tacit theories are not likely to develop due to the lack of awareness, informal knowledge is likely to begin as domain specific knowledge and develop to become domain general. According to this research, formal theorists are likely to be aware of their knowledge, and purposefully modify this knowledge with regards to their goals. The theories presented by Schraw and Moshman (1995) highlight that metacognition may not be static, but rather reflects a process that varies along a continuum. The theories are considered as interactive, whereby information received from one individual may influence others. The concept of social impact and interactivity are consistent with Flavell's original theory, which suggested that metacognitive knowledge, experience and strategies are all interconnected. The inclusion of metacognitive experience is also consistent with Flavell's suggestion that metacognitive processes can be affected by conscious and emotional experiences.

To address the lack of clarity in the identification of metacognitive sub-components, Tarricone (2011) carried out an extensive review of the existing metacognitive literature, categorising all sub-components and presenting an overall taxonomy of metacognition. As part of the categorisation, the taxonomy of metacognitive knowledge identifies with the most common division of the component, namely separation into procedural, declarative and conditional knowledge. From an extensive evaluation of the literature, Tarricone (2011) identified that each of these sub-components could be further divided. The component of declarative knowledge includes person metacognitive knowledge (self-knowledge and knowledge of others) and task metacognitive knowledge (understanding of task and content including task complexity). Procedural knowledge includes the sub-category of strategy metacognitive knowledge. The sub-category includes critical reflection and implementation in complex problem-solving settings. Tarricone (2011) suggests that strategy knowledge is enhanced through an interaction between both person and task components but is also supported by monitoring and

control processes. These monitoring and control processes are more commonly considered as sub-components of metacognitive regulation.

2.4.Metacognitive Regulation

In comparison to Flavell's original Model of Cognitive Monitoring, more recent models of metacognition identify a second component in addition to knowledge: metacognitive regulation. Metacognitive regulation can be defined as adapting and regulating knowledge into goals and employing strategies that can optimise performance. The regulation component incorporates Flavell's facet of metacognitive goals and strategies. Metacognitive experience as defined by Flavell can also be incorporated into regulation. The inclusion of experience, however, is less common in more recent models. Table 2.1 highlights the complexity of defining regulation, describing the numerous facets that metacognitive regulation can further be divided into. Below, each of these facets has been discussed independently.

2.4.1. Self- Regulation

Tarricone's taxonomy of metacognitive regulation includes the sub-components of self-regulation and metacognitive experience (which is discussed in section 4.4). Within self-regulation, monitoring and control processes are included. Tarricone (2011) suggests that monitoring and control interact with metacognitive knowledge to assist with appropriate strategy application. From this perspective, both components enhance performance in complex tasks. Self-regulation, in comparison, helps implement behaviours such as planning, self-evaluation, organisation and monitoring, all of which are behaviours frequently mentioned when discussing metacognitive regulation overall.

Self-regulation, according to Tarricone (2011), also incorporates executive functioning. Executive functioning was originally incorporated into neuropsychology as a means of explaining neurological deficits in patients. These deficits included problem-solving, planning and attentional skills.

Executive functioning, whilst classified as a cognitive process, is key in higher order cognitions. Roebers and Feurer (2016) examined the relationship between executive functioning and procedural metacognition from a theoretical review of existing literature. From the review, Roebers and Feurer propose a two-factor structure of procedural metacognition like that proposed of Nelson and Narens (1990) in that the structure consists of monitoring and control. Roebers and Feurer's theoretical review highlights that there are many theoretical characteristics shared between procedural metacognition and executive functioning. Yet, research does not support a strong link between the two concepts. It is possible that, whilst executive function is key to higher order cognitions, it has a different role in metacognition. Rather than acting as a sub-component of metacognitive processes, executive function, as a separate process, ensures the implementation of strategies at a more basic cognitive level. Monitoring and control, in comparison, form a significant part of many metacognitive models.

2.4.2. Monitoring and Control

Like Flavell's Model of Cognitive Monitoring, Nelson and Narens' Model of Metacognition is often central to previous metamemory research. A product of reviewing the metamemory literature, Nelson & Narens' model of metacognition incorporated what Nelson described as 'abstract principles that have been individually used in isolation by other authors' (Nelson & Narens, 1990, p.125). The first principle relates to the overall structure of metacognition; namely that cognitive processes are divided into two levels. The 'object level' refers to our basic, unconscious cognitive processes. The 'meta-level' refers to a higher order level of processing. The second principle of the framework suggests that the meta-level of processing contains a mental recreation of the object level, whilst principle three determines the flow of information from the object level and the meta-level through two processes; control and monitoring. Nelson and Narens (1999) argued that these processes are not used in isolation, but work in conjunction with each other.

Nelson and Narens further develop principle three, identifying the flow of information through control and monitoring. Critically, the process of control allows the meta-level to modify the object level (Nelson, 1990). The meta-level can instigate, regulate or stop an action within the object level. In comparison, monitoring reverses the direction of the flow of information from object level to meta-level. The meta-level becomes informed by the object level. Moreover, because the meta-level has a simulation of the object level, it is possible to monitor the situation and change the behaviour accordingly. However, the object level cannot monitor the meta-level because it does not have an accurate simulation of higher order processing. When first examining Nelson's metacognition framework, the ideas can seem somewhat simplistic in comparison to other models, as it only consists of two levels. Nonetheless, Nelson's model offered a novel view of the relationship between memory and meta-memory that made specific claims about what processes are involved, and how they are related. Specifically, according to this view, the levels are both hierarchical and dynamic in nature. Whilst the meta-level can control the object-level, the object-level can change the state of the meta-level, thus creating a new way to affect an individual's metamemory and vice versa. These monitoring and control processes influence the strategies we implement to achieve our goals.

2.4.3. Metacognitive Strategy Use

Strategy use normally forms the basis of metacognitive measurement. Often, metacognitive measures will focus heavily on the strategies we employ to complete specific tasks, or how we use strategies to perform academically. There are instances that suggest strategy use can be used to identify when people spontaneously engage with metacognition. Borkowski, Carr and Pressley (1987), for example, aimed to provide an explanatory framework on spontaneous strategy use from a theoretical review of metacognitive literature focusing on the topic. From the review, Borkowski and colleagues highlight that the term spontaneous strategy was often used by researchers to explain unprompted engagement with metacognitive behaviours. Moreover, Borkowski and colleagues' review of the literature surrounding spontaneous

strategy use indicated that children were largely deficient in these behaviours. For example, the authors discuss the research of O'Sullivan and Pressley (1984), who measured spontaneous strategy use using the keyword method. The keyword method is a mnemonic technique designed to improve learning associations. The method was taught to fifth and sixth grade children, whilst one control condition received no training on the technique. O'Sullivan and Pressleys' findings highlighted that, when students were provided with elaborated instructions within the experimental condition, the likelihood of students being able to transfer strategies improved.

Borkowski and colleagues also refer to a series of papers examining the phenomenon of spontaneous strategy use. Flavell and colleagues had identified that these strategies increased with child development. By contrast, a study carried out by Keeney, Cannizzo and Flavell (1967) explored whether children who did not engage with mnemonic strategies could be prompted into doing so. Eighty-nine six- and seven-year olds were given a non-verbal serial recall task. Children were then divided according to their performance as either a 'rehearser' or a 'non-rehearser', with non-rehearsers performing significantly worse on the task. 'Non-rehearsers' were then provided with training to induce rehearsal. The scores of non-rehearsers after training were akin to the scores of the rehearsers. The non-rehearsers, however, did not continue to use the strategies they had been taught after training, despite the clear advantage to their recall. From the reviewed findings, Borkowski and colleagues concluded that the apparently unprompted strategy use was a "misrepresentation of underlying processes" (Borkowski, Carr & Pressley, 1987). According to their account, the so-called spontaneity was a product of interactions between metacognitive knowledge, metacognitive strategies and motivational beliefs.

Because of the theoretical review discussed above, Borkowski, Carr and Pressley (1987) defined a new model of metacognition specific to metacognitive strategy use; the Good Information Processing Model. The model combined various sub-components of metacognition into one integrated theory of metacognition. The factors included were knowledge

about strategies (specifically how, when and where to use them), knowledge about how these strategies relate to others, knowledge about how to monitor and evaluate strategies, and general beliefs about the strategies themselves. Despite designing their research to address limitations in Flavell's research, the model designed is significantly like Flavell's Model of Cognitive Monitoring. Metacognitive strategies are key to understanding the regulation component of metacognition. Specifically, Metacognitive behaviours are directly influenced by metacognitive processes. Observing metacognitive behaviours can often be an explicit method of understanding what strategies individuals choose to use. During a task, for example, an individual may demonstrate behaviours related to a planning strategy by taking the time to consider alternative solutions to the task at hand before beginning. Strategy use, however, is often dependent on situational factors. Metacognitive experience becomes key here, influencing how to approach the task by considering how the environment influences the problem.

2.4.4. Metacognitive Experience

In comparison to the more cognitive models of metacognition that include sub-components such as executive functioning, Flavell's original Model of Cognitive Monitoring also included the sub-component of metacognitive experience. Metacognitive experience, within Flavell's model, has the potential to influence our metacognitive knowledge and strategies through our conscious and emotional experiences, which is highly relevant to learning through our environment.

The absence of metacognitive experience in more recent models is notable, although many of them consider metacognitive experience to influence the development of other factors. Like Flavell (1979), Tarricone categorises metacognitive experiences as both emotional and conscious, and suggests that the retrieval and application of knowledge can be facilitated through the experiences of individuals during cognitive tasks. Tarricone suggests that the monitoring of unconscious feelings also contributes to this facilitation. The role of self-efficacy is also included within metacognitive experience. It is suggested that self-perception can impact on metacognitive experience and,

in turn, influence our metacognitive knowledge. In comparison to other sub-components of metacognitive regulation, there is relatively little research that focuses on the role of metacognitive experience in academic performance. Yet, experience is a key factor to consider when exploring how metacognition influences academic success.

In addition, metacognitive sub-components often have relationships with other psychological constructs such as self-efficacy. The thesis does not explore these other psychological constructs in depth, but there still must be consideration given to how these constructs may help explain relationships between metacognition and academic performance. The next section, therefore, will briefly discuss how metacognition interacts with other psychological constructs, specifically within education.

2.5. Metacognition and Other Psychological Constructs in Educational Practice

The practical implications of psychological theories for attempts to improve academic outcomes are essential to the current thesis. The educational system has been known to incorporate many different theories into educational practice in the hope of encouraging academic success. The role of metacognition has been consistently supported as enhancing academic performance from its inception. Yet, there are other psychological constructs that share characteristics with metacognition. Four of the most prominent modern constructs focus on Motivation Theory, Approaches to Learning, Self-Regulated Learning and self-efficacy. These theories are briefly outlined below.

2.5.1. Approaches to Learning and Metacognition

Metacognition shares characteristics with several psychological theories, including Approaches to Learning. A series of studies conducted in the late 1970s by Marton and Saljo (1970) identified two main approaches to

learning: surface approaches and deep approaches. At the basic level, the surface approach relates to shallow learning, for example, whereby the student will simply try to remember information (e.g., a text), rather than trying to understand the information. In contrast, students who engage in a deep approach to learning will try to understand the information they are presented with, and construct meaning from it (Webb, 1997). Whilst the concept of surface and deep learning is prevalent, they have been enhanced to further examine the relationship between the quality of learning and the processes adopted by the student. For example, the Study Process Questionnaire designed by Biggs (1978) identified three key dimensions of study motivations: utilising, internalising and achieving.

Utilising refers to students reasoning for attending university as minimal; they attend to obtain a degree, and therefore do minimal work to avoid failure. Because the student's behaviour is based on negative (rather than positive) motivation, they will typically study with the aim of regurgitating information, rather than attempting to understand and contextualise the content (Biggs, 1978). By contrast, Biggs suggests that students who 'internalise' attend university as a means of self-actualisation and are more likely to read beyond the basic texts provided, trying to link concepts and information. Students with the aim of achieving will have motivations that revolve around competition and the goal of achieving academic excellence. Biggs relates these dimensions to the identification of surface and deep learning. Surface level processing closely relates to the cognitive component of utilising, whilst there are strong parallels between the cognitive process of deep learning and internalising.

Within the educational literature, an extensive collection of research has demonstrated that students who adopt a deep approach to learning have greater academic success (Chamorro-Premuzic & Furnham, 2008; Diseth, 2003; Entwistle, 1988). Some researchers, however, remain unconvinced that the proposed surface and deep learning categories are complex enough to accurately depict learning. For example, case studies completed by Case and

Marshall (2007) suggested that surface and deep learning processes exist on a continuum, rather than as separate processes (Fig. 2.1).

Before Case and Marshall's approaches to learning theory, Marshall (1995) had identified three separate approaches to learning: information based, algorithmic and conceptual. The information-based approach could also be identified as the surface approach. Marshall identified this response as reflecting students' unwillingness to establish relationships throughout the learning process. This approach relies solely on the memorisation of formulae, with the intention of regurgitation in examinations. By contrast, the algorithmic and conceptual approaches are identified as separate dimensions of deep learning. The procedural deep approach refers to the relation of formulae to each other to allow students to understand them in the future through familiarity with problem solving approaches. The conceptual approach refers to students who relate learning tasks to underlying concepts, with the intention of gaining understanding throughout the learning process. Finally, in an extension to this framework, Marshall also identified the procedural surface approach, based on two sets of findings; Marshall's surface approach incorporated Case's information based and algorithmic approaches, whilst Case's conceptual approach includes both Marshall's procedural deep and conceptual deep approaches. These two intermediate approaches between deep and surface learning led Marshall and Case to propose that deep and surface learning approaches exist on a continuum (Figure 2.1).

It would be reasonable to associate approaches to learning, in particular deep learning, with metacognition. Students engaging with the deep approach focus heavily on understanding what they are learning to adapt the information at a later stage. The theoretical characteristics of the deep approach are very similar to those of metacognition. In comparison, there is the possibility that students can use both deep and surface approaches to learning depending on task conditions. These conditions could include how much time the learner has before an exam, what information is required or the situation in which they are learning. These learners use what is known as the

strategic (Entwistle & Ramsden, 1982) or the achievement (Biggs, 1987) approach. Learners that engage with the strategic approach are motivated by positive outcomes, such as achieving high grades.

Which approach (deep or strategic) is more metacognitive? It could be argued that the deep approach shares the most theoretical characteristics with metacognition. These characteristics are so similar that Case and Gunstone (2002) that metacognitive development could be characterised as a shift in approaches to learning (i.e. using a deeper learning approach). It could also be argued that the difference between deep learners and strategic learners stems from differences in task orientation. Deep learners strive to achieve understanding, whilst strategic learners strive to achieve positive outcomes. The difference here, seems to be more indicative of a student's motivations. Deep learners will be more intrinsically motivated (e.g. motivated to develop their understanding), whilst strategic learners focus more heavily on extrinsic motivations (e.g. high grades). The difference would suggest that motivation plays a large role in how we choose to learn.

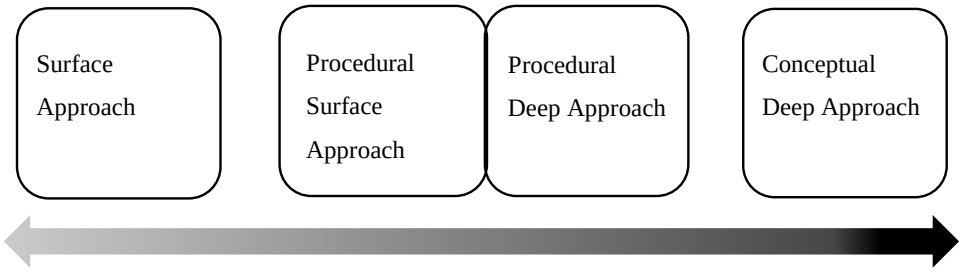


Figure 2.1: The Continuum of Deep and Surface Learning (Adapted from Case and Marshall, 2007).

2.5.2. Motivation and Academic Achievement

It is no surprise that motivations should play a vital role in education. Sansone and Harackiewicz (2000) suggest that psychologists focus on two primary causes of behaviour; biological needs or desires (such as procreation) and extrinsic reward. Both these causes relate to a motivation to achieve a positive outcome. In more recent years, the role of motivation in education can stem from various outcomes. These include achieving high grades or learning for

the enjoyment of gaining new knowledge. Motivation, however, can be categorised in many ways. Which of these categorisations is most successful to learning? The basis of motivational theory, and the most commonly identified motivations, include intrinsic and extrinsic motivation, as mentioned above.

Intrinsic motivations tend to be more focused on the completion of a task based on the completion itself, rather than on a subsequent reward (Sansone & Harackiewicz, 2000). Intrinsic motivations have been linked to high academic achievement in all levels of education. For example, Taylor et al. (2014) examined the role of intrinsic motivation in predicting academic achievement across cultures and school contexts. Four studies were reported on, the first of which was a meta-analysis of cross-sectional research using the Academic Motivation Scale. A moderator analysis of the chosen literature indicated intrinsic motivation as a consistent predictor of academic performance across high school and university, however the effect of intrinsic motivation was more strongly related to academic performance in high school than in university education.

Whilst the meta-analysis carried out by Taylor and colleagues (2014) highlighted the importance of intrinsic motivation on academic achievement, there was little consideration surrounding other factors that intrinsic motivation may have moderated. Other factors could have been accounted for. For example, a descriptive-correlational study by Khalaila (2014) examined the role of self-concept and motivation in academic achievement among nursing students. One hundred and seventy nursing students from a University in Israel completed the Academic Self-Concept Scale (Reynolds, 1988), the Test Anxiety Inventory (Speilberger, 1980) and the Academic Motivation Scale (Vallerand et al., 1992). The scores across these scales were then compared to the average grade performance across all courses and clinical practice. The variables were entered into a multiple mediation analysis, with academic self-concept entered as the independent variable, academic performance as the dependent variable. Both test anxiety and academic motivation were entered as mediators in the analysis. The variables

were further entered into a moderation analysis to determine whether test anxiety and motivation interacted to influence academic performance. The findings indicated that both academic motivation and test anxiety mediated the relationship between academic self-concept and academic performance. Moreover, academic motivation was supported to moderate the negative effect of test anxiety on academic performance.

The focus of research into the role of motivation in education tends to focus heavily on intrinsic motivation. The focus is reasonable, considering that intrinsic motivation stems from a person's self-belief. There are, however, researchers that argue for the role of extrinsic motivation in academic performance. Extrinsic motivations refer to motivation that is driven by external incentives (such as receiving money or high grades for good performance). In a longitudinal meta-analysis, Cerasoli, Nicklin and Ford (2014) explored the relationship between intrinsic motivation, extrinsic incentives and academic achievement. Within the meta-analysis, two moderators were also included: performance type (quality vs quantity) and incentive contingency. From 950 articles, conference papers and dissertations, Cerasoli and colleagues concluded that extrinsic incentives were related more strongly to the quantity of performance whilst intrinsic motivations were more predictive of the quality of performance. Finally, it was suggested that both intrinsic and extrinsic motivations should be considered simultaneously, rather than as antagonistic to each other.

The differences between intrinsic and extrinsic motivations, as highlighted by Cerasoli and colleagues, seem to extend from the type of performance necessary. There is the possibility, therefore, that students require more than just motivation to adapt to the type of performance. Consequently, motivation is often considered as one aspect of learning models. For example, motivation and metacognition are often discussed in terms of the broader model of self-regulated learning.

2.5.3. Self-Regulated Learning

Not to be confused with metacognitive regulation, self-regulated learning is a broader model that incorporates metacognition as a part of the learning process, whilst also including motivation and executive functioning. To establish a broader view of the learning process, the self-regulated learning model was posited. Self-regulated learning, like metacognition, is often described as a multi-faceted and complex theory. Pintrich (1990) suggested that, in addition to metacognitive and cognitive learning strategies, students must also be motivated to improve their own learning.

The term self-regulated learning is often confused with the terms metacognition and self-regulation. In theoretical terms, however, the concepts are distinctly different. Whilst metacognition focuses on the cognitive aspects of learning highlighted by Flavell, self-regulation was initially introduced by Bandura (1986) and focused heavily on behavioural and emotional regulation. At a later stage, Bandura's work influenced the inclusion of another component: motivation. The creation of the self-regulation model led to the emergence of the theory of self-regulated learning. Self-regulated learning initially served as an integrative view of learning, incorporating metacognition and self-regulation, in conjunction with contextual factors to provide a broader account of learning (Corno & Mandinach, 1983). The theory has, since then, been rewritten to become a more concise theory of learning, whilst still incorporating the factors of cognitive learning strategies, metacognition and motivation (Zimmerman, 2002).

Zimmerman (2002), however, considered the earlier self-regulated learning models as lacking in consideration of individual differences. As a response to the limitations in previous literature, Zimmerman amalgamated previous self-regulated learning models with social learning literature and developed a cyclical model of self-regulated learning that incorporates both theories. Zimmerman's self-regulated learning model highlights three key phases of learning; forethought, performance/volitional control and self-reflection.

Each of these phases incorporates two other classes. The Forethought phase includes task analysis and self-motivation beliefs; The Performance phase incorporates self-control and self-observation; The Self-Reflection phase includes self-judgement and self-reaction. The classes within each phase mirror the metacognitive components of planning, monitoring and evaluation. There are additional components that are not included in metacognitive models, however. Whilst forethought includes the planning aspect of metacognition (in terms of goal setting and strategy planning), consideration is also given to self-efficacy during this phase. Similarly, the performance phase includes the environment in components of attention focusing and excluding distractions, in addition to the metacognitive components of self-monitoring and self-instruction.

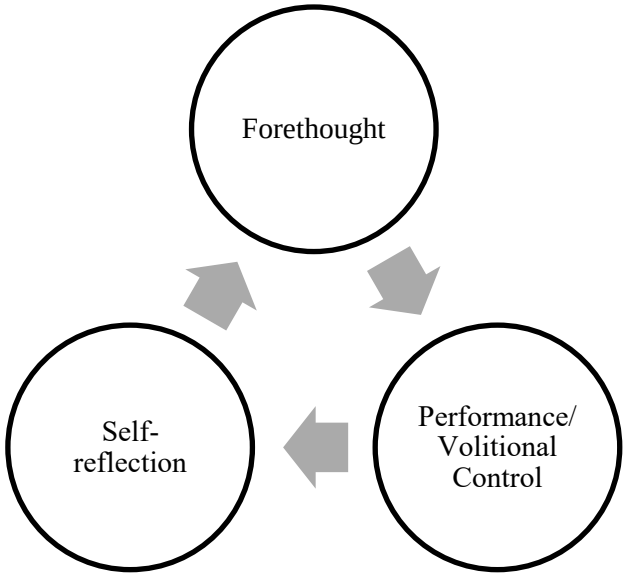


Figure 3.2: Zimmerman's Cyclical Model of Self-Regulated Learning (2002).

The influence of self-regulated learning on academic performance is well documented and well supported. The consensus is that self-regulated learning has a positive impact on academic success (Pekrun, Goetz, Titz & Perry, 2002; Zimmerman, 2001). Such positive findings are perhaps unsurprising, given that the model incorporates so many components already known to impact academic performance. Whilst considering metacognition as an integrated part of the self-regulated learning model has merits (such as

providing a broader model of learning), there is a concern that research may start to overlook the complexity of metacognitive theory independent of self-regulated learning models. Self-regulated learning provides a broad perspective on academic performance, but there is still a need to examine each of the factors of metacognition, motivation, and cognitive strategies independently, and in detail, to ensure that we have an accurate understanding of what determines academic success. Additionally, we need to consider how the individual perceives their own competence in terms of performance. An individual's self-efficacy can both improve and impede their academic success.

2.5.4. Self-Efficacy

Self-efficacy relates to the confidence of an individual in their own ability to manage and complete tasks (Bandura. 1995). Self-efficacy has been related to numerous other psychological concepts, both directly and indirectly affecting academic performance. Honicke and Broadbent (2016), for example, carried out a systematic review incorporating twelve years of research on the relationship between self-efficacy and success. The researchers systematically reviewed electronic databases for research papers, theses or dissertations that specifically investigated the role of self-efficacy on academic performance, either directly or indirectly (e.g. as a mediator). The review identified 59 eligible papers. The review incorporated literature from 16 different countries, the majority of which were from the USA (33 of the 59 identified).

From the correlational findings identified in 53 of the studies (the rest were discounted as they did not include correlational data), Honicke and Broadbent suggest that there is a moderate reported relationship between self-efficacy and academic performance. Several mediating relationships were also observed, including goal orientation and self-regulated learning strategies (incorporating metacognition and motivation). Furthermore, relationships were found between self-efficacy and non-cognitive factors. The personality variable conscientiousness was highlighted as a mediating factor between self-efficacy and academic performance.

The number of observed relationships with other factors may cause the relevance of self-efficacy to be overlooked. Baddareen, Ghaith and Akour (2015) investigated the relationship between self-efficacy, achievement goals and metacognition in predicting academic success. One hundred and forty-five undergraduate students completed the Academic Self Efficacy Scale (Owen & Fromen, 1988), the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) and the Goals Inventory (Roedel, Schraw & Plake, 1994). Additionally, students also completed the Academic Motivation Inventory (Vallerand, Pelletier, Blais, Brierem, Senecal & Vallieres, 1993). Stepwise regression analysis indicated that both mastery goals and metacognition predicted academic performance, however no significant relationship was observed with self-efficacy. Baddareen and colleagues, however, suggest that the lack of relationship observed could be a consequence of the high correlations self-efficacy shares with other predictors. If this were the case, the stepwise regression would have removed self-efficacy on the basis of the shared variance.

In comparison, Aydin (2015) investigated the relationship between self-efficacy, metacognitive strategy use and academic motivation within secondary biology education. Two hundred and eighty-six students from three high schools in Turkey completed the Self-Efficacy for Learning and Performance Scale and the Metacognitive Self-Regulation Scale (both sub-scales of the MSLQ). The students also completed the Academic Motivation Scale for Learning Biology (Aydin, Yerdelen, Gurbuzoglu, Yalmanci & Goksu, 2014). Correlational analysis indicated observed relationships between self-efficacy, metacognitive strategies and academic motivation. A path analysis also indicated that intrinsic motivation had a positive relationship with both self-efficacy and metacognitive strategies, with both variables explaining 34% of the variance in levels of intrinsic motivation. Self-efficacy also explained 20% of the variance in levels of amotivation.

Again, self-efficacy was observed to have relationships with numerous factors that influence academic performance. There is, however, conflicting

evidence as to whether this factor affects academic performance in a predominantly direct way, or whether the relationship is mainly observed through other factors. Throughout the literature, the role of metacognition is linked indirectly to concepts such as self-efficacy and motivation. The next section explores the explicit role of metacognition in academic performance.

2.6. The Metacognitive Influence on Academic Performance

Metacognition can influence our behavioural regulation in many different ways. The methods in which we use metacognition are highly dependent on the tasks we are prescribed. Throughout education, however, these tasks will change. The methods of completing coursework at university level may differ significantly from the methods required to do well on a GCSE maths test. In postgraduate education, completing a PhD may differ significantly from completing an undergraduate degree. Below, the literature surrounding metacognition and education at three different levels (secondary, undergraduate and graduate education) will be discussed. Whilst there is extensive literature on metacognition in primary education, this literature is not relevant to the current thesis and therefore will not be addressed.

2.6.1. Metacognition and Secondary Education

The transition from primary to secondary education can cause some students' grades to decline. In a cross-sectional study of 12- to 16-year olds from four countries (The Netherlands, Switzerland, Czech Republic and Germany), Peetsma et al. (2005) reported a general decline in students' mathematical and native tongue grades. Wijsman, Warrens, Saab, Driel and Weisenberg (2015) also found a general decline in the average academic grades of 1544 Dutch secondary school students from grades seven to nine (aged between 12 and 15). Wijsman and colleagues suggest that this academic decline could be the consequence of lacking metacognitive skills. As the educational level develops, the content becomes more cognitively challenging. Van der Stel and Veenman (2010) suggest that metacognitive skills are still developing during the early years of secondary education. The pre-frontal cortex

(responsible for executive functioning) is also developing, therefore metacognition may still be developing at this age. Wijsman and colleagues, therefore, suggest that the general decline may be simply because students have not developed the metacognitive skills necessary to do well. There is little evidence to support the statement without a further longitudinal analysis on how these students progress in the later stages of their education.

There is, however, an abundance of research supporting the role of metacognition in academic success. For example, Dekker et al. (2016) explored the role of metacognitive self-regulation on goal orientation in secondary school students. Dekker and colleagues provided 735 students aged between 10 and 19 with vignettes from other students discussing goal orientation. Students were then asked to choose the vignette most relevant to them. The researchers used this as a method of determining the students' dominant goal orientation. Academic achievement was measured using average grades for three subjects: Dutch, English and mathematics. The Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, García, & McKeachie, 1991) was used as a measurement of metacognitive self-regulation. A mediation analysis suggested that goal orientation predicted academic achievement through metacognitive self-regulation. Age, gender and level of parental education were controlled for. The researchers suggested that the vignettes could be used as a method of identifying students who are vulnerable to lower academic achievement.

As previously discussed, metacognition is suggested to have both a direct and indirect effect on academic success. Ghamari, Salehi and Foumany (2015), for example, explored the relationship between learning styles, self-efficacy and metacognition in the academic performance of Iranian female high school students. The cross-sectional correlational study, 380 students completed the Learning Styles Inventory (Beronsky, 1992), the General Self-Efficacy Scale (Sherer et al., 1992) and the Metacognitions Questionnaire-30 (MCQ-30; Cartwright-Hatton & Wells, 1997). Average Grade Point Averages (GPA) were used as a measurement of educational success. Multivariate linear regression models indicated that learning styles, self-efficacy and

metacognition were all associated with educational success. More specifically, the use of the MCQ-30 focuses on metacognitive beliefs. The relationship observed between metacognition and educational success was due to the inclusion of a cognitive self-consciousness scale. The findings suggest that, whilst metacognitive skills are important, even in adolescence students can be aware of their own cognitions and this awareness can impact on their academic performance.

Throughout the literature, the effect of metacognition on educational success at secondary school level is recognised as cross-cultural. The findings are consistent across populations. The findings above, specifically within the studies carried out by Peetsma et al (2005) and Wijsman et al (2015), focused both on European countries (such as the Netherlands and Switzerland) and Iran. Whilst the list here is not extensive, there does not seem to be a noticeable difference in the role of metacognition across cultures.

2.6.2. Metacognition and Undergraduate Education

In comparison to secondary education settings, undergraduate education can take place through several mediums. Students, for example, can choose to study full time, part time, or even online through distance learning. Age range can also differ significantly, considering that there are both populations of school leavers and mature students. So, the question remains: does metacognition have a similar effect on academic performance at this level?

There seems to be agreement that, in university, metacognition is still key to academic performance. The research into metacognition in university spans many different topics and contexts. Broadbent and Poon (2015), for example, explored the role of metacognition for students enrolled on online courses through a systematic review. From the 12 papers selected during the review, Broadbent and Poon concluded that metacognition was a significant predictor of academic outcomes. The researchers also highlighted, however, that the effects of self-regulated learning strategies were weaker for students enrolled online than for those enrolled in traditional courses. The review findings

suggest that environment may have an impact on the implementation of metacognitive strategies.

Environment is one factor that may impact metacognition. The other, better documented, factor that needs to be considered is that of domain specificity. Researchers such as Schraw (1999) suggest that individuals are unable to transfer metacognitive strategies from one context to another (i.e. their skills are domain general). Some researchers have, therefore, focused on one specific domain when measuring metacognition. Chevalier, Parrila, Richie and Deacon (2015), for example, examined the role of metacognitive reading strategies in predicting academic performance for both students with and without reading difficulties. Four hundred and thirty-seven participants from an American university completed the Adult Reading History Questionnaire – Revised (Parrila et al., 2007). The Metacognitive Reading Strategies Questionnaire (Mokhtari & Reichard, 2002) was also administered. To measure general learning awareness, the students completed the Learning and Study Strategies Inventory (Weinstein & Palmer, 2002). Multiple regression analysis indicated that metacognitive reading strategies did predict students' GPA, but only for students with a self-reported history of reading difficulties. General learning strategies, which could be classified as general metacognition, was found to predict the GPA of students that did not report any history of reading difficulties. It is possible to suggest that domain specific metacognitive strategies are important for those with deficiencies in particular domains, whilst general metacognition is more useful for general improvement.

Like secondary education, metacognition is suggested to both directly predict academic performance and influence other factors that may impact success. Wolters and Hussain (2015) for example, explored the relationship between grit, self-regulated learning strategies (including metacognition) and academic achievement. Two hundred and thirteen students from across all years of study were recruited from an American university. Data was collected primarily through an online self-report questionnaire. The questionnaire included items to measure grit, procrastination, strategy use,

achievement motivation and academic performance. Stepwise regression analyses suggested that students who reported higher levels of grit also tended to report more frequent use of metacognitive strategies, which in turn predicted academic performance. There are, however, some issues to be raised with the use of self-report to measure GPA. Despite the researchers' suggestion that research has previously shown a high correlation between self-reported and actual grades, there is still likely to be some level of inaccuracy in comparison to the actual GPA of the participants.

Each of the papers discussed above focus heavily on the use of standardised academic measures to represent academic performance. But these measures are not necessarily representative at every level of learning. Moreover, in postgraduate education the focus is more on the individual rather than on the comparison of grades across a cohort. In comparison to secondary and higher education, the literature on metacognition in postgraduate education is sparse. Yet, the literature that is available focuses on the skills we would expect doctoral students to have obtained during their undergraduate degree. Does metacognition differ in this context?

2.6.3. Metacognition and Postgraduate Education

There is limited research on the role of metacognition in postgraduate education. There is the possibility that this is because doctoral students are often perceived as an elite calibre of student that have a concrete understanding of their own learning (Cantwell, Bourke, Scevak, Holbrook & Budd, 2017). Partly, the perception of an 'elite calibre' of student stems from the assumption that doctoral students are more metacognitively aware of their own learning. Cantwell and colleagues investigated the individual differences in the metacognitive behaviours of doctoral students. Firstly, the research aimed to determine whether a doctoral cohort does represent an elite status. Secondly, the researchers aimed to classify the patterns of metacognitive responses to engagement in doctoral learning.

A cohort of 1390 doctoral students across Australia completed a series of metacognitive questionnaires. The questionnaires were chosen according to

different measures. Students completed the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) and the Epistemological Beliefs Questionnaire (Schommer, 1993) as a measure of intellectual management. Within the measure known as affective management, the participants completed the Reaction to Daily Events Questionnaire (Greenglass et al., 1999), the Doctoral Efficacy Questionnaire (Cantwell et al., 2012) and the Need for Cognition Questionnaire (Cacioppo, Petty & Kao, 1984). Finally, students completed measures of contingency management. The measure included the Academic Volitional Control Inventory (McCann & Garcia, 1999), the Doctoral Responsibility Instrument (Kleuver & Green, 1998) and the Academic Procrastination Inventory (Muszynski & Akamatsu, 1991).

Exploring the first research question (do doctoral students represent an elite status), the participant scores were compared against the midpoint of each scale. The cohort scored clearly above the midpoint of each scale in affective and intellectual management. The cohort also scored highly on recognising and accepting responsibility, whilst scoring low on procrastination measures. The researchers concluded that, from these scores, the metacognitive profiles of doctoral students do suggest an elite learning status.

To address the question of individual variation across the cohort, Cantwell and colleagues also carried out a two-step cluster analysis. Three clusters were identified: cluster one (36% of the cohort) was named as constructively engaged. These students were identified as those who understand the intellectual demands and complexities of doctoral study. These students perceive doctoral study as intellectually and affectively manageable, whilst also being controllable when faced with contingency. Cluster two (42% of the cohort) was identified as students who were struggling to engage. The researchers suggest that these students are less likely to understand the complexity of doctoral study, whilst also feeling incapable. The cluster was defined heavily by what the researchers suggest is an ‘overregulation’ of cognition and of coping measures. Cluster three (22% of the cohort) was identified as students who were disengaged. These students did not understand the complexity of doctoral study. There is also a lack of cohesion

between task perception and what is required, relating to the students' understanding of their own capabilities.

The proportions of students in each cluster, however, differed depending on the stage of doctoral study. When split into different stages (early, mid and late stages) of study, there were a higher proportion of students in the early stages found in the struggling to engage cluster in comparison to clusters once and three. A higher proportion of students in the mid stages of their studies was found in the disengaged cluster. No real differences were found in the final stages. The importance of a student's stage of study is highlighted here. Whilst the researchers suggest that metacognition is key to a doctoral student's elite status, the other key factor identified is a student's epistemological understanding of their own capabilities. The researchers suggest that a student's epistemic framework underlies the clusters identified.

Students in the disengaged cluster, however, seem to struggle with their own epistemic framework. It is possible that, whilst these students do engage in metacognitive behaviours, their broader metacognitive awareness is not developed. The lack of awareness in mid stage doctoral students, particularly, could have a detrimental impact on their performance. The analysis suggests that metacognition is impacting on doctoral students' epistemological beliefs, in comparison to earlier stages of education which focus on metacognition from a behavioural perspective.

2.6.4. Key Comparisons and Research Questions

There are a few key contrasts and comparisons to be made between the studies mentioned above. Firstly, the methods of measurement are similar regardless of educational level. Many of the studies used similar self-report questionnaires. Whilst Cantwell and colleagues used self-report to determine whether doctoral students could be considered as 'elite learners', there was no real consideration of context in the measures used. The Metacognitive Awareness Inventory, for example, may not be as useful for measuring metacognition in a classroom environment as the Learning Styles Inventory. There is, however, one significant difference between the groups. Whilst

academic achievement was measured using GPA for both secondary and undergraduate students, there was no real standardised measure of performance for doctoral students.

Secondly, whilst the above research does support metacognition as a predictor of academic performance, there is little consideration given to a broader understanding students should have of their metacognitive awareness. Students, for example, may be aware that they use certain skills to learn, but that does not necessarily ensure that they understand their own capabilities. The lack of awareness may be prominent at all levels of education but is particularly evident in postgraduate students. The above point is strongly related to the third comparison, which is the role of other individual differences in the relationship between metacognition and academic performance. There needs to be an understanding of how metacognition interacts with other individual differences to have a broader understanding of what makes a successful learner. This understanding then needs to be integrated into educational practice to improve the academic outcomes of university students.

These comparisons highlight the four key research questions that the thesis aims to address. Firstly, do metacognitive skills differ between postgraduate and undergraduate education? The literature above has suggested that postgraduates perform above average in metacognitive skills questionnaires but may have limited metacognitive awareness. The literature does not, however, identify whether postgraduate students engage with different metacognitive skills to undergraduate students. Secondly, what role does social context play in the relationship between metacognition and academic performance? There seems to be limited consideration in the literature for how our environment or our peers impacts on our ability to be academically successful. Additionally, are there other individual differences that impact metacognition? Previously, Honicke and Broadbent (2016) identified that conscientiousness has a mediating effect on the relationship between self-efficacy and academic performance. Considering the relationship between self-efficacy and metacognition, it is possible that personality has a similar

effect on the relationship between metacognition and academic performance. Finally, how can we incorporate what we understand about metacognition into educational practice? According to the literature, there can be a decline in student's performance once they transition between educational levels. Could an intervention designed to improve metacognition address the identified deficits?

2.7. Defining Individual Metacognition to Address the Research Questions

The research questions addressed above all address different areas of metacognitive processing. Figure 2.2 identifies the sub-components that are key to addressing the questions posed here. The first research question addresses the differences in the metacognition of postgraduate and undergraduate students. The question addresses two key differences: the first is metacognitive skills. Metacognitive strategy use is therefore a key foundation for this question, addressing whether doctoral students do differ in their adaptation of metacognition to their learning in comparison to undergraduate students. Since there is already an abundance of literature on the role of individual metacognition in undergraduate education, the question here will focus more heavily on the use of metacognitive skills from a social perspective. The second key sub-component, therefore, is identified as metacognitive experience in terms of environment. There is also an interest in broader metacognitive awareness, namely whether doctoral students are self-aware of their capabilities and spend time reflecting on their learning. For the purposes of this question, strategies and experience are components that need to be considered.

The second research question addresses the role of social context on metacognitive processes. To address the role of social context, there are different areas to consider. Firstly, can students learn effectively from others, including peers and authority figures? Secondly, are students capable of understanding the diversity of cognitions in others, and how does

metacognition influence this understanding? Metacognitive knowledge is key to understanding whether students can obtain and understand information from others. Again, metacognitive experience plays a role in the question at hand in understanding how students' conscious experiences involving others impact on their metacognitive ability.

The third research question addresses how individual differences impact on the relationship between metacognition and academic performance. As there have been previously established relationships between metacognition, self-efficacy and motivation, the question will specifically focus on the relationship between personality and metacognition. The relationship has not yet been explored, and so the metacognitive components addressed are broader than in previous research questions. The question explores the role of both metacognitive knowledge and regulation, specifically focusing on the relationship between personality and these components. The relationships between personality and the sub-components of metacognitive knowledge (procedural, declarative and conditional) will also be explored.

The final research question aims to bring together the chosen sub-components to design and implement a metacognitive intervention. The intervention is designed to improve metacognitive skills in students transitioning from high school to undergraduate education. Importantly, the intervention aims to promote metacognitive skills that are transferable across all levels of education, addressing deficiencies in metacognitive knowledge, experience and strategy use at the early stages of university education.

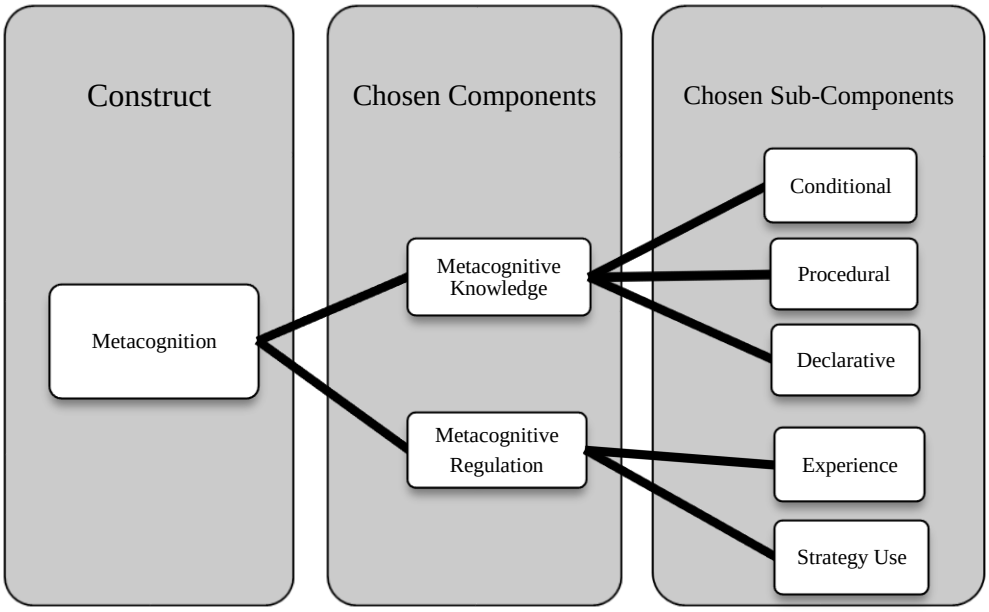


Figure 2.2: Key sub-components of metacognition addressed in the thesis

2.8. Chapter Summary

Metacognition, the knowledge and regulation of our cognitions, has a complex history. In modern models of metacognition, there is a focus on two key sub-components: metacognitive knowledge and regulation. These sub-components can be further divided themselves, focusing on different areas of metacognitive processing. Metacognitive knowledge, for example, is further divided into procedural, conditional and declarative knowledge. Metacognitive regulation is more varied, but commonly includes a sub-component that addresses metacognitive skills or strategy use. Less commonly, these models incorporate a more socially oriented component of metacognition: metacognitive experience. Metacognitive experience is influenced by context in relation to our conscious and emotional experiences, making it a key factor to consider when exploring metacognition in academic learning environments.

Metacognition is strongly related to other psychological theories, particularly those related to academic performance. Self-efficacy, motivation and approaches to learning, for example, all seem to have relationships with

metacognition. These relationships, in some cases, feed into more comprehensive models of learning. Self-regulated learning, for example, incorporates both metacognition and motivation into one broader model of learning. Additionally, metacognition is supported to have a relationship with academic performance at all levels of education. The relationship is sometimes described as direct, whilst other researchers discuss the indirect role of metacognition on academic performance through other psychological constructs (for example, self-efficacy). There are, however, key similarities and differences in how metacognition is perceived at different levels of education.

Firstly, at each level of education (secondary, undergraduate and postgraduate), the research focus tends to be on the development of metacognitive skills. Whilst there seems to be a deficiency of skills at early secondary level, the same skills seem to develop through undergraduate and are proposed to reach an 'elite' level in doctoral study. There seems to be little consideration given, however, to how these skills differ. The same skills may be used, but the environment changes. Secondary and undergraduate education, for example, tend to have standardised measures of performance to compare with metacognition (such as GPA). There is no real standardised measures of performance for doctoral study, apart from completion. In comparison to undergraduate education, metacognition at doctoral level seems to be more heavily related to the doctoral experience. If this is the case, what impact does metacognition have on educational experience?

The thesis aims to address three key gaps in the current literature surrounding metacognition and academic performance. Firstly, how do skills differ between doctoral study and undergraduate education? Secondly, what role does experience and social context play in these differences? And thirdly, what other individual differences may impact on the relationship between metacognition and academic performance? The thesis then aims to incorporate the research carried out here into an intervention designed to promote metacognitive skills that will be adaptable to all levels of education, regardless of social context.

There seems to be a limited understanding of the role of metacognition in postgraduate education. The first chapter, therefore, will detail the evaluation of a metacognitive improvement programme designed for postgraduate students, exploring the role of metacognition in doctoral experience.

3. METACOGNITION IN A POSTGRADUATE POPULATION: A COMPARISON OF INTERVENTION VS ISOLATION

3.1.Introduction

Whilst there has been an abundance of research to support metacognition in higher education (see section 2.6.2), the consensus in postgraduate education seems to be that students should have already developed their metacognition (see section 2.6.3). Yet, the research supporting enhanced metacognition at doctoral level focuses on metacognitive skills, rather than overall metacognitive awareness and experience in doctoral experience. Doctoral students also have a unique set of challenges to address, for example the well documented issues of 'Imposter Syndrome'.

Students entering postgraduate education must deal with numerous changes. No longer able to compare themselves to their undergraduate peers, the phenomenon known as "Imposter Syndrome" is often manifest. Whilst common in many areas, imposter syndrome is well documented in academia. The concept refers to feelings of self-doubt and an inability to "internalise academic success" (Watson & Betts, 2010, p.1). Part of the self-doubt stems

from blaming personal deficiencies for academic failures, and external forces for academic success (Acker & Armenti, 2004; Bell, 1990; Clance & Imes, 1978; Gibson-Beverly & Schwartz, 1986). One of the most common attributes of Imposter Syndrome is that individuals believe that others are not aware of who they truly are and are susceptible to feelings of inferiority when comparing themselves to their peers. Individuals suffering from Imposter Syndrome often believe that their inferiority will eventually be discovered (Clance, 1985). Imposter Syndrome highlights a broad spectrum of metacognition that is not necessarily identifiable through metacognitive questionnaires. Whilst individuals suffering from Imposter Syndrome within academia often engage with metacognitive behaviours in terms of their work, their broader self-awareness and understanding of their own capability is lacking. Despite the implications of this aspect of metacognition, in practice the majority of metacognitive improvement programmes introduced to postgraduate education have been focused on harder skills, such as language acquisition (Feng & Chen, 2009), writing (Bao-Chun, 2009) or general research skills (Rahman, Yasin, Salamuddin & Surat, 2014).

One of the earliest attempts to examine metacognitive training comes from Zuber-Skerritt (1987), who introduced an intervention to improve the development of research skills in postgraduate programmes. Again, this intervention was designed to combat the relatively sparse literature surrounding postgraduate skills, as many researchers and practitioners assumed that doctoral students should already have developed basic research skills at undergraduate level. More specifically, the intervention was based on literature identifying the main problems in doctoral study, including high drop-out rates and late completion, problems with student-supervisor relationships, social isolation and lack of confidence (Barrett, 1983; Moses, 1981; Ibraham et al., 1980; Rix, 1984; Welsh, 1979). Despite the historical nature of the literature, these problems are still regularly highlighted in modern accounts of doctoral study. Some metacognitive improvement programmes like Zuber-Skerritt's work have been introduced to postgraduate populations, however many of them still focus on the individual (e.g. Horvath, 2005; Kjaer, Maargaard & Wied, 2006). Whilst this focus can be

useful in improving metacognitive skills, it seems unlikely that these programmes will have any effect on improving imposter syndrome, which essentially stems from an individual comparing themselves to the capabilities of others. Experiential training, specifically peer support, seems more likely to be beneficial in reducing Imposter Syndrome (in comparison to more individualised interventions).

There has been some support for the use of experiential learning in postgraduate metacognitive development. Ladyshewksy (2006) created a peer coaching intervention to assist with postgraduate management education. Their findings support peer coaching as advantageous for metacognitive improvement, developing metacognitive skills through perspective sharing, acquiring new knowledge and verifying existing knowledge. Again, however, the intervention focused heavily on the acquisition of metacognitive skills, rather than focusing on the broader improvement of metacognitive awareness.

In comparison to the metacognitive interventions discussed above, the current chapter aims to evaluate a programme specifically designed to improve metacognition through experiential learning and peer support: The Learning Process. The Learning Process (LP) was an event designed to improve general metacognitive awareness in doctoral students. The programme was designed around RCUK good training needs for PhD students, with a focus on raising metacognitive awareness through peer interaction at its core. In addition, the LP was run across all disciplines, rather than focusing on skills specific to one area of study. The LP was designed by both a Professor of Psychology at the University of Stirling and an external executive coach. The executive coach also acted as the facilitator within the LP sessions. The LP was run over two full days, with a break of roughly one month between day one and two to allow time for students to reflect on their progress thus far.

During the course students were encouraged to engage with their peers and reflect on their individual approaches to learning, highlighting the key approach of experiential learning. The course used several different

theoretical frameworks, including the Myers Briggs Type Inventory and Maslow's Hierarchy of Needs, to support students as they identify their key challenges and develop more effective outcomes. A number of core aspects of skills development were continually explored through the course, including:

- Communication - examining how to present clear and concise information and dealing with the challenges presented by individual styles.
- Personality - encouraging students to consider the implications of personality on learning approaches, decision making and managing information.
- Feedback - encouraging participants to consider the implementation of feedback and their reactions to critique.
- Networking - how to effectively engage with key individuals and how to best present oneself in an academic environment.
- Learning Strategies - discussing the most effective and appropriate methods of learning for each individual, identifying key strengths and weaknesses to help overcome challenges.

Whilst each of these components is important in doctoral study, the overall aim of the Learning Process was to encourage metacognitive awareness in doctoral students, enhancing self-awareness and helping participants develop and enhance key skills that have strong implications for both PhD study and future goals. Despite consistent positive feedback surrounding the course, an in-depth evaluation to systematically assess the course had yet to be carried out. Rather than evaluating each of the components listed above, the evaluation focused on two key questions:

1. Do students who participated in the Learning Process demonstrate improved metacognitive awareness?
2. Does improving students' metacognitive awareness address the issues of isolation and Imposter Syndrome?

In sum, therefore, the present study aimed to explore the impact of the Learning Process on participants' experiences and perceptions about their metacognition using qualitative methods.

3.2.Method

3.2.1. Approach and Recruitment

The current project differs significantly from much of metacognitive research in two ways. The study focuses heavily on how experience informs metacognitive belief and practice. In comparison to most metacognitive research, the current study will be conducted from a contextualist perspective, assuming that knowledge can be accessed through language (Madill et al., 2000). Here, we are interested in how the experiences of a metacognitive improvement programme (The Learning Process can change the perceptions of doctoral study, and the behavioural implications that can stem from them.

Whilst a quantitative design could have informed the researcher on the metacognitive behaviours employed by doctoral students, the focus here is on how students experience metacognition, and how that informs their practice. Although other self-report measures could have been used, the use of questionnaires on such a specific population was unlikely to yield any useful data, especially considering the lack of normative data available regarding doctoral students' performance on metacognitive questionnaires. Qualitative semi-structured interviews were therefore used as a method of collected richer and more in-depth data regarding doctoral students' experiences that would not have been accessible through quantitative means.

Purposive sampling (that is, selecting data cases that can provide information rich data) was used (Braun & Clarke, 2013). Forty students who had completed the Learning Process were contracted regarding participation in an evaluation of the course. The LP alumni participants were recruited via the Stirling Graduate School. Participants were recruited through email, asking them to contact the researcher should they feel comfortable taking part in an

interview designed to evaluate the effectiveness of the learning process and to assess their perceived metacognitive improvement. Of the 40 former participants contacted, ten of these participants agreed to complete a semi-structured interview (See Appendix Six), with the researcher exploring their thoughts on the usefulness of the Learning Process as a metacognitive evaluation event. Table 3.1 details the area of study and year in which participants took part in the Learning Process. Participants were fully informed of the procedure before participation and consented to both taking part and being recorded (Appendix Nine).

After the initial Learning Process Interviews, further ten PhD students who had not completed a metacognitive improvement programme were recruited to take part in a semi-structured interview designed as a comparison with the Learning Process Participants. Interviews with both the LP alumni and control cohort were carried out face–to-face in a quiet room within the psychology department at the University of Stirling. Before starting the interview, participants were fully informed of the procedure and provided consent both for their participation and audio-recording (See Appendix Nine). Interviews lasted between 45 minutes and one hour 30 minutes, depending on the engagement of the participant. The recruitment of both former participants and non-participants of the Learning Process allowed for patterns across data to be identified. For patterns to be identified, Crough and Conner (2006) suggest that a sample size between 15 and 30 is common within qualitative research.

Table 3.1: Background and Year of Participation of Learning Process Cohort.

Participant	Background	Year
1	Psychology/ Health Sciences	2013
2	English/Philosophy/Education	2013
3	Psychology	2013
4	Health Sciences	2013
5	Sports/Management	2011
6	Psychology	2014
7	Applied Social Sciences	2012
8	History/Politics	2014
9	Psychology	2011
10	Arts and Humanities	2012

In comparison to inductive approaches often used in qualitative analysis, the hypothetico-deductive method (Evans & Kakas, 1992) used here focuses on testing a hypothesis using a top-down approach. The method is based on deductive reasoning from already generated theories and is then tested by collecting and analysing data. The research question here has its foundations in the already existing metacognitive theories. The theory driven approach stems from metacognitive models that specifically incorporate metacognitive experience within their framework. The theories used here incorporated both theoretical domains of historical metacognitive theories that specifically include experience, namely from Flavell's Model of Cognitive Monitoring (see section 2.2.2). The behavioural domains used within the coding framework were extracted from Schraw and Moshman's Model of Metacognition.

Table 3.2 outlines the themes and sub-themes drawn from the literature. The designed framework focused on two key themes: metacognitive awareness

and social context. Metacognitive awareness focuses on the broader understanding a student holds of their capabilities, and the behaviours they put in place to improve this understanding. The behaviours can also be in response to the students' awareness, for example putting appropriate strategies in place according to their own strengths and weaknesses. Metacognitive literature specifies reflection as a key metacognitive process across all levels of education (Desautel, 2009; Ford & Yore, 2011; Rhem, 2013). In terms of improving metacognitive awareness, reflection is particularly key to doctoral practice (Brew & Peseta, 2007). The reflective element links closely with self-awareness, which also forms part of the coding framework.

As a method of comparing the metacognitive skills of doctoral students to those of undergraduates, the framework also includes learning strategies under the theme of metacognitive awareness. The theme was generated from previous literature that suggests doctoral students should be more effective at applying learning strategies than their undergraduate counterparts (Cantwell et al., 2017). The learning strategies theme was particularly relevant to understanding the application of metacognition in postgraduate education, and how this differs from other levels of education.

The focus of the current study is on doctoral experience. Two key issues around doctoral study are social isolation and deteriorating mental health (Delamont and Eggleston, 1983; Hockey, 1991; Hyun, Quinn, Madon & Lustig, 2007). In addition to measuring metacognitive awareness, therefore, the study also used the themes of peer interaction to address whether metacognition was linked to peer support, and whether reflection and metacognitive awareness would have an impact on the health and well-being of the participants.

Before the coding process began, each of the interviews were transcribed verbatim. The data was then collated and printed. Each of the sub-themes detailed in Table 3.2 were initially coded independently by hand. After each of the interviews had been coded for these sub-themes, the data was then re-

analysed, identifying cross-over between sub-codes, and identifying patterns forming between the themes. After the data had been fully coded, the supervisor of the thesis, the supervisor checked five transcripts, ensuring that the coding assigned by the researcher were appropriate, and addressing inter-rater reliability.

Table 3.2: Coding Framework Used in Evaluating the LP.

Theme	Sub-theme	Definition	Quote
Metacognitive Awareness	Reflection	Evidence of reflecting on challenges, awareness and implementing behaviours due to reflection	"(The Learning Process) made me reflect on my own challenges and, in a way, put things into perspective."
Metacognitive Awareness	Learning Strategies	Changes in the implementation of appropriate strategies to improve learning.	"(The Learning Process) helped me think more about time management and the organisation of my time, to try and separate both of them."
Metacognitive Awareness	Self-Awareness	Changes in confidence, improved understanding of capabilities.	"Definitely (The Learning Process) has helped me not to question myself so much. So it's confidence in that way."
Social Context	Peer Interaction	Impact of social interaction during the course, changes in behaviour due to this interaction.	"I found (the Learning Process) useful as a way to meet other PhD students and just talk about what other people do and why they're doing their PhD and…what challenges they face."
Social Context	Health & Wellbeing	Changes in understanding appropriate behaviours to protect health and wellbeing during PhD.	"Well, I mean the other thing that (the Learning Process has) helped me think about is health and wellbeing because it's easy to neglect when you're studying."

3.2.3. Reflexivity Statement

Metacognition can be studied from a purely cognitive perspective. In contrast, the perspective taken here have foundations in the experiential aspects of metacognition. Rather than focusing heavily on cognitive processes, the researcher's perception of metacognition focuses heavily on how it applies in

learning and education specifically. These perspectives could be interpreted from the coding framework in place here. For example, rather than focusing on purely metacognitive behaviours in response to cognitive tasks (such as planning, monitoring and evaluation, for example), the codes here are more focused on the broader understanding of oneself. Additionally, the metacognitive skills described here are discussed in the broader context of learning strategies, rather than specific metacognitive behaviours (focusing on understanding how to learn rather than how to regulate cognitions).

Should the data here be interpreted by an experimental paradigm from a purely cognitive perspective, it is possible that the conclusions could have been markedly different. Data could have been collected and analysed using experimental paradigms or more quantitative techniques. Doctoral study, however, is inherently individual. It seems unlikely that approaching doctoral experience from an experimental perspective would have provided the same understanding of doctoral experience, nor would it have provided the same understanding of how metacognition can be applied in doctoral study.

Like the perceptions of doctoral study detailed above, the researchers have discussed university learning as being highly individual, focusing on independent learning rather than other-led teaching. Metacognition, from this perspective, is key to being academically successful. Within the researcher's own experience of being a doctoral student, there is a much stronger onus on individual learning. The researcher had to be mindful of these perceptions, particularly when discussing social context and isolation, and how they may have coloured the interpretation of the data. Namely, this bias was countered by a supervisor of the researcher.

The interviews themselves were face-to-face with the participants. The interviews took place in the participant's place of study, which may have prevented them from discussing issues as openly as possible. An important question to address was whether interviewing participants within their work environment would have prevented them from voicing their experiences

freely, particularly when discussing matters regarding to their health and well-being or feeling socially isolated.

3.3. Analysis

Whilst the evaluation of the Learning Process yielded positive findings overall, the aim of the course was to significantly improve metacognition within postgraduate students. As a result, metacognitive improvement was coded for according to three key behaviours: reflection, learning strategies and self-awareness. Here, we discuss the findings from the analysis according to two specific cohorts: Cohort 1, which consists of the LP participants, and Cohort 2, consisting of PhD students who have never participated in a metacognitive improvement programme.

3.3.1. Cohort 1: Reflection

The first code to be analysed was that of reflection. Reflective abilities were coded both if they were discussed in abstract terms (such as discussing general self-reflection), or specific strategies (such as reflecting as a product of feedback).

In an initial noteworthy finding, Participant 7 felt that engaging with the Learning Process led to improved reflection. The participant believed that reflection helped them identify frequent problem behaviours and encouraged them to consciously change these behaviours to the advantage of their PhD. Quote 1 (below) highlights a lack of previous understanding regarding detrimental behaviours. Conscious reflection was necessary to identify problematic behaviours, and Participant 7 felt that they would not have been aware of these problems without having been prompted to reflect.

1. *"It made me reflect a lot on the things I used to do that were not very helpful (laughs) so hopefully I've kind of changed…all the*

things that I've kind of been doing wrong" (Participant 7 on reflection).

Not all participants agreed, however, that the Learning Process had a lasting effect on their reflective abilities. Participant 2 suggested that reflection should be an in-built part of PhD study, and therefore reflection should be a frequent occurrence (Quote 2). Although Participant 2 found short-term benefit in terms of the perception they had about their PhD, the benefit was short lived. For them, viewing the PhD as a positive experience was constrained by the daily challenges of their doctoral career. Like Participant 2, Participant 3 perceived the Learning Process as having short-term benefit. The impact of the Learning Process on their learning strategies was more a consequence of consciously reflecting on them (Quote 3). Taken together, the data suggest that there is typically a reversion back into old methods of learning when students do not engage with conscious reflection on an ongoing or frequent basis.

2. "As a PhD student you always end up thinking a lot about your PhD so I mean I already thought a lot about it but maybe…for a period of time after the Learning Process it made me think about my PhD as a positive and…not too stressful experience but…its coming again and again and again so I don't think it changed that much" (Participant 2 on reflection).

3. "I think old habits die hard a bit, like I think…training things like the Learning Process, like…at the time…you're obviously focusing on it you're thinking about it, and then there is maybe the tendency to go back and just do things the way you've always done them" (Participant 3 on reflection and learning strategies).

Participant 4 again highlighted the necessary conscious reflection required during a PhD, and identified that, whilst the reflection did not necessarily

provide new skills, reflective behaviours did provide an opportunity for reassurance. It is clear, however, that the lack of change observed by the participant was a consequence of their reflection.

> *4. "you know it's helped to stand back it's helped to distance myself, like I said before when I came across the course there were a lot of things I was familiar with…I was quite aware of the field I think the value of the course for me was giving me an opportunity to reassess a lot of things rather than introduce new things or change things particularly drastically" (Participant 4 on reflection).*

Although reflection was often viewed short-lived, participants clearly understood the significance of reflection for their own development, and the mechanisms through which the benefits of reflection occurred. For example, quotes from Participant 10 highlighted the usefulness of programmes that did not focus on hard skills, but rather the more individualistic skills necessary for a PhD. Emphasising and encouraging reflection were clearly key to the beginning of reflective development in the case of Participant 10. Similarly, Participant 1 agreed in principle with the perspective of encouraging reflection, but also highlighted that the reflection, in part, was related to a change in perspective that resulted directly from peer involvement (Quote 6, below)

> *5. "Self-reflection is something I didn't really consider until and I had to do my PhD and definitely the Learning Process was the first and only thing that I've been to that sort of put an emphasis on thinking" (Participant 10 on reflection).*

> *6. "…It made me reflect on my own challenges and, in a way, put things into perspective...so I kind of realised that there were so many PhD students who were in a worse situation than me so I'm quite fortunate although I didn't think I am, but now I know I am" (Participant 1 on reflecting on challenges).*

Other participants highlighted more specific skills gained as a product of self-reflection. For example, Participant 6 discussed their view that identifying strengths and weaknesses through reflection was key to doctoral success. Reflection, in this case, prompted increased self-awareness in terms of an individual's understanding of their own requirements to succeed.

> *7. "What I learned in the Learning Process is that you have to make use of your strengths and identify your weaknesses…and have to overcome your weaknesses to match it with your strengths. Hopefully by doing this you will sail through" (Participant 6 on reflection).*

Whilst many of the participants discussed the short-term effects of the Learning Process, Participant 5 discussed their perception of the long-term effects of the programme. Quote 8 highlights that the Learning Process introduces conscious reflection on problems throughout the course. Some individuals adapted the skills for long term use, highlighting and promoting conscious reflection when faced with a challenge. A further example is presented in Quote 9, where Participant 9 discussed the skills they had taken from the process, with similarity to that of Participant 5. The discussion highlights reflection as a mechanism for combating negative self-belief, instead of focusing on particular aspects of a problem that can be corrected.

> *8. "I think when I do encounter challenges now like I've got that….confidence to give myself a bit of space to just step back from that and look at it and not allow it to become a big…monster maybe whereas before like I might have just panicked and thought 'oh I'm not capable of solving this'" (Participant 5 on the long term effects of the Learning Process).*

> *9. "I think it is just about, you know, being able to go back, and just having…giving yourself, or giving myself, the extra option of am I*

not understanding this because I don't have the technical lingo? Am I not understanding this because I don't have the context? Or is it complex enough that I need to go away and talk to somebody about it? Or do I need to go away and find someone for whom this is their jam? And have them speak it at me?" (Participant 9 on reflection).

There was also some focus on appropriate learning skills. For example, Participant 9 explained that reflection is required to learn more effectively, indicating a positive understanding of the benefit of self-reflection. Whilst most individuals have discussed reflection in abstract terms, there are examples, such as Quote 9 above, that demonstrate how self-reflection can lead to mechanisms used to improve learning. These processes are reflected in Quote 10 below, in which Participant 8 highlights the use of self-reflection in problem solving processes. Similar to Participant 9, there is an understanding of using self-reflection as a method of self-control, focusing on the behaviour necessary to achieve success. Like previous participants, Participant 8 again highlights the need to reflect consciously, rather than relying on automatic behaviours that are not necessarily beneficial.

10. "It's something that you kind of know, but remember that you need to reflect, and if things aren't working, instead of just panicking…maybe reflect first and then find out, maybe try these methods of getting around it" (Participant 8 on reflection)

3.3.2. Cohort 2: Reflection

Cohort 2 were asked questions detailing the same principles as the Learning Process, but in a more generic form, given that the students had not attended a specific course. The participants here were asked whether they felt that they spent time reflecting on their work. The quotes below illustrate the opinions of each participant in Cohort 2.

Participant 11 demonstrates relative confidence in their reflective abilities, however, they also voice the opinion that these reflections are not always advantageous to doctoral study (Quote 11). The discussion highlights that, whilst some reflection is appropriate, an overabundance can lead to a circular way of thinking, preventing progression. Participant 16 highlights that, like Participant 11, there can be some concern that spending too much time reflecting can be detrimental. In comparison to Participant 11, however, Participant 16 demonstrates that, whilst some individuals might be aware of the necessity of reflection, there is a fear of engaging with the behaviours for fear of being less proactive in their studies (Quote 12).

11. "Erm, yeh I think I have spent time reflecting on it (the PhD) I think…at the end of first year, definitely spent a lot of time about helping me to understand…what the PhD was about, as in not topic wise but actually, what is the point of doing a PhD erm…yeh I did spend quite a bit of time reflecting, probably more than I should…sometimes you get a bit kinda caught up in your own thoughts that you can go round in circles again, rather than being productive"(Participant 11 on reflection)

12. "Probably not enough (time spent reflecting) sometimes…because I'm like 'oh I just want to try and get more things read, try and get more things done and like, I'm trying to take my time, but I keep thinking like am I going off on a tangent or am I on track? But yes should probably spend more time reflecting" (Participant 16 on reflection)

Although Quotes 11 and 12 demonstrate a level of engagement with reflection to a certain extent, there is a significant difference here between the nature of reflection as viewed by Learning Process participants and by students who had never attended a metacognitive improvement programme. For example, both participants 11 and 16 thought they should reflect on aspects of their

PhD, rather than reflecting more broadly on themselves or on how these factors might influence their learning.

Contrary to the view of over-reflecting, Participant 12 demonstrated a significant lack of reflection. Not only did the participant suggest that they did not engage with these behaviours throughout their PhD, but insinuated that lacking reflection was a normal part of their learning (Quote 13).

13. "I find, and I think I've always found this, I don't actually reflect on how I learn I just kind of get on with it" (Participant 12 on reflection).

Whilst Participants 11 and 12 considered reflection to be an individual learning process, Participant 15 engaged with reflection as a product of feedback (Quote 14). Quote 14 provides another clear example of a student considering social interaction to have an influence on reflection, similar to Quote 6. Overall, however, there was limited evidence of individual reflection without the constructive input of others. Equally, however, it is evident that not all students learn effective behaviours from others. For example, Participant 19 discusses the reflective behaviours of others. Despite the advantageous behaviours they can observe, they make it very clear that they do not engage with these behaviours themselves.

14. "Mostly what happens is I spend time-Once I've done a piece of work I send it to my supervisor, and she sends me something with sort of like critiques, and that's when I reflect on the work then…so the reflection happens, I think, once I get feedback from a second person" (Participant 15 on reflection).

15. "I definitely don't (spend time reflecting), I know that (another PhD student) in the office apparently writes a reflection journal every week, at the end of the week she goes, these are the things I've

done this week…so she remembers that, what she did and reflects on them…and I never do that" (Participant 19 on reflection).

Participant 17 has a more negative outlook on reflection in general. Whilst they expressed the view that they are made to reflect in concrete terms, such as with Personal Development Plans, they do not necessarily engage with reflection willingly. There was, however, an understanding of reflection and the tasks that can promote reflective behaviours (Quote 16). Similarly, Participants 18 and 20 demonstrated an understanding of tasks that could promote reflective behaviours. Participant 18 cultivated these behaviours from previous experience and adapted strategies from previous feedback (Quote 17). Participant 20 demonstrated general reflective abilities through questioning strategies they were already employing (Quote 18).

16. "Yeh, I'll probably have to reflect, as much as I hate reflecting, in general, PDP (Personal Development Plans), stuff like that. I hate that nonsense; I kind of categorize that in reflecting" (Participant 17 on reflection).

17. "In a way, especially if you've been given sort of like say a new task to do that is similar to something you've done before, I reflect back on what I had done before and take on all the feedback from that" (Participant 18 on reflection).

18. "Hmmm, I definitely do do it, I don't know about a lot of time…because what I've done is kind of read in the different areas…then I start thinking, should I actually spend that much time on this at the moment, and should I have already been reading about this kind of thing?" (Participant 20 on reflection).

The analysis above demonstrates that, whilst both cohorts demonstrate reflective behaviours to an extent, the Learning Process participants

demonstrated a greater understanding of the need for, and benefits of, reflection. Moreover, whilst there were examples of participants from Cohort 2 engaging with reflective behaviours, these behaviours were rarely used to address challenges, or to promote an understanding of one's own abilities. In comparison, the LP cohort demonstrated an understanding of the importance of reflection to self-awareness, and the mechanisms that could be used to incorporate their reflections into appropriate learning strategies. To address this point, the next section discusses the learning strategies highlighted by each cohort.

3.3.3. Cohort 1: Learning Strategies

Like reflection, comments made about learning strategies were often discussed in abstract terms (for example, discussions surrounding academic challenges). Discussions were documented that detailed both abstract learning strategies and more specific skills.

There were some instances in which the role of the Learning Process in influencing learning strategies was neutral. Participants did not necessarily believe that the programme had an advantageous or detrimental effect on previously used strategies (Quotes 19, 20 and 21). Neutral views often stemmed from participants having effective strategies already in place. Others believed that the theories presented were not applicable to their learning approach (Quote 20).

19. "Erm…I think before the Learning Process I actually knew my academic challenges and how to identify them, so I had my own approach and it didn't really change my perception of that" (Participant 1 on academic challenges and learning strategies).

20. "I have always been someone that monitors themselves quite a lot when learning and I like to learn by myself, so yeh it didn't really…I mean I remember the theories that they presented about

how to organise your work and be efficient but I can look at these theories and, you know, it never really applied to me" (Participant 3 on learning strategies).

21. "I don't think that it impacted in any way, and how I tackle the learning aspects of my PhD. I'm still reading and erm…addressing understanding issues the way I did before" (Participant 4 on learning strategies).

In comparison, Participant 2 demonstrated that new learning strategies could be introduced through self-reflection. Again, discussing learning strategies in abstract terms, Participants 2 and 10 discuss a change in the pace of their work, resulting in more time spent reflecting, and presenting this change as an improvement in their learning approach (See Quotes 22 and 23 respectively).

22. "I quickly realised that you can work as hard as you like, you're not going anywhere unless you can think critically and that doesn't involved running around on that hamster wheel that involves something…different, you know, going for a walk, thinking, not doing anything, thinking about it, talking to my mum, talking to colleagues, that kind of thing" (Participant 2 on learning strategies).

23. I think the Learning Process was quite good for, like highlighting that this is (pause) highlighting that you should think strategically about how you approach things rather than sort of just jumping in and doing it, which I still do. But I do think when I jump in and do things 'I should be thinking strategically about this', and sometimes it happens" (Participant 10 discussing learning strategies).

In comparison, Participant 5 discussed more structured improvements to their learning, focussing on specific strategies such as managing their time and carrying out reviews. Similarly, Participant 6 shared their experiences of improved learning behaviours by discussing more explicit changes to their routine that have improved their productivity (See Quotes 24 and 25 respectively).

24."It gives us some insight, especially how to do a systematic review, how to manage your time, the most difficult part is your do's and don'ts in your PhD and surviving the Viva"(Participant 5 on approaches to learning).

25."I hate referencing, even though I've got Refworks I just find it boring and awful and I've just ignored it until the deadline and obviously we talked about that and how, you know, you shouldn't avoid doing things that you don't like to do. So now I try to do that on a Friday afternoon when I'm tired and kinda sit down and do my referencing for the week" (Participant 6 on improved study habits).

Whilst Participants 5 and 6 demonstrated routine changes to their study behaviours, other participants provided more explicit examples of employing these behaviours to more singular tasks. (Quote 26). Again, in an abstract example of learning strategies, Participant 7 incorporates reflection into their learning and incorporates these reflective abilities into skills that promote more effective study strategies.

26. "I'm working on my systematic review at the moment and I'm going through the data extraction for the results section so I'm going through all the papers and extracting all the stud I want to know about them and I think I'd done that for about 10 papers and then I stopped and I thought 'right ok, I need to know what the bigger picture is here so I did…I printed this out and I said I had to stop and I had to do this, and I think before I would maybe just have,

because I'd agreed with him, right ok this is what I'm doing I would have kept going, even though it didn't feel right" (Participant 7 on learning strategies).

Other participants, in comparison, could identify learning strategies discussed in the Learning Process, however found it difficult to implement these strategies (for example see Quote 27). Time management was one of the more common strategies discussed, and yet one of the most complex for individuals to engage with. A common theme throughout the discussions surrounding learning strategies was the understanding of their importance, but difficulty engaging with them on a consistent basis.

27. "(I learned about) Time management. At first I didn't know about it, and then I knew I needed to do days. Although I haven't done it very well but I learned about it, I think it's very important. Sometimes I tried to do this as I learned. It works, but it doesn't work very well for me. It's my problem, not the programmes" (Participant 9 on learning strategies).

3.3.4. Cohort 2: Learning Strategies

The cohort that had not previously taken part in a metacognitive programme demonstrated mixed results. Participants 11 and 12 voiced their concerns that they felt lacking in strategies they could use to complete their thesis. Whilst Participant 11 felt that developing these skills should have been facilitated through supervisors (Quote 28), Participant 12 discussed the narrow methods taught in formal training programmes, and that these methods are not always appropriate for everyone (Quote 29).

28. "I don't think I've used any, I'm no further ahead than when I started…I came to the PhD knowing that I had to develop certain skills, I still feel I need to develop those skills…and that's what I wanted my supervisors to move me forward with, I think and that's

why I'm so frustrated that I don't feel further ahead when I started my PhD" (Participant 11 on obtaining learning strategies).

29. "I know people go along to these talks and seminars about, you know, how to do your PhD and how to do x, y and z and how to write a paper and I have to say, I avoid those like the plague because they never help me, and I can never follow those kinds of steps they set out and ways of thinking and ways of getting things done or ways of organising yourself and not procrastinating" (Participant 12 on using learning strategies).

Some participants were able to detail very explicit strategies that they engaged with on a regular basis. For example, Participant 15 discussed techniques for motivating themselves to work routinely (Quote 29), whilst other participants discussed the use of cognitive techniques such as summarising and using mind maps as effective learning strategies (see Quotes 30, 31 and 32). Importantly, Participant 17 also stated that the strategies they are employing successfully now did not work for them previously, suggesting the participant is developing adaptability to different learning environments (Quote 32).

30. "As a general rule what's happened is that, well, for a work technique what I do is work for 25 minutes, then take a 5-minute break, that's been really helpful. That's been good…what I tend to do is I write summaries of papers now. So, that's been good, that's been really helpful" (Participant 15 on learning strategies).

31. "In terms of kind of reading and going over the literature and stuff, I've been taking notes on everything that I read so I can come back to then and kind of mapping it out on a mind map? I've been sort of using software that does that. So kinda all the notes are in one place and I can move it around and play with it" (Participant 16 on using learning strategies).

32. "I used a mind map for the first time in my life. Like, I used to really hate mind maps in general, I think they're really unhelpful, but I have actually found it helpful, so I'm kind of starting to eat my own hat a bit. I've been trying to not admit that I'd mind map" (Participant 17 on learning strategies).

33. "Ok, so I have a good strategy I think now, for reading papers which I never had before. I read the whole paper and highlight as I go through, and at the end I write a summary of it?...and I've got a few documents, I've got one that just have these summaries of papers, and then I have one where I've got like particular headings…because there's lots of different topics, or you know concepts or whatever" (Participant 20 on learning strategies).

In comparison, some participants seemed generally unaware of the learning strategies they may engage with daily. Whilst Participant 18 demonstrates a lack of consideration for the learning strategies they might employ (Quote 34), Participant 19 does not consider the learning strategies they have employed as conscious, despite explicitly describing a learning strategy they engage with frequently (Quote 35).

34. "Who has a list of learning strategies in their head? Clearly not very reflective…I don't know, I can't put into words, I don't know maybe that's one of the things I'll learn with time" (Participant 18 on learning strategies).

35. "I don't think I've used any conscious learning strategies, I've just been kind of reading and…like trying to make sure I like quite structured mess, I've discovered if I put everything into a table, it makes me very happy, but yeh, that's the only thing I've consciously

done everything else seems to just be like, read this, have faith it will be fine" (Participant 19 on learning strategies).

Whilst both Cohort 1 and 2 demonstrated some level of using learning strategies, Cohort 1 were able to articulate what a learning strategy was for more effectively, and how to employ these strategies appropriately. Whilst there was evidence of participants in Cohort 2 adapting to changes in learning environment, Cohort 1 explicitly discussed how the Learning Process encouraged them to change approaches to routine behaviours and were more equipped to provide explicit examples of the learning strategies they used. In comparison to the explicit learning strategies discussed, the next section will discuss the broader concept of self-awareness in both cohorts.

3.3.5. Cohort 1: Self-Awareness

Self-awareness is possibly the broadest of the codes discussed here. In comparison to reflection and learning strategies that can both be explained in terms of explicit behaviours, self-awareness refers to the person's confidence and awareness of their own abilities in terms of completing their PhD.

One of the main aims of the Learning Process was to demonstrate improved self-awareness in participants. The Learning Process cohort, therefore, have been coded according to whether participants deemed the programme to have an impact on their confidence in their PhDs. There was a consensus amongst participants that the Learning Process did have an impact on their confidence. The impact, however, differed for each participant. Some participants felt that the Learning Process improved their confidence in terms of their general ability to complete a PhD. Whilst Participant 1 felt that the Learning Process reassured them of their actions up to that point (Quote 36), Participant 2 felt that it had encouraged them to deal with past failures they had not felt previously capable of dealing with (Quote 37).

36. "It's probably increased my confidence. I think I was, before the Learning Process, I wasn't very confident in what I'm doing or the

way I'm doing it, probably because I just started my PhD. But, talking about different challenges the different PhD students experience and what they do to overcome these challenges kind of showed me that what I'm doing is fine and it's working for me, so it's improved my confidence I think, I definitely feel more confident in what I'm doing" (Participant 1 on the Learning Process and confidence).

37. "Because the Learning Process is thinking about you and also looking back and reflecting on the past and things like that…the course helped with clarifying some of that and helping to define some of that and consequently that helped with building my confidence with being able to face up to my situation and say 'I'm ok on my own I can do this on my own" (Participant 2 on the Learning Process' influence on confidence).

Other participants suggested that their confidence was improved through discussions with their peers. The Learning Process helped participants understand that other PhD students were struggling with similar concerns. The peer interaction helped participants change their perceptions of their own challenges (for examples see Quotes 38 and 39). Participants 3 and 7 compared themselves directly with their peers, creating a passive perspective that improved their understanding of their own capabilities. For Participant 9, however, the use of peer interaction to improve their confidence came from peer support, actively discussing issues to help reach a conclusion (Quote 40).

38. "It was really nice, like psychology therapy, you know, when you feel relieved when you talk about your feelings and stuff like that it was quite the same effect of complaining about the PhD experience and how we were all struggling with that especially at the beginning about not being confident and stuff like that. So, yeh for me it was, really even if I didn't learn that much about learning, thinking about

and reflecting about the whole project, the whole PhD was quite cool" (Participant 3 on the Learning Process and confidence).

39. "I think, yeh, confidence wise, I think that's something I've always kind of struggled with kinda self-doubt and stuff so I think just, yeh, seeing other people maybe struggle with things as well it's to be expected and I guess if it was easy, it wouldn't be a PhD…I think now when I do encounter those challenges now like I've got that confidence" (Participant 7 on confidence).

40."I think at that moment I couldn't find if it improved my confidence, but later, later I found that what I've learned from that 2 day course gave me some ideas and encouraged me to contact with other participants so…the more times we meet, the more confident I feel" (Participant 9 on confidence).

For some participants, explicit aspects of the Learning Process had an impact on the participants' confidence, providing them with what they perceived as essential skills they were lacking. For example, both Participants 6 and 10 felt that explicit feedback provided them with more effective presentation skills, improving their confidence in academic situations (Quotes 41 and 42).

41. "It has (influenced my confidence) in a lot of ways...like, we did a thing where I stood up and stuff and (facilitator) gave me good pointers but it just boosted my confidence a little bit cause you know, she said 'well that's really good'" (Participant 6 on the Learning Process and confidence).

42. "It definitely helped…it did definitely help with confidence in some things so like I said the elevator thing was really helpful, thinking about how you approach other people that you have to work with, that was extremely helpful, the elevator thing (elevator

statements) definitely improved my confidence with regards to me talking about what I was doing with regards to the stuff about working relationships" (Participant 10 on confidence).

The data do reveal that many participants felt that the Learning Process had influenced their self-awareness at the time. Participant 4 discussed their own experience of improved confidence (Quote 43), describing how they felt more confident whilst participating in the programme. The confidence, however, could still be heavily impacted by daily academic life. Participant 4 was unsure of the long-term effects of the programme on their confidence despite initial reactions.

43. "…at the time, I was feeling more confident, but because I am at this stage of preparing my research proposal, I am at the doubting stage, so I go between feeling confident that I am doing ok and then when it's a bit more challenging, trying to get down and writing what I want to say, that's when my confidence goes a little bit. So it did initially, but I'm not sure now because the time passed" (Participant 4 on the long terms effects of the Learning Process on confidence).

3.3.6. Cohort 2: Self-Awareness

The data within Cohort 1's analysis of self-awareness was focused heavily on the improved confidence provided by taking part in the Learning Process. Within Cohort 2, however, the data focus on more specific areas of PhD study that can cause a problem with a student's self-awareness; completion.

The majority of participants demonstrated confidence in their own ability to complete the PhD (as illustrated by Quotes 44, 45 & 46). Each participant, however, registered their own concerns that demonstrated a level of doubt. For example, Participant 18 registered their concern about the challenges of deadlines (Quote 44). Participant 19 felt more concerned about detailing a

concise research question (Quote 45). Whilst Participant 15 suggested that they were not as capable as those who had already published (Quote 46).

44. "Funnily enough I haven't really worried about finishing it, which I probably should have, I think I work well to deadlines, making sure I'm constantly ahead of all, lots of deadlines is going to be more the issue…so I think that will more be the challenge, making sure it's all ahead of time. But yeah, I don't like finishing things so I think I will finish" (Participant 18 on finishing the PhD).

45. "I think I'm gonna pass…occasionally I think about oh God what am I doing? Because especially you'll get a kind of idea in your head and you'll start running with it and you'll think, no this is too big, I cannot answer that question. That question is too large, I'd need 15 years and a team of undergraduates to do all my data collection for me, and I am not doing that" (Participant 19 on completion).

46."I think I'm capable of doing it (the PhD) yeh, I mean, the PhD is not about being brilliant, it's not about being brilliant, it's about work. So it's just a question of…I mean I know this last year is going to be busy, but that doesn't mean it's going to be bad…I mean that, I know I'm not as good as the people who are publishing regularly, but I'm learning how to be, but yeah I know I can do it" (Participant 15 on finishing the PhD).

There were participants whose PhD journey had not been as linear as they wished. Participant 11 acknowledged the feelings of inadequacy often seen in the first-year population, related to being unsure of their direction (Quote 47). Participant 12 highlighted that passing their original submission date would be upsetting, especially when more recent PhD students were nearing completion (Quote 48).

47. "In my first year I was like, I just doubted myself hugely all the time, like, I didn't know what I was doing. I felt in a complete fog, I didn't know where I was going with it" (Participant 11 on first-year confidence).

48."I'm a little bit distressed about the idea of all these people who started much later than me kind of, graduating well before me…It's always kind of like I'm going to ignore that…in terms of what it says in comparison to me, so yeh I think I'm pretty confident I'm going to finish yet, I think once I've started something like this you have to finish it or it's just going to knock your confidence forever" (Participant 12 on finishing after submission date).

49. "Yeh I guess it does kind of worry be a bit, just because I am kind of a slow worker at times…I think it was three years I'd be a bit more worried, because I know, yeah, some people take an extra 6 months to write a thesis and like struggle at the end" (Participant 16 on finishing the PhD).

There were also some instances of self-doubt in more specific areas of the PhD, although these were not vocalised as often. For example, Participant 7 discussed a more specific concern regarding networking with more senior academics in their field. The quote below demonstrates a general feeling of inferiority when having conversations with senior academics (Quote 50).

50. "I'll be really nervous, I'm kind of hoping that it just doesn't happen, but I know it will. So I'm kind of like dreading the day, for now, because I'll just be really awkward and probably say something stupid" (Participant 17 on networking).

The data presented above possibly demonstrate the most significant differences between Cohorts 1 and 2. Each of the participants in Cohort 1 agreed that the Learning Process had influenced their confidence, although some participants were convinced that the increase was a short-term fix. Participants in Cohort 1 were also more explicitly aware of their capabilities in terms of explicit situations, such as networking. In comparison, participants in Cohort 2 demonstrated a more implicit lack of confidence. Whilst many of the participants explicitly discussed their confidence in terms of completing their PhD, a lack of confidence was often evident when participants were comparing themselves to others, for example comparing themselves to senior academics or comparing themselves to other PhD students who had more publications. In response to this point, the next section focuses on the experiences of PhD students when interacting with their peers.

3.3.7. Cohort 1: Peer Interaction

The participants explicitly discussed two main factors that went beyond the core structure of the interview: interaction with their peers and their health. These codes, therefore, were inductively coded post-hoc.

Participants generally found the interaction with their peers to be a useful experience. As evident in some other codes previously highlighted (e.g., Quotes 6, 38 & 39) participants found that peer interaction changed their perceptions of their own isolating thoughts (Quotes 51, 52 & 54). Discussion within the group encouraged participants to consider their own challenges and change perspectives of their capability to deal with problems. The engagement with other students also reduced the feelings of isolation held by some of the students, to the extent that some members have continued to contact each other out with the course (Quote 53).

51.“I found it a useful way to meet other PhD students and just talk about what other people do and why they’re doing their PhD and how they’re doing their PhD and what challenges they face” (Participant 1 on peer interaction).

52. "I think what was helpful on the Learning Process is talking with other people and realising that other people feel the same way" (Participant 2 on peer interaction).

53. "There's a few, for the first few months we do this, then we become very busy so…not very often but sometimes we also have some yeh…some of them I do have contact with" (Participant 6 on peer interaction).

54. "Networking with everybody I realised that everybody was at the same stage, regardless of whether you were just a few months into it or a year down the line, that you go through peaks and troughs, where you're really happy with things and then you have lapses in confidence or you might be feeling anxious about things, so that was quite helpful" (Participant 5 on peer interaction).

The interaction with peers, however, can have a detrimental effect on some participants. The issue of "imposter syndrome" was discussed in detail. An explicit example of this could be observed in Participant 9's discussion about their experiences of peer interaction. Participant 9 demonstrated the opposite effect to many other PhD students, suggesting that comparing themselves to other PhD students encouraged feelings of inferiority, rather than reducing them (Quote 55).

55. "I think this was a mixed bag because like I said, I was at such an early stage and there was only one other girl there at an equally early stage…she had like a fully funded PhD and everything was going really well …so she already had her foot in the door with starting things and so things like that was actually probably a bit of a confidence knock if anything" (Participant 9 on peer interaction).

3.3.8. Cohort 2: Peer Interaction

The overall consensus in Cohort 2 matched the opinions of the majority of Cohort 1: the majority of participants voiced the importance of peer support. For example, Participant 11 suggested that peer interaction was important to ensure students don't become isolated (Quote 56).

> *56. "And then there's other PhD students, other postgrads, yeh it's really nice to have them around. They've been, some of them have been through it before, some of them are still, you know, kind of working their way through things, it's helpful having them around. I think it's really important to have them around so you don't feel on your own" (Participant 11 on peer interaction).*

Some participants, unfortunately, had already experienced feelings of isolation. Participant 12 details their experiences of social isolation when working from home. Working from home is a common practice for PhD students, and Participant 12 felt that, whilst there were fewer distractions at home, they also had limited support (Quote 57).

> *57. "When I was doing the PhD full time, it's what you're doing with the bulk of your time and if you're doing that on your own, at home then it does-it does end up getting you down a bit and you do end up feeling isolated and lonely and I know that's not the case when I come in but then, I will always say, and this is not to do with my peers, this has more to do with me, I'm very good at distracting my peers and if there's a conversation going on and I have a choice of taking part in the conversation or doing work then I will absolutely be trying to keep the conversation going" (Participant 12 on peer interaction).*

In addition to avoiding isolation, some participants detailed the relationships with their peers as a positive method of learning. For example, Participant 13

details using other PhD students to find previously unknown information (Quote 58).

> *58. "I think I'm also quite good at, like, if I can find like-like for instance…pinpointing the kind of person that I need to help me with a certain task, so I knew (officemate) would have experience with RND, so I knew she was the person I had to speak to and I think that is quite a crucial skill is that sort of problem solving of where to get information" (Participant 13 on personality).*

On a more general level, many participants discussed PhD isolation as a key concern for PhD students, detailing the ease by which students can fall into isolating environments (Quotes 59 & 60). For example, Participant 17 details the difficulties of commuting for some students, leaving limited time for socialisation (Quote 60).

> *59. "I think if it happens, it's absolutely horrible. Because I remember times in my PhD when I've just been trying to get my head down and just study and everything is well and while I feel as though you know sometimes you just need to crack on with work, it's not helpful being cut off from people if that makes sense?" (Participant 15 on PhD isolation).*

> *60. "I wouldn't have said it was such a problem, but I do sometimes worry it's going to be a problem…like obviously with my group of colleagues which are all in the same room and it's great, but out with that, sometimes I just kind of worry because it's going to get busier…with travelling and stuff like that, I travel every day and it doesn't kind of leave a lot of time in the day for like socialising and stuff" (Participant 17 on PhD isolation).*

Participants also highlighted that social interaction may not be easy for some students. For example, Participant 18 describes social interaction in terms of personality, and suggests that isolation can be a product of someone's willingness to engage with others, making the effort to form relationships (Quote 61).

> *61. "...because it depends on how you get on with people, because a PhD can be really lonely and you kind of have to make the effort yourself to get on with everyone, so you know if you come into the office and you don't want to be friends with anybody it'd be a very awkward situation, or if you were in a room by yourself then that could be quite hard if you're not going to be able to deal with that, if you became a really shut off person and couldn't cope, then you could see how you could slip quite quickly into not coping with it"(Participant 18 on personality and the PhD).*

Participants within Cohort 1 explicitly discussed the impact of the LP structure. Within the course, peer interaction was key to changing students' perspectives concerning the challenges PhD students face, whilst also reducing feelings of isolation. The experiences of Cohort 1 are reflected in Cohort 2. Participants within the second Cohort had personal experiences of isolation that they struggled to counteract. Others found it difficult to interact with other PhD students and remain proactive in their studies simultaneously. The analysis suggests that PhD students struggle with peer support out-with courses such as the Learning Process. Students also discussed the problems that isolation can have on their mental health. The next section details the experiences of PhD students in terms of maintaining positive health and wellbeing during doctoral study.

3.3.9. Cohort 1: Health and Wellbeing

Health and wellbeing was discussed throughout both the Cohort 1 and Cohort 2 interviews. Often discussed in terms of social isolation and metacognitive

awareness, explicit discussions surrounding health and wellbeing were coded separately.

Throughout the Learning Process Cohort, work-life balance was a common topic of discussion. Participants, even at an early stage of their studies, struggled with maintaining a life outside academia. For some participants, the lack of balance stemmed from feeling overwhelmed (Quote 62). Others, such as Participant 8, detailed how lacking a work-life balance is deemed as a norm of being in academia, often to the detriment of their life outside their PhD (Quote 63). Participant 4, however, discussed how the Learning Process encouraged them to re-evaluate their work-life balance, and focus on how to manage their time effectively (Quote 62).

62. "It did make me re-evaluate, I suppose what was important and how I could manage my time because it did feel quite overwhelming at that point. But, I have to consciously remember to do it…I think the Learning Process made me more conscious of what I was doing. And how I could improve my work-life balance, because work-life balance was a problem" (Participant 4 on health and wellbeing).

63. "Academia is an awful environment and people talk a good game about work-life balance but then I hear conversations between academics like 'oh yeh, no I had my PhD and I broke up with my fiancé but that's just the price you pay'" (Participant 8 on health and wellbeing).

Some participants detailed how attending the Learning Process made them consciously consider their work-life balance. Specifically, Participant 3 details the common activities that have been neglected for the sake of their studies (Quote 64). The Learning Process encouraged Participant 3 to consider the impact of doctoral study on their health and wellbeing. Participant 6 highlighted that the Learning Process had encouraged them to consider how they were spending their time at home (Quote 65).

64. "Well, I mean the other thing that it's helped me think about is health and wellbeing because I think it's easy to neglect when you're studying. Well, exactly that's what's happened really, is that I'm not going to the gym, I'm not doing any exercise because I'm just thinking all the time about reading." (Participant 3 on health and wellbeing)

65. Just with the work-life balance. I suppose I'm more conscious of trying to have quality time at home, because both are tied in really. I just know that I've used it to make sure that when I do go home, I need to switch off and do more things with the family. (Participant 6 on using the Learning Process outside of Academia).

3.3.10. Cohort 2: Health and wellbeing

Cohort 2 detailed similar problems to those in Cohort 1 yet struggled to consciously engage with improving behaviours detrimental to their health and wellbeing. There was often a close relationship between adverse situations out with academia, and the person's relationship with their PhD. Participant 12 for example, details their illness and the impact this had on their studies. The lack of engagement with the PhD during their illness led to feelings of resentment and a lack of confidence in their ability to complete (Quote 66).

66. "I also needed to think, because (the illness) went on for so long I needed to feel some connection to the PhD and to the university so from that side of things I kinda got to the point where I got so anxious and stressed about the fact that I wasn't doing anything in the PhD and it was like this was going to go on forever that I really started resenting the actual PhD" (Participant 12 on emotional support).

Different perspectives towards work-life balance were also demonstrated depending on the participant's year of study. Whilst participants further along in their PhD career viewed their work-life balance as inappropriate (Quote 67), students earlier on in their studies felt that their balance was appropriate, but acknowledged that the balance may change over time dependent on their progress (Quote 68). Participant 16, in comparison, detailed that their work-life balance is normally effective. The balance, however, can be affected by stress and other environmental factors (Quote 69).

67. "I'm doing well at the life part, not the work part, my balance has gone, yeh, there's no balance because I'm in a kind of, at this point that you're asking me, so you know maybe if ask me in a couple of months I would answer the completely opposite way round in that I'm going through one of those troughs at the minute" (Participant 15 on work-life balance).

68."so it's ok to do it, and I'd like to say, I've managed to do that but whenever I do get stressed, social life goes out the window because I really just prefer to just buckle down and get work one, so I find myself not hanging out with a lot of people, just to get work done. But on the whole. I would say it's really helped a lot, finding out that you can just do 9 to 5, get it done and it will work. And it was worked so far, I do feel like we've been able to make enough progress" (Participant 16 on work-life balance).

69. "Like, I'm being quite strict with myself to make sure I do like my 38 hours a week or whatever, but not really been doing much more than that at the moment. I'm sure I'll have to at some point, but right now I feel like the balance is good. .. (as I go along) I think I'll probably do more work? Not that I'm not working hard at the moment, but obviously there'll be times you're kind of doing more hours in a week" (Participant 17 on work-life balance).

The analysis within the current section has highlighted several key points. The Learning Process training course promoted a positive change in participants' health and wellbeing. Whilst students struggled with their work-life balance, the LP encouraged students to consciously consider how they can maintain a work-life balance, and in turn improve their health and wellbeing. By contrast, Cohort 2 believed that the work-life balance shifted drastically in later years of the PhD. Students in the earlier stages of study felt that they had an appropriate work-life balance, but voiced concerns that the balance would shift as their studies progressed. Students further on in their studies in Cohort 2 demonstrated a significant lack of work-life balance, either sacrificing their social life for work time or finding it difficult to progress in their PhD whilst trying to maintain relationships.

3.4.Discussion

Overall, the Learning Process cultivated a significant improvement in the PhD experience of participants. Not all participants demonstrated significant improvement in more specific aspects of metacognitive awareness, such as reflection and learning strategies. A lack of improvement, however, seemed to be a consequence of participants already having these behaviours in place. It is not surprising, therefore, that similar behaviours could be seen in some participants of Cohort 2 who had not received any metacognitive training, and yet demonstrated metacognitive behaviours consistently. Bottom line, the data appears to suggest that students within a cohort vary in whether metacognitive ability has already developed-and for the students who are not metacognitively aware, training is beneficial.

The main outcome of the Learning Process can be viewed as related to improved self-awareness. Each of the participants in the Learning Process cohort suggested that their awareness of their abilities had been improved by the programme, although some more recent participants suggested that the improved confidence had a limited effect over time. Despite the short-term effects suggested by some participants, however alumni from previous years also suggested that the LP had an effect on their confidence years after they

had participated. The data provided evidence to suggest the Learning Process did meet its aim of improving the self-awareness of its attendees.

The control Cohort demonstrated a much more mixed picture of student self-awareness. Whilst some participants demonstrated a strong self-awareness of their own abilities despite lacking metacognitive training, there were more implicit instances of imposter syndrome, such as participants suggesting that PhD students who published were better, or lacking confidence in discussing their PhD with more senior academics. These findings are consistent with what the literature tells us about Imposter Syndrome (Clance, 1985; Watson & Betts, 2010). Comparing Cohort 1 in this respect to Cohort 2 suggests that the Learning Process influences Imposter Syndrome, fostering perceptions of belonging and capability in newer doctoral students.

Fostering feelings of belonging and perceptions of confidence were strongly tied with the Learning Process structure. Rather than focusing on individual metacognition, the programme is heavily focused on learning through others. The opinions of previous participants on the peer interaction aspect of the Learning Process serves to further highlight the importance of developing metacognitive behaviours, such as reflection. Also of note, many of the participants in both cohorts stressed the importance of peer interaction in doctoral success. There were instances in which individuals discussed using their peers to obtain information and develop clearer strategies of working. More commonly, participants expressed their need for peer interaction to prevent social isolation. Isolation in PhD candidates is a well-documented phenomenon (Gardner, 2008; Golde & Dore, 2001), often stemming from the inherently unique focus of each PhD. Yet, many students experience their PhD in similar ways, making it therefore possible for students to support each other when provided with the opportunity.

One of the codes heavily linked with all other aspects of the analysis was the participants' health and wellbeing. Whilst lacking self-awareness led to some participants feeling anxious and unprepared, Cohort 1 highlighted that the LP had encouraged them to be more pro-active in maintaining a work-life

balance. The data also highlighted a norm around academia and poor work-life balance. PhD students' perceptions are often guided by the observed behaviours of their seniors. The data does suggest that if senior academics provide an example that suggests a poor work-life balance is necessary to be successful, doctoral students will be likely to follow this example.

One of the questions raised within the reflexivity statement was whether participants felt constrained by their work environment when discussing their health and well-being. Yet, many of the participants felt comfortable enough to disclose feelings of anxiety and being overwhelmed, whilst also discussing the norms of working in an academic environment. There is little evidence to suggest that participants felt they could not discuss their experiences freely.

Another key consideration mentioned throughout the interviews was the inadequacy of current programmes offered to postgraduate students. Both Cohorts 1 and 2 mentioned that they had attended previous courses, including courses on writing skills, data analysis skills and public speaking, for example. These courses, however, were largely designed to teach one strategy, rather than encouraging and facilitating students to reflect on the methods that work best for them. Many of these 'hard skill' courses actually harmed students' confidence if they were unable to engage with the strategies being taught. The Learning Process, in comparison, improves self-confidence by facilitating students' ability to identify the learning strategies that work best for them.

The present chapter highlights a few key messages. The first is that, despite the obvious academic success, doctoral students are still suffering from adverse perceptions of themselves. The concept of imposter syndrome is well documented, and yet little seems to be being done to improve the confidence of doctoral students, specifically at an early career stage. The second is that metacognitive improvement in postgraduate education differs quite drastically compared to that of secondary or even undergraduate education. The present study suggests that focusing more heavily on the broader factor of metacognitive self-awareness is more beneficial than focusing on key study

behaviours, often already ingrained in postgraduate students from their undergraduate education.

3.5.Conclusion

The qualitative analysis of student experience of the Learning Process has demonstrated that it has the capability to provide postgraduate students with the necessary skills to succeed. Rather than trying to improve hard skills, the Learning Process provides postgraduate students with a framework to build upon. The programme differs from much of postgraduate training in its heavy reliance on peer interaction, and yet this aspect seems to be the most beneficial to the participants. The overall conclusion of this chapter is that by merging individual and social aspects of metacognition, courses like the Learning Process can significantly improve a doctoral student's experience. How does this relate, however, to undergraduate education? Peer support in doctoral education seems to be of the upmost importance. Not only do doctoral students rely on peer support to ward against isolation, but they also are aware that other students can provide valuable information and insight. The question remains: can undergraduate students engage in the same way with their peers? Do undergraduate students see their peers as individuals who can provide them with information they may not have? The next chapter aims to address whether undergraduate students can engage with metacognitive skills when working together, like the behaviours of doctoral students.

4. SHIFTING FROM INDIVIDUAL TO SOCIAL METACOGNITION: THINKING ABOUT THINKING ABOUT OTHERS

4.1.Introduction

"Whenever two people meet, there are really six people present. There is each person as they see themselves, each person as the other person sees them and each person as they really are." - William James

The previous chapter detailed the impact of a metacognitive intervention on doctoral students. One noteworthy finding was that structured peer interaction improved doctoral students' metacognition. The finding does raise concern, however, that postgraduates were not aware of the benefits to peer learning prior to attending the LP. The questions remain: are undergraduate students aware of the benefits of peer learning? Do students recognise that others have information they can use? How do students view their peers' abilities in comparison to authority figures?

Research into the relationship between peer learning and metacognition is relatively new. Many cognitive perspectives of metacognition suggest that the process is entirely individual, and social context has a limited effect on it. In comparison, some metacognitive research has considered the role of social

context on metacognitive processes. The idea of social metacognition is not new. Research into the area, however, has gained traction more recently. The next section briefly outlines the current understanding and models of social metacognition.

4.2.Social Metacognition

Whilst most metacognitive theories provide a thorough understanding of the cognitive basis for metacognition, the potential for social factors to influence metacognitive ability has been largely disregarded. In Flavell's original metacognitive model, the inclusion of metacognitive experience implicitly suggested that social factors may have an influence on metacognition, through our conscious and emotional experiences. The wider literature on social cognition, however, suggests that other factors are highly likely to influence our behaviour, including social norm enforcement and the perception of peers. Given this context, here we ask why social influences have been neglected in modern metacognitive studies.

The concept of social metacognition is not a new one. Jost, Kruglanski and Nelson (1998) suggested that the complexities of metacognition cannot simply be explained through individual cognitive processes. Rather than examining metacognition from a purely cognitive perspective, Jost, Kruglanski and Nelson argue that social psychologists have had a strong input into the understanding of "thinking about thinking". Despite this input, research that emphasises social factors is often misrepresented, and not classified as metacognitive. Moreover, within the literature, a comparison is often made between "traditional" metacognitive beliefs, such as the beliefs about one's own thinking, and social metacognitions, such as normative beliefs about how we ought to think. The emergence of two largely separate research domains highlights the neglect of research into the social influence on metacognitive processes.

Despite a lack of understanding around social metacognition, there is a substantial amount of research into the area of human social learning from an evolutionary perspective. For example, Morgan, Rendell, Ehn, Hoppitt and

Laland (2012) suggest that humans are dependent on information transmitted culturally and socially. This study examined the impact of adaptive learning theory on human social learning. Participants took part in four experiments involving computerized binary choice tasks. Within these tasks, participants were asked to make choices based on their own decisions or manipulated to believe that they were making decisions in conjunction with others. The experiments also included manipulations of the cost of the decision (a higher risk to go against the consensus) or manipulations of the participants' rank. The findings of the study supported the view that adaptive learning is a regulator of human social learning. Importantly, however, despite the aim of the study, the experimental design was based on manipulating beliefs about the consensus between participants, with little actual social interaction between participants.

The failure to use social interaction limits how much this kind of study can tell us about social learning in naturalistic environments. Moreover, the Morgan et al., (2012) study focused on an individual's confidence in their decisions, rather than what they were learning. If confidence impacts on beliefs, there is a possibility that those beliefs further impacted on their knowledge. For example, if participants of low confidence viewed their allotted collaborator as an authority figure, they may have made decisions purely based on what they viewed as the opinions of the "right person".

The question remains, how do we decide who to learn from? Heyes (2016) suggested that to effectively learn from others, we need to be able to learn from appropriate others (i.e., people who know more than we do). Furthermore, Heyes theoretical paper posited that social learning strategies have the potential to create cultural evolution. Despite evidence of social learning strategies observed in animal behaviour, there is debate as to whether these behaviours are only being interpreted as social learning by the observer, rather than being inherent in the animals themselves. Heyes suggests that only humans exhibit a specific kind of metacognition that induces "culture promoting social learning strategies" (Heyes, 1995, p. 3). From this perspective, only social learning strategies in humans are metacognitive, in

that they demonstrate conscious cognitive strategies of the individual and other parties. Like Jost, Kruglanski and Nelson (1998), Heyes argues that there is a distinct difference between the individual metacognitive processes used, and the metacognition that defines our social learning strategies. What Heyes (2015) neglects to consider is how we choose the right "other". There is a possibility that decisions will depend on the other" seeming trustworthy, confident or authoritative. If so, individuals will not necessarily choose the right people on the right terms. It is unlikely that individuals would always choose "appropriate others" from chance encounters.

Models of social metacognition characterise two distinct aspects of metacognition: individual metacognitive strategies and social metacognitive strategies. For example, Shea, Boldt, Bang, Yeung, Heyes and Frith (2014) defines the individual metacognition as supporting our own conscious control of our cognitive processes, and a second social system as allowing metacognitive information to be transmitted between individuals when they are involved in a shared task. This particular model focuses primarily on the transmission of metacognitive information. Surprisingly however, there is limited examination of how the transmission of this information impacts on the metacognitive ability of the receiving individual. Indeed, it is assumed that the information transmitted is not internalised by the other participant. Although the social interaction influences behavioural decisions, it has no direct impact on the individual's metacognitive processes. There is also a limited explanation of how social metacognition may impact on our individual metacognitive processes.

Efklides (2008) argues that the key to understanding social processes in metacognition is to focus on metacognitive experiences. These experiences are, at least in part, influenced by social comparisons and stereotypic knowledge. According to this account, social influences can cause individuals to make inferences about their own (or others') cognition. For example, normative beliefs (i.e., perceived behavioural expectations of referent groups) can have an effect on how we infer ability and make confidence judgements about our own capabilities. In contrast with Shea's account, Efklides suggests

that metacognition can have an impact on the co-regulation of both behaviours and cognitions when learning collaboratively. The multi-level metacognitive model presented by Efklides argues that social metacognition is a part of metacognition as an overall concept (see Figure 4.1). The model incorporates a social level of metacognitive processing, but also represents each level has having multiple facets. A non-conscious level incorporates basic cognitive processes. Within this level, the regulation of cognition and emotion are incorporated, with aspects of monitoring and control also included. The next level describes what would generally be viewed as metacognition in the wider literature. This personal awareness level reflects Flavell's original metacognitive model, including the facets of metacognitive knowledge, experience and strategies. The more novel addition in Efklides' model is the meta-meta level. This level reflects metacognition of social processes. Like the individual metacognitive levels, social metacognitive knowledge and strategies are present, however an additional facet of metacognitive judgement is also included.

There are a few features of Efklides' proposed model that are noteworthy. Firstly, the hierarchical nature of the overall model. The model suggests that the social level monitors the personal awareness level. There is, however, little consideration that this process might be interactive, in that the personal awareness model might also monitor the social level. The absence of monitoring between the personal and social levels is possibly an omission given that metacognitive judgements are reliant on individual metacognitive processes as well as social context. The second aspect of note is the regulation of cognition and emotion within the non-conscious level. The presence of regulation within this level suggests that the processes are not entirely unconscious, especially considering the basis of metacognition focuses on the regulation of cognition. The differences between the regulation within the cognitive level and the metacognitive level are not clearly defined.

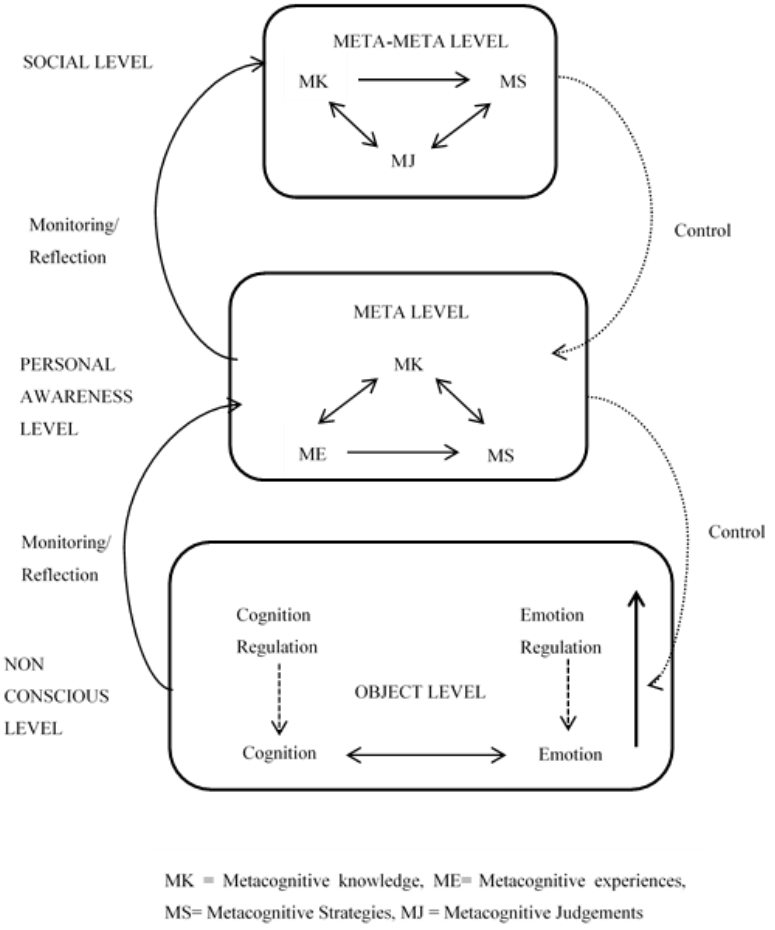


Figure 4.1: The Multi-level and Multi-faceted Model of Metacognition Demonstrating a Novel Approach to Social Metacognition (Adapted from Efklides, 2008).

Regardless of the concerns highlighted above, Efklides' model provides a novel conceptualisation of metacognition. The inclusion of social processes within the model is necessary, given the connection between social context, semantic knowledge and metacognitive processes. In the absence of research investigating these issues, however, there are limits to current understanding of the relationship between social context and metacognition. Whilst the proposed model suggests a hierarchical relationship, it seems reasonable to expect that the relationship between the personal awareness levels and social level are interactive in nature. For example, models of Socially Mediated Metacognition suggest that social context influences individual metacognition. From a review of collaborative learning literature, Salonen,

Vauras and Efklides (2005) suggest that when a student's independent functioning is low, scaffolding, teacher direction and social structure, can all help improve metacognitive ability. Salonen and colleagues also suggest that perceptions of metacognitive experience are impacted by teachers' and peers' normative understandings of performance, impacting on metacognitive judgements. There are some conceptualisations of social metacognition, however, that suggest it is completely independent of individual metacognition, for example socially shared metacognition.

4.2.1. Socially Shared Metacognition

Volet, Vauras and Salonen's (2009) review of self-regulatory processes in learning highlighted a key conceptual problem in current metacognitive literature: a neglect of understanding the relationship between social and individual regulation. The review highlighted that research into self-regulated learning processes in the classroom suggest that it not only relies on a child's regulation of task performance but is also heavily influenced by their environment and behaviour. Moreover, data suggest that these influences are evident from a young age. From a review of research into the development of self-regulation in infancy, Volet, Vauras and Salonen (2009) concluded that social regulation (especially within child-parent dynamics) is already evident in an infant's development of self-regulation.

Volet and colleagues heavily criticise the more cognitive perspectives of metacognition that are commonly implemented. The authors suggest that socio-cultural theorists question the validity of these cognitive models, on the basis that they exaggerate individual agency, and treat social and group contexts as separate entities, rather than as interconnected. From the perspective introduced within the review, Iiskala, Vauras, Lehtinen and Salonen (2011) introduced the term 'socially shared metacognition'. Socially shared metacognition refers to joint cognitions that take place in challenging situations, when groups of individuals work collaboratively. According to the socially shared metacognition account, an individual's metacognition operates as a separate social entity when the individual is working towards a shared goal. Whilst this theoretical development is justifiable in principle, at

present there is limited empirical evidence to support the introduction of a separate social entity.

A study carried out by Iiskala et al., (2011) explored how socially shared metacognition influences problem solving performance in collaborative situations. The study focused on socially shared metacognition in high achieving students when they were asked to work together on a problem-solving task. Mathematical word tasks were presented to eight paired pupils who previously knew each other, increasing in difficult over five levels. During solving the tasks, the verbalisations and nonverbal communications were recorded. Qualitative analysis of these communications demonstrated a clear relationship between problem difficulty and the introduction of socially shared metacognition into the pairs' collaborative discourse. Iiskala and colleagues, however, conclude that the findings were not strong enough to determine the importance of socially shared metacognition in collaborative problem solving.

These socially shared processes do not, however, necessarily have an independent impact on academic performance. There are other factors to consider, particularly when determining how socially shared metacognition works in collaborative learning environments. For example, Jarvela, Jarvenoja and Veermans (2008) examined how the dynamics of motivation changed in terms of socially shared learning, when comparing groups to individuals. Ninety-nine educational psychology students were divided into two learning conditions; face to face and virtual learning. The students within each condition studied in groups of three to five, and took part in three different learning tasks, each with a shared goal. The authors assessed each participant's individual and socially shared interpretations of the goals through three different methods: general self-report questionnaires, task specific questionnaires and video data. Quantitative analysis demonstrated that students within a face to face setting focused more heavily on learning goals and less heavily on performance goals than those in the virtual group. Qualitative analysis of the task specific questionnaire demonstrated that students emphasised the role of the group in goal achievement, whilst also

reporting that their group had played a positive role in their success. Jarvela and colleagues suggest that the findings demonstrate that, when students work collaboratively, the group plays a substantive role in individual's personal goal achievement and motivation towards said goals.

The studies presented by Iskala, Vauras, Lehtinen and Salonen (2011) and Jarvela, Jarvenoja and Veermans (2008) provide an initial basis for the introduction of social theories such as socially shared metacognition. To date, however, there is insufficient evidence to support these theories. Moreover, it remains unclear how all-encompassing social metacognitive processes are; there is no evidence about the extent of the influence of social context in metacognition. One key issue is highlighted by current theories, namely whether metacognition is simply influenced by social context, rather than having a separate metacognitive process for social information.

4.2.2. Socially Mediated Metacognition

Socially mediated metacognition, in comparison to socially shared metacognition, has a less precise definition. Many researchers define socially mediated metacognition simply as the influence of metacognition through social context. Research using the term socially mediated metacognition exists across a broad spectrum from theoretical educational research to metacognition in applied clinical psychology settings. For example, Goos, Galbraith and Renshaw (2002) use the term socially mediated metacognition when discussing collaborative zones of proximal development in group problem solving. The study aimed to examine the use of zones of proximal development (the difference between what a student can learn independently and what they need help with) to assist students moving from assisted learning (other-regulated) to independent performance. Goos, Galbraith and Renshaw (2002) expanded on Forman and colleagues work (1989, 1993), which demonstrated that collaborative problem solving creates a bidirectional zone of proximal development that can help students adapt their perspectives and improve problem solving ability.

In a 3-year research study, Goos, Galbraith and Renshaw (2002) investigated collaborative learning in five senior secondary school mathematics classes across five different schools. From these five classrooms, one was selected for intensive analysis due to a demonstration of a more positive metacognitive disposition than the other classrooms. Within the chosen classroom, students were selected for observation based on their more advanced metacognitive ability, and their preference for working collaboratively with peers. These students were observed once a week for 2 years. The observed interactions were videotaped, transcribed and coded for instances of behaviours such as understanding, analysis, planning and exploration.

The qualitative analysis of Think-Aloud Protocols from Goos, Galbraith and Renshaw's (2002) research demonstrated that collaborative conversations between peers could make monitoring and regulation processes more explicit. The data also demonstrated the importance of the teacher in promoting advantageous collaborative learning environments. Critically, the inclusion of the teacher highlights a potentially serious problem for collaborative learning research in higher education environments. The secondary school environment is potentially very different from a university setting. Universities often lack the resources to promote similar teaching time to classrooms and promote a more self-directed learning environment. In the context of the current thesis, the importance of the teacher as an authority figure supporting social learning represents a potential limit on students' learning. It is unclear if students can effectively engage with collaborative learning if they do not have an authority figure to mediate the process.

Whilst it would be expected that authority figures in higher education would be less involved in collaborative learning contexts, teachers in primary and secondary education can help promote metacognitive skills in younger children. For example, Larkin (2009) investigated whether metacognition could be improved in children through collaborative writing. The project was designed around three learning activities: presentational talk (practicing comprehension in discussion before writing), process talk (generating content) and reflective talk (thinking about writing). Children worked in pairs

and were observed throughout the project. Teachers were encouraged to act as a facilitator for metacognition within the classrooms. The observational data demonstrated that partners engaged in collaboration appeared more motivated towards their task and engaged with discussion regarding their overall goal. There were also points of silence which Larkin interpreted as thinking about the task. The author also suggested that not all highly collaborative talk was metacognitive. At times the discussion was focused more heavily on creative tasks, such as generating ideas.

Both Goos and colleagues (2002), and Larkin (2009), demonstrated similar findings, despite the difference in age groups. Both studies required the use of a teacher as a facilitator, although the facilitation would be more appropriate for younger children. Larkin's interpretation of silence as metacognitive highlights some limitations of socially shared metacognition. The silence may have been metacognitive, however the processes engaged with during silent periods would necessarily be more reflective of individual metacognition rather than social metacognition. Socially mediated metacognition would more appropriately explain these findings, suggesting that, whilst social context influenced the metacognitive processes, individual processes are still operating independently.

Both socially shared metacognition and socially mediated metacognition are currently abstract theories. The abstract nature reflects at least in part the fact that inter-personal metacognition is still a relatively new area of research. At present, however, there is limited research to support either theory in its entirety. There is, however, research that supports a relationship between metacognition and collaborative learning.

4.2.3. Metacognition and Collaborative Learning

The impact of metacognition on collaborative activities can be inferred from a qualitative phenomenological study on transformative learning, metacognition and collaborative learning online carried out by Boyer, Maher & Kirkman (2006). Content analysis on graduate students' reflective writing demonstrated evidence of improved reflection through discussion. More

importantly, the study indicated that, through collaborative learning, a quarter of the students' fundamental beliefs about their own capabilities changed. Moreover, within this study the instructor was found to be vital to the facilitation of the groups. Given the definition of metacognition as the knowledge and regulation of one's own cognitive processes, truly collaborative learning should not require a facilitator, particularly if a student's metacognitive abilities are flexible and adaptable to new situations.

It remains unclear, therefore, whether collaborative learning is truly metacognitive if a facilitator is present. One reason for the lack of current knowledge is that the majority of research into metacognition and collaborative learning has focused on online environments (despite the inherent lack of interpersonal face to face interaction involved). For example, White, Shimoda and Frederiksen (1999) introduced a new software system to facilitate collaborative learning projects. The system included software agents that could provide students with advice and guidance on working collaboratively. White and colleagues highlighted that one of the advantages of the system was the ease with which students could modify it to express their own theories. Although the system was designed as an attempt to promote metacognitive development, it did not focus on the complex interactions between students. Most collaborative learning research has neglected the differences between problem-solving in groups versus individually. If we are to understand the exact role of metacognition in collaborative learning, well designed and controlled comparison of the two scenarios are necessary.

There is evidence to suggest that metacognition can be improved through collaborative learning activities. Metacognitive training may be more effective in groups when compared to individuals. Kramarski and Mevarech (2003), for example, investigated the effect of metacognitive improvement, in conjunction with cooperative learning, on mathematical reasoning. Three hundred and eighty-four students were placed into one of four conditions: one individual and one group condition received metacognitive training, whilst the second individual and group conditions received no training. The

metacognitive training took the form of questions designed to promote self-reflection; comprehension questions, strategic questions and connection questions. Students were assessed through a graph interpretation test, a graph construction test, and a metacognitive questionnaire. A Multiple Analysis of Co-Variance (in addition to post hoc tests) indicated that students placed in the metacognitive group condition outperformed students in the metacognitive individual condition on graph interpretation and mathematical explanation, whilst both metacognitive groups and individuals outperformed their non-metacognitive equivalents on graph construction and metacognitive knowledge. The findings suggest that, whilst individual metacognition can improve performance, improving metacognition in groups can have specific advantages.

Most of the research into metacognition and collaborative learning has been focused on online environments (Garrison, 2003; King, 2007). Whilst there is support for improving metacognition within these environments (Boyer, Maher & Kirkman, 2006), there seems to be less support when focusing on face to face interactions. For example, Stacey (1992) examined the role of group work in mathematical problem solving. The study administered a 45-minute test to Year 9 students at 2 secondary schools. Two classes were asked to complete the task individually, and two classes were asked to complete the task in groups. The findings demonstrated a significant decrease in metacognitive ability when Year 9 students worked in groups: individuals working in groups found it more difficult to select correct approaches to the answer than individuals working alone.

In comparison to the findings presented by Stacey (1992), Goos (1996) compared the Think-Aloud Protocols produced by pairs of high school students completing mathematical problems. Qualitative analysis demonstrated that metacognitive ability could either be improved or hindered by working in groups when problem solving. Goos (1996) suggested that the improvement or detriment was reliant on whether students could be flexible in their metacognitive behaviours, and the roles they acquired (e.g., someone taking a stronger leadership role) during problem solving tasks.

Whilst most of the studies such as Stacey's (1992) and Goos' (1996) research demonstrate inconsistent findings between metacognitive ability in groups, it remains unknown whether these behaviours also occur in higher education contexts. The study below aims to determine whether individuals (engaged in learning at undergraduate level) completing a problem-solving task behave differently to those completing the task in groups.

4.3. Study 1: Metacognitive Processes in a Peer Group

4.3.1. Method

Participants

Thirty 1st Year University of Stirling students were recruited via Psychweb. Participants were fully informed of the procedure before commencement (See Appendix 10). Participants were also asked to consent separately to the recording of information. Students were offered tokens as an incentive for participation. The procedure was approved by the University Of Stirling Division Of Psychology Ethics Committee.

Procedure

Participants registered their interest in participating in the study through a recruitment system. Once participants had registered, they were administered the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) online via Qualtrics (Version360, 2017). After completing the questionnaire, participants were asked to consent to a second stage of the study. If the participant consented, they were asked to attend a follow up session. The second stage of the study consisted of two different conditions; an individual group and a paired group. The 30 participants were randomly allocated into one of these groups.

During the follow up session the participants were asked to attend a face to face appointment. During the session, the participants were asked to complete the Tower of Hanoi (ToH) task. Participants were presented with a puzzle

consisting of three pegs with 7 disks on one of the pegs. The participants were then asked to transfer all of the disks from a source peg to a goal peg. There were 2 rules however: only one disk can be moved at a time, and a larger disk cannot be placed on a smaller one. The time taken and the number of moves taken to complete the puzzle were recorded. Participants were given 1 hour to complete the puzzle. Performances were also evaluated by asking participants to voice their explanations aloud, and these were recorded with participants' permission.

4.3.2. Qualitative Coding Framework

A thematic coding framework used Schraw and Moshman's (1995) approach to metacognitive knowledge and regulation. Working from one framework allowed a variety of different phrases to be coded as the same type of regulation. The approach was deemed more appropriate in comparison to alternative frameworks such as the Keywords-in-context framework (Fielding & Lee's, 1998, as cited by Onwuegbuzie et al., 2009) where an interaction is only coded as evaluation simply if a specific word is mentioned. The framework was also decided ad-hoc, in comparison to constant comparison analysis (Strauss & Corbin, 1998, as cited in Onwuegbuzie et al., 2009), which generates sub-themes post-hoc dependent on the behaviours observed. Participant's behaviours were split into three sub-themes; planning, monitoring and evaluation. The framework included definitions for each sub-theme (see Table 4.1).

Both individual and group recordings were transcribed verbatim, including any pauses in communication. Group and individual transcripts were then collated and coded for each sub-theme independently. After the initial coding stage, it was decided that the theme of metacognitive knowledge overlapped too heavily with aspects of metacognitive regulation. It was therefore decided that the analysis should focus solely on metacognitive regulation, as demonstrated in Table 4.1 below.

Table 4.1: Detailing the themes, sub-themes and examples of codings for Think Aloud Protocols.

Theme	Sub-Theme	Definition	Transcription Example
Regulation	Planning	Detailing how the task should be approached before beginning	"right…before we start let's have a think about this"
	Monitoring	Assessing progress throughout the task	"Right so I've moved that there, if I move this ring here, then I'll have made a tower on this one"
	Evaluation	Assessing a completed task or series of moves	"I've gone wrong somewhere, I'm not sure where. I need to think about what I've done wrong."

4.3.3. Reflexivity Statement

In comparison to the previous qualitative study (Chapter Three), the current study aimed to focus on the behavioural aspects of metacognition rather than metacognitive experience. Whilst it would have been possible to explore metacognitive experience at undergraduate level, the aim here was to determine whether undergraduate behaviours reflected the perceptions doctoral students had of peer learning.

It would have been possible to record the frequency of the behaviours observed, rather than the content of the transcriptions themselves. As highlighted below in the Justification for Methods section, however, often there are periods of silence in Think Aloud Protocols that can signal unconscious processing that may have been key to performance. The researcher therefore felt that the content of the transcriptions were more important than frequencies to account for these pauses.

The researchers needed to be aware of their involvement in the process. The researcher was present during the participant sessions, to record the number of moves made in case of a problem with recording equipment. However, within these sessions the researcher had to be very conscious of their own presence. It would have been easy to talk with participants, providing prompts when a mistake was made. It was decided, however, that the researcher

needed to talk minimally during the session. Minimizing discussion was also necessary to ensure that Think Aloud Protocols were not skewed by conversation. There is an issue, however, that regardless of the researcher's silence, participants may have still felt the need to talk more than they would have independently.

The researcher also needed to be aware of their perceptions of working in groups, particularly when observing participants working together. The researcher perceived working together as an advantage in problem solving tasks. There was the possibility that biases could have affected the coding. A research assistant was therefore recruited to assist with coding. The research assistant blind coded two individual and two group transcriptions, and these were then compared with the researcher's coding of the same transcriptions.

4.3.4. Justification for Method

The issue with many studies of metacognition is using tasks that require previous knowledge. There is argument over whether metacognition is domain specific (skills can only be used in the contexts they are learned in) or domain general (skills should be transferable across contexts).

Domain specificity

There is debate as to whether metacognition is domain general or specific. Georghiades (2000) addressed the problem of domain specificity in metacognitive processes by reviewing literature around conceptual change learning, transfer and durability within metacognition. Conceptual Change Theory suggests that people are responsible for their own learning. According to this account, individuals can only learn if they build new knowledge, based on previous experience. Georghiades argues that the transferability of knowledge and skills to other contexts is a necessary element of metacognitive theory. The issue of transferable knowledge, as explained by Georghiades, mirrors the key problem of domain specificity in metacognitive research. Schraw (1998) hypothesised that metacognition is effective across numerous domains, in comparison to cognitive monitoring, which is characterised as domain-specific.

Veenman and Verheij (2003) further explored general versus specific metacognitive skills. Sixteen first year male students recruited from a technical university completed two tasks. The first was based in a fictitious environment that Veenman suggested did not require any previous domain-specific knowledge. The task required participants to create a formula based on fictitious materials. The second task was a mathematical problem requiring answers to be provided for two given tasks. Veenman and colleagues observed that, as metacognitive skilfulness increased, so did task performance. The increase was not affected by controlling for intellectual ability. The finding supported metacognitive skills as domain general in technical students, whilst also supporting metacognition as at least partly independent of intelligence.

There are, however, questions as to the actual domain general nature of the tasks provided. It seems unlikely that the tasks differed entirely in the strategies required, considering both tasks were of a mathematical nature, requiring the participants to provide formulae and construction models. Consistent with this critique, Veenman et al., (2006) has argued that much of the research investigating metacognitive knowledge has been carried out in one specific domain, such as mathematics or test reading.

In the current study, the issue of domain specificity has been addressed by using a task that does not require previous knowledge. The action of problem-solving is one of the most consistently measured metacognitive behaviours. Problem solving requires strategic analysis and consideration of alternative solutions. One of the most commonly used problem-solving puzzles is the Tower of Hanoi (see Figure 4.2). The Tower of Hanoi has long been a task-oriented procedure for problem solving research (Simon, 1975; Zook, Davalos, DeLosh & Davis; 2004), often described as a measure of executive functioning. In terms of the research within this thesis, the Tower of Hanoi presented a problem that requires no previous knowledge or training, but was intricate enough to provide an insight into the problem-solving behaviours of individuals and groups.

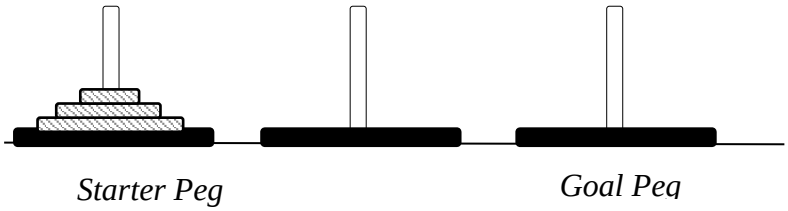


Figure 4.2: Example of the Tower of Hanoi: Task used to measure problem solving

Think Aloud Protocols

Whilst the Tower of Hanoi does provide an insight into executive functioning processes, there is some argument as to whether these processes should be classified as cognitive or metacognitive (Roebers, 2017; Scherling et al, 2016). There is difficulty in determining whether successful completion of the task itself implies the use of metacognitive processes, due to the highly subjective and reflective nature of metacognition. The use of Think Aloud protocols, however, introduces another method for understanding what cognitive and metacognitive processes are being employed when individuals are solving the Tower of Hanoi puzzle. Whilst participants can be trained to think aloud, they were not trained for the current study. Training students to think aloud could have possibly influenced their performance, creating bias in the findings.

Think Aloud protocols are often said to have stemmed from the historical concept of introspection, or the analysis of our thought processes (Ericsson & Simon, 1998). Think Aloud protocols have since been adapted into a method of verbalisation during cognitive tasks, to further understand the ongoing processes that support behaviour (Ericsson & Simon, 1998). Using Think Aloud Protocols provides an insight into the strategies employed throughout the problem-solving process.

There are, however, recognised limitations to the use of these protocols. According to Jaaskelainen (2010), only conscious processes are verbalised, and therefore Think Aloud data cannot present a complete account of the cognitive processes employed. There also may be some slowing down of performance due to the difference in time it takes to process information

consciously and unconsciously. These limitations may cause some problems within complex cognitive studies, where the aim is primarily to develop an abstract model of metacognition. By contrast, for the purposes of the research within this thesis, the limitations should not have an adverse effect on the findings presented. Despite the limitations of both the Tower of Hanoi and think aloud protocols, when used in conjunction they provide an effective means to investigate the use of metacognition in practice.

4.3.5. Results

Table 4.3 above details the means and standard deviations of the individual condition and group condition scores. Initial observations demonstrate a difference in the time and number of moves taken between groups and individuals. Due to limited statistical power, T test scores were then converted to Cohen's D effect sizes. Small effect sizes were observed between the groups (M =37.84, S.D. = 13.85) and individuals (M = 31.84, S.D. = 13.4) in the time taken (*d* =.448). A similar trend was observed between the groups (M = 418.94, S.D. = 130.06) and individuals (M=507.17, S.D. = 277.45) in the number of moves taken (*d* = .407).

Table 4.3: Demonstrating the Differences in Means and Standard Deviations between Groups Vs Individuals.

	Individuals		**Groups**			
	Mean	S.D.	Mean	S.D.	**T Test**	**Cohen's d**
Metacognition	190.00	26.63	189.50	20.45	.957	.002
Time Taken	31.84	13.40	37.84	13.85	.282	.448
Moves Taken	418.94	130.06	507.17	277.45	.272	.407

Think-Aloud Protocols: Qualitative Analysis

The quantitative analysis above demonstrates a lack of relationship between the group condition and completion. To be clear, there was no evidence that compared to working alone, working in a group led to an improvement in performance. To further investigate the individual and group processes, Think-Aloud Protocols were analysed for metacognitive regulation, including planning, monitoring and evaluation.

Individuals

Figure 6.1 details an extract from an individual's Think Aloud protocol. The figure demonstrates some evidence of metacognitive behaviours. Participants within the individual condition often began the task with metacognitive engagement, focusing on the outcome they wished to achieve. Metacognitive planning was lacking, however, with few students preparing a logistical plan before beginning the task. Whilst evidence of metacognitive evaluation was frequent (using statements such as 'I think I've gone backwards, that's where I've gone wrong), the evaluation rarely led to a change in behaviour. Rather, participants in the individual condition preferred to return to the original disk positions and begin again.

The engagement with metacognitive behaviours often seemed to be constrained by a lack of self-efficacy. Participants were often engaged with appropriate metacognitive behaviours, but their judgements were impaired by negative self-belief schemas. These were categorised by statements such as 'I can't do this' or 'I'm not very good at these kinds of things' (referring to the task at hand). When faced with these negative schemas, participants tended to revert from the correct method of solving the task- increasing the number of moves taken for completion and, on occasion, preventing completion overall. Interestingly, individuals completing the task engaged with the Think Aloud protocol during the initial stage of the task. At the point of a change in the pattern to complete the tasks, however, individuals typically began to disengage from the Think Aloud protocol, choosing instead to work silently.

Groups

Theoretically, it was expected that groups of students would interact very differently from individuals. However, the pairs of individuals completing the task often engaged with similar behaviours as the individuals. Rather than interacting with each other to determine a plan, one person tended to take control from the beginning, only including the other participant when unsure of how to proceed.

Participants were typically unwilling to monitor their partner's progress. Reassurance was often offered (e.g., that's what I was thinking, that's what I would have done). Participants rarely offered constructive feedback regarding the process, preferring to agree with an incorrect solution. Moreover, Metacognitive evaluation was rarely observed, and the groups tended to follow a similar pattern of behaviour to the individuals. Participants would observe their behaviours as incorrect, but rarely changed behaviours to improve performance.

Like individuals, once the pattern of the puzzle changed, the pairs often became silent. Rather than using their partner's knowledge to further their progression, each participant began to work individually, often not discussing their thought processes with the other. The pattern of silence typically extended until there was a progression within the puzzle (e.g., getting 6 discs on one peg). Once a progression had been made, participants once again began to evaluate the process thus far and interact to ensure completion.

P1: Eh I don't know, I really don't know
P1: I've got the little one on the left, I've started another tower. (10s)
P1: Put the little one on the tower, it's just going to go back there and that's where I got it from so that's not right, oh no. (6s)
P1: I think I've maybe mucked this up haven't I? Put them all back to the start (8 moves) yeh, and then try and (4s) move the tower over, I think I'm going backwards now, oh no. (4 moves)
P1: Move this back to this one, try and move. (.) oh wait, that one there, that one there, that's smaller. (4s) (3 moves)
P1: I've done it again, (6 moves) Put them back, put that there - ah maybe that's where I've gone wrong, It's not meant to be this confusing.
(s) = pause in seconds

Figure 4.2: Think Aloud Protocols Individual Example

P1: Can I try something?
P2: Yeh, go for it.
(P1 makes 2 moves)
P2: Yeh, that's what I was thinking,
(P1 makes 10 moves)
P1: Your turn
P2: So move it here, (3 moves) erm... (5 moves) feel like I'm just ruining it. I'm literally just moving them all back. I'm thinking of the best way to move this one to this one erm (30s)
P1: You have any ideas?
P2: No
(s) = pause in seconds

Figure 4.3: Think Aloud Protocol Group Example

4.3.6. Discussion

The current study aimed to determine whether the thought processes used to problem solve differed between individuals and groups. The quantitative analysis confirmed a previously supported relationship between metacognition and problem-solving performance (Davidson & Deuser, 1994; Mayer, 1998; Swanson, 1990). In addition, however, the data suggested that in terms of overall performance, there was no significant difference between participants working individually and participants working in groups.

The demonstration of metacognitive behaviours in both the individual and group conditions raises some concern for the relevance of metacognition in an undergraduate population. Few students seemed to understand the importance of engaging with metacognition in problem solving. Students rarely engaged with planning behaviours before beginning the task, preferring to start immediately with no real concept of what the task entailed. Whilst participants seemed to understand when they had made an error, often no consideration was given to how the error was made or how it could be rectified.

One difference observed between individuals and groups was the common vocalisation of negative self-belief in individual but not in group contexts. Negative belief schemas and low self-confidence are well documented hindrances to metacognitive performance (Bandura, 1989; Lester, Garofalo & Kroll, 1989; Urdan & Pajares, 2006). Despite the lack of evidence to support negative beliefs impacting on group performance, it is still possible that these self-beliefs were impacting on metacognitive awareness. Students may simply be less likely to vocalise these beliefs in front of peers.

One possible explanation for the similarities between the conditions could be the lack of interaction between the individuals within each group. Collaborative learning is suggested to improve metacognitive performance by using another person's knowledge, monitoring peers' performance and evaluating each other accordingly (Bruffee, 1993; Dillenbourg, 1999). In the present study, there was, however, very limited evidence that participants were using their peers in this way. Participants predominantly engaged in individual behaviours because they were, in essence, acting as individuals rather than using their peer as a resource for progression.

There is also the possibility that the task involved influenced the findings reported. The ToH, as explained in Chapter 4, is specifically used to measure problem solving ability. The task was chosen because of the domain general skills required to solve it-students do not require any specific previous information to engage with the solution. The domain general nature of the task, however, could be the reason for a lack of difference between participants working individually and participants working in groups. As previously discussed in Chapter 2 (p.38), however, there is debate regarding whether metacognition is domain general or specific. The findings may have differed if students had been given a domain specific task.

Another possible explanation for the level of social effect in the current study is that collaborative learning is only effective when students are familiar with the individuals they are working with. Familiarity may allow students to feel

more comfortable in monitoring their peers' progress and in providing constructive feedback to improve performance. In addition, familiarity may promote more effective dialogue, encouraging peers to engage with others' ideas. Rather than reflecting a confound in the current study, however, the lack of familiarity between group members reflects the reality of higher education environments, where familiarity with people you work with is not necessarily feasible (e.g., due to large class sizes).

Proximity may also mediate the effects of working with strangers (in place of familiarity). Collaborative learning seems to be very effective in online contexts, possibly because people feel more comfortable critically analysing someone's work from a distance. The ability to monitor the work of others is key to collaborative metacognitive ability, in that individuals must be willing to monitor their own work in addition to others if they wish to achieve their goals (King, 1998; Volet, Summers & Thurman, 2009). Collaborative learning online, however, does not provide students with the skills necessary to work face to face, and could be detrimental to the performance of students when they are placed in a different learning environment. The complexity of face to face interactions in comparison to online interactions should provide some insight into the complexities of collaborative learning in unfamiliar environments.

Another, albeit related, interpretation of the current findings could be that students simply do not trust their peers enough to value their input. Peer learning should involve the reciprocal sharing of knowledge and ideas to reach educational attainment (Boud, Cohen & Sampson, 2014). Critically, however, if students do not believe that their peers' ideas are worth engaging with, peer learning becomes impractical. A number of important questions have been raised by the outcomes of this study to understand why peer learning may be impractical. Do students understand that their peers may have information unknown to them? Are undergraduates aware of how to access information from others? Would students be more likely to value the information if paired with someone they viewed as an authority figure, such as a lecturer or professor?

Previous research suggests that peer collaboration is only effective when students view others as being as competent as them (See Chapter 2, p.60: Goos et al., 2002; Hurme, Palonen & Jarvela, 2006). It has also been suggested that the complexity of a task impacts on metacognitive engagement, with highly metacognitive individuals only activating metacognitive skills when a problem becomes challenging (Efklides, Papadaki, Papantoniou & Kiosseoglou, 1998; Prins, Veenman & Elshout, 2006). The relationship between students and teaching staff changes drastically following the transition from secondary to higher education, but the student perception of the teacher does not necessarily reflect the dynamic nature of the relationship. Regardless, as students engage at university, peer learning necessarily increases. For peer learning to be effective, students need to develop a clear understanding of the competencies of other students, in comparison to the authority figures they are used to receiving information from. To date, however, there is little research investigating whether these factors interact, or whether changes in the complexity of learning also change the way in which students view their peers' competencies in comparison to authority figures.

The next study aims to address two key questions: First, how do students perceive the competencies of their peers in comparison to authority figures? Second, how do these perceptions change with the complexity of the learning task? Are students more likely to value the performance of an authority figure in comparison to the performance of their peers as tasks get more difficult?

4.4. Study 2: Identifying the Appropriate Other: Metacognition and the Perception of Authority

4.4.1. Method

Participants

Thirty undergraduate students were recruited from an introductory psychology module. Participants were recruited via Psychweb. Of the 30 participants, 18 were female. Participants were informed of the procedure before commencement (See Appendix 11). The study was approved by the University of Stirling General University Ethics Panel.

Procedure

At the beginning of the study, students were placed in a cubicle, and asked to complete the Metacognitive Awareness Inventory (Schraw & Dennison, 1994). The questionnaire was administered via Qualtrics (Version 360, 2017). Participants completed the questionnaire via an anonymised link, however they were provided with a participant number to allow questionnaire responses to be matched with further data.

In the second stage of the study, participants were presented with a series of pre-set solutions to the Travelling Salesman Problem (TSP: Applegate, Bixby, Chvatal & Cook, 2007). The task requires the solver to find the most efficient route through a set of dots. The task is believed to measure spatial awareness and problem solving. Each participant viewed 15 different problems with three different complexities. The first level of complexity provided 10 dots to find the most efficient path through, the second level 20 dots and the third level 30 dots. The problems were presented using E-Prime software (Version 2.0, Copyright 2012). Responses were recorded by the participant pressing a designated button. Participants were randomly allocated to either a peer or an authority condition. Participants were told that either a first-year undergraduate student had completed the problem, or a professor, and were asked to identify the number of errors the person completing the task had made. However, regardless of the condition the participant was placed in, the solution they were presented with remained the same. At the end of the study, participants were fully debriefed, advised of the deception and its purpose. The number of errors for each of the 15 puzzles was recorded.

4.4.2. Justification for Method

The Tower of Hanoi presents an interesting examination of problem solving processes, the errors that can be made whilst completing it, however, are very explicit. When aiming to examine how we identify the errors of others in relation to our metacognitive awareness, a method is required that provides less explicit errors, without requiring domain specific knowledge. The Travelling Salesman Problem (TMP, see Figure 4.3) is often used in branches of mathematics and computer sciences as an optimisation problem, and in psychology in terms of spatial reasoning and problem solving. Similar to the Tower of Hanoi, there is the potential to design the TMP according to the level of complexity you wish to employ. Figure 4.3 below demonstrates a completed version of the TMP. Participants are presented with several dots on the screen and are asked to join the dots in the shortest path possible. Like the ToH, the TMP does not require any previous knowledge, but should a participant make an error, it is less explicit.

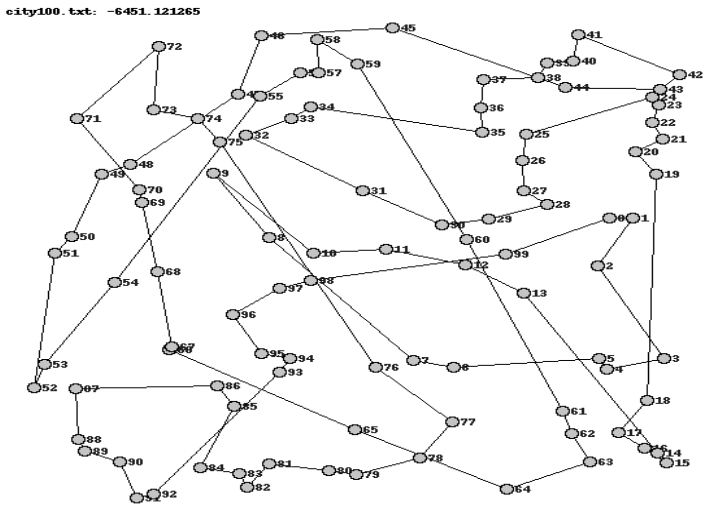


Figure 4.3: Example of the Travelling Salesman Problem: Task used to measure spatial reasoning and problem solving.

4.4.3. Results

The numbers of errors were calculated overall for each participant. In addition, the overall numbers of errors were calculated for each level of

complexity. Table 6.3 demonstrates the means and standard deviations for each complexity level and the overall number of errors recorded.

Table 4.4: Demonstrating Significant Differences between Peer and Professor Conditions According to Complexity Level.

	Peer		Professor			
	Mean	S.D.	Mean	S.D.	t-test	Cohen's *d*
Complexity 1	7.50	1.40	14.00	8.93	**.391***	1.107
Complexity 2	15.07	4.21	12.29	4.04	.086	0.670
Complexity 3	20.36	8.01	17.86	5.65	.349	0.361
Overall Errors	42.93	12.91	39.07	11.07	.404	0.321

An independent samples t-test was used to compare the number of errors made in the Peer and Professor conditions. As there is limited statistical power in the sample, t-test findings were converted to Cohen's D to report effect size. Surprisingly, only a small effect size was observed between the overall number of errors made between the Peer (M=42.93, S.D.=12.91) and Professor (M=39.07, S.D.=11.07) conditions; [t (26) =.848, p=.404, d=0.321]. Large effect sizes were observed between the errors made for the Peer (M=7.50, S.D.=1.40) and Professor (M=14.00, S.D. = 8.93) conditions at the first level of complexity; [t (26) =-2.12, P=.043, d=1.107]. In comparison, a moderate effect size was observed between the two groups for the second level of complexity. [t (26) =1.784, p=.086, d = 0.670]. Only a small effect size was reported between the Peer and Professor condition at the third level of complexity [t (26) =.954, p=.349, d=0.361].

4.4.4. Discussion

Previous research into problem solving in peer learning contexts demonstrated inconclusive findings. Researchers (e.g., Goos, 1994; Stacey, 1992) suggest that problem solving can either be helped or hindered, depending on students' engagement with metacognition. The findings of these previous studies also suggested, however, that poor problem solving in

group contexts stems from participants' unwillingness to monitor or regulate another person's learning. The question asked in this study was whether students are likely to identify errors in their peer group in comparison to identifying errors made by an authority figure. Is the unwillingness to monitor errors because of students being unable to identify them, or because they do not want to?

The current findings provide support for the view that it may not be an unwillingness to identify errors in their peers, but rather a 'normative belief' that their peers make correct decisions. When students viewed a problem that lacked complexity, they were more likely to believe that their peers made fewer errors on the problem than professors. One possible interpretation of this data is that students believe professors are incapable of solving simple problems. A more likely interpretation, however, is that students believe their own problem-solving abilities are reflective of their peers. If the participants believed that they could complete the problem, their peers' performance should also reflect that likely level of success.

The latter interpretation is supported by the lack of significant difference between Peers and Professors in the higher complexity conditions. Participants are less likely to be able to solve these problems efficiently, and it is therefore not surprising that participants identified higher errors in their peer group. Interestingly, in contrast to the low complexity level, the number of errors identified in the peer condition when problems were more complex was higher than the number of errors identified in the professor condition. The findings therefore, present support for the idea that normative beliefs have a significant impact on the ability of students to monitor others' work.

The current findings reflect the issues with group work previously demonstrated in Study One of Chapter Four. During performance of the ToH task, individuals working in groups struggled to monitor and evaluate others' work and preferred to work independently as the complexity of the task increased. The current study suggests that, rather than students underestimating the ability of their peers, the participants may have been

using their own capabilities to estimate the ability of their partners. In light of these considerations, it remains possible that, if students were paired with a partner they perceived as more authoritative, they would have been more likely to engage with their partner as the problem's complexity increased.

One concern with the interpretations offered above is that it conflicts with Dillenbourg's (1999) work, which suggests collaborative metacognitive learning is more likely to occur when students share a proficiency level. In comparison, the findings here suggest that sharing a proficiency level may be detrimental to a student's performance. The participants within the current study demonstrated that, whilst in easier tasks sharing a proficiency level can be advantageous, when tasks become more challenging participants would benefit from working with someone they perceive as of a higher proficiency. Whilst Dillenbourg (1999) also specifies that these learning processes can only occur when students share a common goal, there are likely to be other factors to consider. The first is whether these processes are likely to be mediated by negative belief schemas (Bandura, 1989; Lester, Garafalo & Kroll, 1989). Students engaging with normative beliefs would be likely to impose their own negative belief schemas onto their peers. These beliefs would suggest to them that their peers are also incapable of completing the task.

With collaborative learning becoming more prominent in classroom and university contexts (Barkley, Cross & Major, 2014), these findings cause some concern. Students are interpreting their peers' abilities as similar to their own, whilst failing to act similarly towards authority figures. If this interpretation of the current findings is correct, then they conflict with the general theory of collaborative learning as an effective strategy. In this context, it is necessary to understand the processes underlying the normative beliefs of students. If students generally believe that their peers are similarly capable, it seems unlikely that a process such as collaborative learning will work.

Research suggests that understanding other's perspectives can promote learning development (Van der Graff, Branje & Wied, 2014). Nonetheless, it is unclear what makes perspective taking so important in learning. Jarvela and Hakkinen (2002) suggest that all communication is reliant on a mutual understanding of the persons involved and supposes that each participant has perspective taking skills. At least for some individuals, learning is heavily reliant on communication with others, both in peer and authoritarian form. In the context of socially mediated learning, the ability to take the perspective of others, and to understand the impact of these perspectives, could be key to enhancing metacognitive development.

Within the metacognitive literature, there is an understanding of the importance of perspective taking for metacognitive development. Tarricone's Taxonomy of Metacognition (2011), for example, highlighted that metacognitive knowledge could be described in three contexts; person, task and strategy. The person category of metacognitive knowledge is further divided into an understanding of the cognitive differences within individuals and amongst all individuals. The addition of the person category could, at least in part, be interpreted as a method of merging the processes of metacognition and Theory of Mind. The introduction of the person category also suggests that metacognition is not simply an individual process, but also has relationships with how individuals perceive others and learn from them.

Theoretical accounts of metacognition to date have a strong focus on individual self-awareness, but an individual's perception of themselves is known to rely not only on their own individual cognitions, but on their social experiences. For example, Dialogical Self-Theory (Hermans & Gieser, 2011) suggests that, whilst we are individuals, our entire identity is formed from external interaction being internalised. Dialogical Self-Theory provides an entirely social view of identity formation and does not allow any role for individual development. From this perspective, it is possible that the external context being internalised is a significant part of identity formation. Considering that metacognition is based, in part, on our own self-awareness,

these social contexts and perceptions of others should therefore be taken into account when measuring metacognition.

In broad terms, it is possible that the transition to higher education carried a wide range of non-academic challenges for students. A key element for learning may be the need to develop a new identity, as becoming an undergraduate student can disorient an individual's self-awareness. No longer within secondary education confines, university students can often feel a lack of confidence in their abilities. Scanlon, Rowling and Weber (2007) suggest that many undergraduates suffer from a "student identity discontinuity", continuing to engage with their past learning even though it is not applicable to their new surroundings. It is possible that, due to identity discontinuity, students will try to engage with the social norms of their new in group, the undergraduate population, rather than focus on adapting to a new way of learning.

Whilst the dominant view of social norms is that they are enforced to protect the welfare of an in-group (Horne, 2001), there is also evidence that these behaviours are only enforced when the in-group views the behaviour as significant (Feldman, 1984). If students do not view independent learning as a behaviour that is significant to their identity, it is unlikely that they will engage with it. From this perspective, a key question is what do students really think a 'good student' does?

Given the current findings, there is possibly a need to understand how students perceive their peers and authority figures. Do students' attitudes towards metacognitive abilities feed in to their own metacognition? Do students view social learning as an effective learning method? Do students interpret institutional norms as important to their learning? To address these questions, the next study aims to further investigate the complexities of normative beliefs in metacognitive ability by investigating the attitudes of students and their beliefs about their peers' attitudes.

4.5.Study 3: Metacognition and Perspective: What do 'good students' do?

4.5.1. Method

Participants

Two hundred first and second year undergraduate students were recruited from the University of Stirling (179 of which were female). The participants were fully informed of the procedure before participation (See Appendix 12) and ethical approval for the study was obtained through the University of Stirling Psychology Division Ethics Committee.

Procedure

Students were recruited via Psychweb. Students were required to complete 2 questionnaires: the first being the Metacognitive Awareness Inventory (Schraw and Dennison, 1994) and the second being a novel questionnaire based on the Interpersonal Perception Method (Laing, Phillipson & Lee, 1966). Both questionnaires were administered via Qualtrics (Version 360, 2016). Students were initially recruited to complete the Metacognitive Awareness Inventory, including demographic information such as age, gender, school of study and year of study. An anonymous link was made visible once students had registered to participate. At the end of the study, participants were asked to consent to a follow up. If the participants consented, a second link was sent to access the second questionnaire.

Interpersonal Perception Method

The Interpersonal Perception Method (IPM) refers to a questionnaire format designed to determine the perspectives of the participant, whilst simultaneously examining the participant's understanding of others. Each questionnaire item requires three answers: the direct perspective (what the participant thinks), the meta-perspective (what the participant believes the 'other' thinks) and the meta-meta-perspective (what the participant believes the other thinks about their perspective). The questionnaire consisted of 30 items. Ten of the 30 items consisted of questions designed to examine

undergraduate attitudes towards metacognitive behaviours, 10 items examined attitudes towards the role of social learning in academic performance, and the remaining 10 examined the role of institutional norms in higher education learning.

Ten of the items used in the questionnaire were adapted from the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) to measure attitudes towards metacognitive behaviours. Each statement was rated according to the three perspectives, on a 5-point Likert Scale, from strongly disagree to strongly agree. The scale included statements such as 'to be a good learner you need to be aware of your own strengths and weaknesses' and 'learning is much better when tutors give you all the information required to pass the exam' (negatively coded). The 10 social learning items were rated on an identical scale and included statements such as 'discussions with peers about your work can help you reflect on your own academic practice' and 'it is much more difficult to solve a problem when you need to work with someone else' (negatively coded). Finally, the 10 items within the institutional norms scale were based on the institutional norms within university. This scale contained statements such as 'Watching a peer challenge a tutor in class is unsettling' and 'taking tutors opinions as fact is important to do well'.

Due to the novel design of the questionnaire, a reliability analysis was calculated. The Cronbach's Alpha, a measure of internal consistency, was therefore calculated to determine whether the questionnaire used could be described as reliable. When calculating a Cronbach's Alpha, Field (2005) identifies scores between .7 and .8 to be an acceptable value. The Cronbach's Alpha for the IPM questionnaire was found to be .79, suggesting the scale is reliable in its measurement.

4.5.2. Justification for use of novel self-report measurement

In comparison to other self-report measurements, the IPM can help identify key misunderstanding and miscommunications often present in social

interactions. The use of the IPM has the potential to answer two key questions: Do people with high metacognition simply rate the importance of metacognition in academic performance as higher? And do social norms play a role in our engagement with metacognitive behaviours? The purpose of adapting the items rather than creating new statements allowed for an accurate comparison between the MAI scores of the students and their understanding of the mentioned behaviours. The study also aimed to understand the attitudes of students to metacognition in social contexts. Rather than focusing purely on the individual applications of metacognitive behaviours, the questionnaire also explored the attitudes of students to metacognitive improvement via peer learning.

As previously identified in Study 4.4, the perception of authority can have an impact on how students perceive performance. Yet, a distinct feature of university teaching is to encourage independent learning (Field, Duffy & Huggins, 2015). Despite this focus, there seems to be an increase in students struggling to engage with their own learning throughout their university years (Ding, 2017). The purpose of the institutional norms scale is to determine whether students feel that university teaching is hindering their metacognitive development rather than helping it.

4.5.3. Results

As a novel measurement, a factor analysis was carried out to determine whether each scale was valid in their measurement. For a full factor analysis, Gorsuch (1983) and Kline (1979) suggest that the sample size should be at least 100 (MacCallum, Widaman, Zhang & Hong, 1999). In comparison, Hatcher (1994) suggest that the sample size should be the larger of 5 times the number of variables. The sample size here fits both criteria, as the sample size is roughly 6.5 times the number of items (30).

Scale reliability analysis

Firstly, all three scales were independently tested for reliability. The Individual Metacognitive Behaviours Scale was observed to be reasonably consistent in its measurement (α=.620), as was the Social Metacognitive

Behaviours Scale (α=.633). A low Cronbach's Alpha, however, was reported for the Institutional Norms Scale (α=.527). The scale was then removed from further analyses.

Exploratory Factor Analysis

The factorability of the remaining 20 IPM items was examined. Several recommended criteria for the factorability were used. Firstly, within the correlational matrix it was observed that all 20 items correlated at least .5 with at least one other item, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .619, above the suggested values of .6. Bartlett's Test for Sphericity was significant [χ^2 (190) = 425.151, p<.001]. Finally, communalities for all items were all above .5, suggesting that each item shared some common variance with other items. The 20 items were all deemed to be suitable for factor analysis.

Principal Components Analysis was carried out to identify the components underlying the IPM design. Initial analysis indicated that three components explained 34.3% of the variance. Solutions for two and three components analysed through both varimax and oblimin rotations. A two-factor solution was chosen as there were an insufficient number of primary loadings (n=1) on the third component.

Table 4.4 below gives the loadings of each question on the two components. Two coefficients below .2 were suppressed. Five items of the 20 were eliminated because they had over .3 cross-loading with another component or did not score above .4 on their primary loading.

Confirmatory Factor Analysis

Whilst the exploratory factor analysis provided two key components that could be identified as Attitudes towards Individual Learning (Component one) and Attitudes towards Peer Learning scales (Component two). A determination of model fit was then carried out based on the comparison of

fit indices including Chi Square values. The initial non-significant Chi-squared analysis indicated that there was a good model fit [χ^2 (53) = 55.281, p=.369]. Whilst Chi-square is used to determine model fit, it is also influenced by other factors and cannot be used as the sole determinant of model fit. The analysis, therefore, also included CFI, TFI and RMSEA values. The RMSEA (root mean square error of approximation) indicates a good model fit if below .6. The RMSEA value in this model was observed to be .021. The CFI (comparative fit index) should be above .9 to suggest acceptable model fit. The CFI index registered here was .975. All indicators suggest a good model fit when including the independent learning and peer learning scales.

Table 4.4: Demonstrating the factor loadings of the included 20 IPM items

Statement	Factor 1	Factor 2
1. To be a good learner you need to be aware of your own strengths and weaknesses.	.461	
3. Studying is much more effective when working with peers.	.357	.522
5. Discussions with peers about topics being studied can hinder learning rather than help it.		.400
6. Working through problems with peers is much easier than working through them with tutors.		.321
8. It is much more difficult to solve a problem when you need to work with someone else.		.529
9. You only need to consider one solution to a problem.	.527	
11. Feedback given to students about their assignments should always be read and considered, regardless of their grade.	.531	
13. Comparing yourself to your peers does not motivate you to do well academically.	-.221	.359
15. You need to be aware of the strategies you use to learn to be academically successful.	.262	
16. You can't expect to solve a problem without understanding all the information first.	.458	
19. Remembering information to pass an exam is not the same as learning.	.591	
22. Time management is easier when working in groups.	-.210	.503
23. Students should be expected to find information for themselves rather than rely on tutors to provide it for them.	.250	
26. Reflecting on previous work will help you improve on future assignments	.743	
27. Discussions with peers about your work can help you reflect on your own academic practice.	.351	.639
28. It is preferable for peers to ask you questions to work out your problems rather than just offering solutions.	.443	.287
29. Understanding people's perspectives is an important part of learning	.571	
30. Working with peers makes it much easier to consider alternative solutions to a problem.	.553	.356

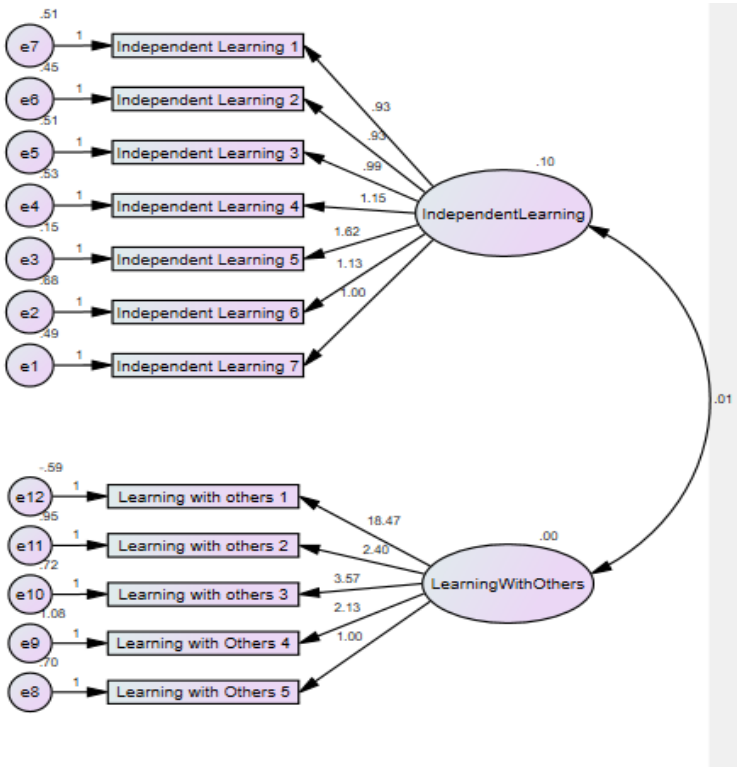


Figure 4.4: Amos path diagram identifying the factor loadings of each item and co-variances between scales

Analysis with Revised Scales

The sum of the revised scales was calculated as above. Table 4.5 demonstrates the means and standard deviations of each scale, metacognition and academic performance. The initial analysis deemed to determine whether the individual or peer learning scales were predictors of academic performance. Regression analyses were carried out with the two scales independently. Attitudes towards individual learning had a very limited effect on academic performance (β = -.068, 95% CI -1.021, .526), only explaining about 0.5% of the variance independently [F (1, 86) =.405, p=.526, r^2=.005]. In comparison, students' attitudes towards peer learning negatively predicted academic performance (β = -.292, 95% CI -2.011, -.352), explaining 8.5% of the variance in academic performance independently [F (1, 86) = 8.014, p=.006, r^2 = .085]. Both predictors were entered into a stepwise regression analysis with the mean grades of the participants. The analysis indicated that, whilst both scales together predicted 8.5% of academic performance [F (2, 85)

=3.97, p=.022, r^2=.085], the variance explained was due to the inclusion of the Peer Learning Scale.

Metacognition was entered into a Pearson's Correlation analysis with both the individual learning and peer learning scales. A small effect size was observed between metacognition and independent learning (r = .213, n=124, p =.037). A moderate negative effect was also observed between metacognition and peer learning (r=-.292, n=124, p=.006). Metacognition was not observed to have a relationship with academic performance (r=.065, n=124, p=.526). The participants' individual metacognition scores were then entered into the regression to determine whether there would be a moderating effect on the relationship between peer learning and academic performance. Metacognition did not directly predict academic performance (β = .081, 95% CI - .083, 1.85). The relationship between peer learning and academic performance did differ with the inclusion of metacognition (β = -.286, 95% CI -.1954, -.305). Attitudes towards peer learning, however, still accounted for 8% of the variance in participants' academic performance. [F (2, 83) =3.902, p=.024, r^2=.08.

Table 4.5: Showing the Means and Standard Deviations for the Revised Scale Perspectives, Metacognition Score and Grades

	Mean	Std. Deviation
Metacognition Score	190.07	14.30
Independent learning	32.88	3.68
Peer Learning	16.29	2.76
Independent Learning Meta-Perspective	30.87	3.95
Independent Learning Meta-Meta Perspective	30.77	3.54
Peer Learning Meta-Perspective	17.68	2.48
Peer Learning Meta-Meta Perspective	17.23	2.15
Mean Grade	59.04	11.59

Convergence between revised scale perspectives, metacognition and academic performance

Table 4.6: Showing significant correlations between metacognition, mean grade and differences in peer learning perspectives

	Mean.	S.D.	Metacognition	Mean Grade
Difference Independent learning direct/meta	6.03	3.76	.096	-.051
Difference Independent Learning direct/meta-meta	6.13	3.23	.110	-.067
Difference Independent Learning meta/meta-meta	.1	2.27	-.007	-.011
Difference Peer Learning direct/meta	-1.39	3.21	.163	-.304**
Difference Peer Learning direct/meta-meta	-.933	2.95	.065	-.243*
Difference Peer Learning meta/meta-meta	.4583	1.66	-.201*	.146

Table 4.6 above shows the means, standard deviations and correlations between the converging scales, metacognition and academic performance. A small relationship was observed between metacognition, differences between peer learning meta-perspectives and meta-meta perspectives. In comparison academic performance was related to two differences in peer learning scales. The difference between direct and meta perspectives of peer learning were negatively related to a person's academic performance. A similar trend was observed between differences in direct/meta-meta perspectives and academic performance.

4.5.4. Discussion

Previous research on collaborative learning and metacognitive improvement has yielded inconclusive results. The findings from Study 3 presented within this Chapter suggest that many of the problems within collaborative learning stem from students' lack of ability to evaluate and monitor someone else's work. Overall, the findings from Study 3 suggest that students are unable to evaluate the work of others because of normative beliefs (i.e., believing that their capabilities are like those of other students). The current study aimed to determine whether these normative beliefs are constraining students' capabilities to work together, and how these beliefs are related to metacognitive performance.

Normative beliefs are defined as beliefs a person holds about what behaviours are expected of them, and whether they should engage with these behaviours (Ajzen & Fishbein, 1972). For example, students who believe that metacognitive behaviours are important are more likely to engage with these behaviours. The observed relationships between individual metacognitive awareness and beliefs about metacognition support the view that these normative beliefs have an impact on metacognitive engagement. Students who believed that metacognitive behaviours were important to student identity also reported greater engagement with metacognition. These students also perceived their peers as holding the same views as them, suggesting that participants who believed that metacognition is important also thought their peers believed the same. Participants who engaged with positive normative beliefs about metacognition projected these beliefs on to their peers. The students believed that, if they viewed metacognition as important, so would their student counterpart. Participants also believed that, if their peers perceived that metacognition was important, the peers would believe that they would hold the same view. Contrary to expectations, however, these beliefs did not seem to have any impact on participants' academic performance. In fact, the grades students achieved were only affected by their views towards social learning behaviours. A negative view of social learning behaviours was related to better academic performance; however, it is of course possible that the view of social learning was itself enforced by the participants' normative beliefs.

The idea of reinforcing the normative beliefs reported is supported by the relationships demonstrated between the perspectives on social learning. Again, participants believed that the perspectives they held on social learning behaviours were shared by their peers, and similarly, participants believed that their peers thought the same of them. Similar trends were observed when examining the perspectives towards institutional norms, suggesting that normative beliefs not only have an impact on the attitudes of individuals towards individual behaviours, but also on the overall norms within the university environment. Importantly, these normative beliefs do appear to be

related to a person's metacognitive ability. Whilst individuals with lower metacognitive ability perceived that their peers held similar views, individuals that were higher in metacognition were more likely to view their perspectives as different to other students. It is therefore possible that, when examining these findings in conjunction with previous literature, poor performance in group work could be a consequence of poor metacognitive ability.

Although the role of normative beliefs in academic performance is not well documented, other factors such as social-motivational processes have been researched in-depth. Wentzel and Wigfield (1998), for example, carried out a review exploring how academic and social motivations were linked when influencing academic performance. Wentzel and Wigfield make the point that both academic motivation and achievement are social derived constructs, and therefore social context must be considered when discussing academic performance. The review also suggests that successful students actually pursue goals that they perceive as valuable to others, including academic goals. The review, in conjunction with the suggestion that metacognitive ability impacts on group learning, presents a clear theoretical conflict with current models of socially shared learning (see Section 4.2.1). Rather than joint cognitions being a separate entity from individual cognitions, these present findings suggest that individual and inter-individual metacognitions work in conjunction with one another. By this view, individual metacognition influences a person's ability to be 'metacognitively flexible' in group contexts. If student perceptions have as strong a relationship with metacognition as the results suggest, collaborative learning may not be effective. Given the diversity of views present across the student population, normative beliefs may need to be actively managed if universities want to ensure students can engage and learn successfully from their peers.

4.6. Chapter Summary

The initial introduction of collaborative learning as a tool for enhancing academic performance seemed promising. Learning is thought by many to be

inherently social, making peer learning models theoretically sound. The findings within this chapter, however, suggest that theories of socially shared and socially mediated metacognition need to be researched in further depth. The chapter aimed to begin a conversation about why models such as collaborative learning and socially shared metacognition may not be effective. Initially, the chapter explored the thought processes students undergo when working together. The findings suggest that, in fact, a key problem when working in a group is that individuals do not take full advantage of other's knowledge. Whilst working together, individuals would only engage with their peers when the complexity of the problem was low, and they felt competent in their ability to solve it. When the complexity of the problem increased, individuals tended to work individually.

The findings within the current chapter directly contradict existing theoretical accounts of collaborative learning. Dillenbourg's book on collaborative learning (1999), for example, was written based on a series of workshops on collaborative learning. As discussed previously, Dillenbourg suggested that collaborative learning is only effective when students share a proficiency level. Yet, the findings from Study 2 suggest that working with others of a similar proficiency can be detrimental to task performance. In comparison, the findings within the current chapter are consistent with others' findings, such as Goos and colleagues' (2002) research that suggest students are only capable of peer learning when they perceive others as of a similar competency to themselves. More importantly, perhaps, the findings from Study 1 can tell us very little about how to improve collaborative learning. There first needs to be an understanding of why students refuse to engage with the behaviours we would typically associate with effective problem solving, namely monitoring and evaluation of the process.

The second study reported here suggests that students typically project their own capabilities on to their peers. When a problem is initially simple in its complexity, individuals will believe that their peers will solve it. By contrast, however, the same individuals do not impose these beliefs on to authority figures, typically identifying more errors in professors' work than in students'

work when task complexity is low. In comparison, however, when students view the complexity of a task as more difficult, they will transpose negative beliefs about their own capability on to their peers. Individuals believe at this stage that their peers perform poorer on the task than professors. In practice, this pattern of behaviour is important because it suggests that, in order for collaborative learning to be effective, students must understand the diversity of their peers' cognitions. To foster students' understanding of the diversity of cognitions, research must first develop an understanding of the extent to which normative beliefs influence students' perceptions of their peers.

Another point to consider regarding metacognition and collaborative learning is how 'grounding' may be impacted by metacognitive processes. In a review of collaborative learning literature, Baker, Hansen, Joiner and Traum (1999) suggest that the establishment of agreement during collaborative learning tasks (known as grounding) is central to useful group learning. Grounding also refers to how the mutual understanding between participants is maintained. It is possible that the ability for students to ground themselves when working in groups is also heavily influenced by metacognition (whether students are willing to be metacognitively flexible when trying to reach an agreement with peers) and normative beliefs (whether students value the ability of their peers to perform).

The initial investigation into students' normative beliefs presented here highlights that students engage with these beliefs heavily. Students do impose their own beliefs on their peers and believe that their peers perceive them in the same way. There is, moreover, evidence within Study 3 that this process is related to metacognitive ability. As metacognition increases, the differences between the perceptions of the individual and the perceived attitudes of their peers increases, suggesting an understanding of the differences observed in the general student population.

If metacognition is related to the individual perceptions an individual has of their peers, then the model of socially shared metacognition is not accurate. Socially shared metacognition considers social metacognition as a separate

entity from individual metacognition. The findings here suggest that both individual and inter-individual metacognition influence each other. Individual metacognition can impact the joint cognition processes identified by socially shared metacognition. Furthermore, the relationship can also be reversed, to allow inter-individual metacognition to be influenced by an individual's cognitions.

There are other factors to consider, however, when exploring the relationship between metacognition and collaborative learning. Individual differences, such as personality, have been supported as affecting how someone engages with collaborative learning situations (Sheffield, 2016; Stenlund, Jonsson & Jonsson, 2017). Yet, there is little known about the relationship between metacognition and personality. The next section aims to explore how these factors interact to affect academic performance. Specifically, the personality factors explored will be conscientiousness (which is consistently supported as a positive predictor of academic performance) and extraversion, which is often found to negatively predict academic performance.

5. INDIVIDUAL DIFFERENCES AND METACOGNITION: DO GREAT MINDS THINK ALIKE?

‘We should take care not to make the intellect our God; it has, of course, powerful muscles, but no personality.”

-Albert Einstein

5.1.Introduction

When examining academic performance, socio-contextual factors need to be considered, as supported in Chapter Four. There are, however, factors that feed into a person’s perception and behaviour in different social environments. Emerson, English and McGoldrick (2016), for example, explored how personality can impact the perceptions of university learning when comparing collaborative learning with individual learning environments. Participants were recruited from undergraduate microbiology courses in two American universities that used identical syllabi. Participants completed the Myers Briggs Type Inventory to categorise their personality. Participants were then randomly presented into one of two conditions: a control condition and an experimental condition. Participants in the independent learning (control) condition were given eight to ten minutes at the beginning of class to complete a problem. The teacher then presented the student with the correct answer. In comparison, students in the collaborative

learning condition were also given the problem at the beginning of class. The participants were then paired and were asked to discuss solutions to the problem at hand. Demographic information and academic performance were also measured (from SAT scores). All participants reported perceived interactions with their peers. Introverts in the experimental groups reported higher levels of engagement with their peers than their counterparts in the control group. In comparison, extraverts reported similar levels of engagement regardless of whether they were in the experimental or control version. The researchers suggest that the extraverts are likely to seek out interaction regardless of condition, in comparison to introverts.

Supporting the findings by Emerson, English and McGoldrick (2016), Thiele, Sauer and Kauffeld (2018) suggest that integrating personality and socio-contextual factors when examining academic performance is plausible. The researchers explored the relationships between personality and network position, suggesting that highly extraverted individuals perform better as they tend to seek out advantageous relationships and occupy more advantageous positions to help them succeed, placing themselves in the centre of beneficial networks. As a method of measuring whether extraversion linked to network centrality, 47 undergraduate university students from a German institution were recruited within the first week of their studies during a compulsory introductory course.

The study took place at three time points. Time point one was taken at the beginning of the students' first day, time point two was taken at the end of day one and time point three was taken at the end of semester. At time point one, students were asked to complete a German short version of the Big Five Inventory, only including the scales for extraversion and agreeableness. At time point two, students' network centrality was measured by asking students to choose peers from an exhaustive list. The students were asked who they were friends with, who they would seek advice from, and who they would like to work together with. Their network centrality was measured by examining the number of focal points they formed in other's networks, hence measuring a level of popularity. At time point three (the end of semester),

students were asked to report their GPA. In German universities, GPA ranges from one (excellent) to four (fail). A mediation model analysis showed that extraversion was positively related to network centrality. Centrality was positively related to academic performance when controlling for extraversion. There was, however, a negative total relationship observed with Academic Performance when both extraversion and centrality were included. From these findings, Thiele, Sauer and Kauffeld suggest that understanding the developmental social networks of students can help broaden our understanding of academic performance.

Yet, Thiele and colleagues have only focused on socially oriented personality traits. Both extraversion and agreeableness are socially situated, measuring how individuals interact with others. Within the literature surrounding personality and academic performance, however, individual personality traits such as conscientiousness are most consistently related to academic performance. Poropat's (2009) meta-analysis of personality in academic performance supports the importance of considering these traits in education. Based on a meta-analysis, consisting of a cumulative sample size of over 70,000 students, Poropat identified conscientiousness, agreeableness and openness to experience as key correlates of academic success. The relationship between conscientiousness and academic performance was also observed to be largely independent of intelligence. All of the reported correlations, however, were found to be moderated by academic level (i.e., level of education).

Similarly, a meta-analysis carried out by O'Connor and Paunonen (2006) highlighted conscientiousness as the strongest and most significant predictor of academic performance. In comparison to Poropat's review, however, both openness to experience and extraversion provided mixed results in predicting academic performance. Openness was sometimes found to be positively associated with academic success, whilst extraversion was, at times, found to be negatively related to academic performance. These differences could be related to the concentration of O'Connor and Paunonen's review on post-secondary performance. Moreover, agreeableness was observed to be largely

unassociated with academic success within higher education environments. Despite inconsistencies in some of the observed relationships with academic performance, the overall message of both reviews is clear; personality has a substantial impact on academic performance, both at a socially oriented and an individual level. As the current thesis is providing an understanding of the relationship between metacognition and socio-contextual factors, it seems reasonable to assume that the relationship between personality and metacognition should be explored. Examining the relationship between the two factors can help explain the previous relationships observed with individual and social metacognition in terms of academic performance.

5.2. Study 1: Investigating the Complexities of Academic Success: Personality Constrains the Effects of Metacognition

The outcomes of study 1 were accepted for publication on 07/03/2016 by BPS Psychology of Education Review (Kelly, & Donaldson, 2016). As a result, the study is reported here as it appears in print.

5.2.1. Method

Participants

One hundred and twenty-five undergraduate students were recruited from the University of Stirling. Four participants were excluded from the results as they did not give consent to access their grades, and 32 were excluded due to lack of completion. Participants were aged between 16 and 50, with the majority aged between 16 and 25. Of these participants, 74 were female. All participants provided informed consent (See Appendix 13), consistent with the University of Stirling Division Of Psychology Ethics Committee.

Procedure

Participants were asked to complete a questionnaire through an email link disseminated through university administrators. The questionnaire was delivered via Qualtrics software (Version 2009, copyright 2016 Qualtrics) and consisted of demographic information, the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), and the NEO-Five Factor Inventory (Costa & McCrae, 1992).

Metacognitive Awareness Inventory: The Metacognitive Awareness Inventory (MAI) is a 52-item scale measured on a five-point Likert scale. The inventory is used to measure metacognitive awareness and can be divided to measure the two components of metacognition: knowledge and regulation. The scale includes items such as "I ask myself periodically if I am meeting my goals" and "I think of several ways to solve a problem and choose the best one". The reliability and validity of the MAI has been assessed as being an appropriate measurement of metacognition (Schraw & Dennison, 1994). The Cronbach's Alpha for the current study population was calculated at .93

Neo-Five Factor Inventory: The NEO-Five Factor Inventory (NEO-FFI) is a revised and shortened version of the NEO PI-R. The NEO-FFI consists of 60 items on a five-point Likert scale, used to measure the Big Five personality traits; Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The Cronbach's Alpha for the current study population was calculated at .70.

Demographic Information was also requested, including the age of participant, nationality, country of previous education, current year of study and gender. Participants were asked to give consent for the researcher to access their grades. Averages of the participants' final semester grades were used as a measurement of academic performance. The average grades were a combination of final coursework and exam grades of participants' 3 core modules. Participants were asked to consent in the event of a follow-up study.

5.2.2. Justification for method

There have been several self-report methods used to measure metacognition. These include the MCQ-30 (Wells & Cartwright-Hatton, 2004), the Awareness of Independent Learning Inventory (Meijer et al., 2013) and the Metacognitive Awareness Inventory (Schraw & Dennison, 1994). More commonly, metacognition is measured as part of self-regulated learning in questionnaires such as the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia & McKeachie, 1991) and the Approaches and Study Skills Inventory for Students (Entwistle, 1997). Many metacognition questionnaires have been designed for assessing metacognitive awareness in classrooms or in psychotherapy contexts and are therefore unsuitable for examining metacognition in university contexts. The Metacognitive Awareness Inventory, however, is specifically designed to examine metacognitive behaviours outside secondary school environments.

The overall reliability of the Metacognitive Awareness Inventory has been consistently supported. In the original test for internal consistency, the sub-scales of metacognitive knowledge and regulation had Cronbach's Alpha (α) scores of .83 and .91 respectively. When calculating a Cronbach's Alpha, Field (2005) identifies scores between .7 and .8 to be an acceptable value. There has, however, been less robust support for the subcomponents. The division of metacognition into knowledge and regulation is well justified and supported by examining the internal consistency of the scales used. The consistency is also supported in the use of the metacognitive knowledge sub-components. There is, however, some debate regarding the division of regulation into the 5 sub-facets presented by Schraw and Dennison. The conflict is reflected in the consistency of the regulation scales. Whilst the MAI provides a reliable account of someone's metacognitive regulation overall, there seems to be less reliability in measuring the sub-components. When the MAI is therefore divided into knowledge and regulation (as part of study two), regulation is only measured as an entire concept rather than dividing it further.

In comparison to metacognition's various methods of measurement, personality can only really be measured through self-report questionnaires. Like metacognitive measurements, there are many questionnaires designed with this purpose in mind. Personality is most commonly measured in terms of the Big Five measures of personality (identifying the traits of Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism). The measures of these five factors include the NEO-PI-R (Costa & McCrae, 1992), the NEO- Five Factor Inventory (Shortened-item version of the NEO-PI-R), the Big Five Inventory (Goldberg, 1993) and a 100-trait descriptive measurement (Goldberg, 1992).

The problem with many of these measurements is the number of items. Costa and McCrae's NEO-PI-R has 240 items across 5 personality traits, each with 6 specific dimensions. Whilst the level of detail provided by the questionnaire is incredibly in-depth, there is a problem of participants developing questionnaire fatigue, which is why shorter measures have been developed. The current research uses the more refined and shorter NEO-Five Factor Inventory. The reliability of the NEO Five Factor Inventory is well tested and supported across various samples. Lopes, Salovey and Straus (2003), for example, calculated the Cronbach's Alpha to be .86 for the inventory in a university sample, suggesting high internal consistency.

Using the NEO-FFI in comparison to the NEO-PI-R does have some repercussions. As discussed previously, the NEO-FFI is a shorter scale that does not measure personality dimensions further than the Big Five personality factors. As a result, there is significantly more in-depth data that would be collected using the NEO-PI-R. Nonetheless, most studies examining the relationship between personality and academic performance use the NEO-FFI. So why use a measurement that provides less data than the more exhaustive version?

Like the sub-components of metacognitive regulation in the MAI, the dimensions of each personality factor submitted by Costa and McCrae are much less consistent than the Big Five personality factors in general. Whilst

there may be some situations where examining the dimensions in full adds value to a study, the present study was exploring where an initial relationship between personality and metacognition could be found. Considering the reliability of the measurement used, there seemed to be adequate data provided by the NEO-FFI to test the proposed hypothesis. Similar to previous studies, the Five Factor Inventory's length was a major advantage when exploring academic performance. Using a shorter measurement reduced the likelihood of questionnaire fatigue, ensuring a more accurate response from participants.

Some personality measurements focus on the emotional aspects of the five factors. The NEO-Five Factor Inventory, in comparison, focuses on the behaviours exhibited by participants with each trait. Whilst there may still be a confound in those with higher metacognition engaging more accurately with self-report, it seems that this is less likely when discussing explicit behaviours daily.

5.2.3. Results

Table 4.1 below demonstrates the means and standard deviations of the Big Five personality traits, metacognition and academic performance. Pearson's Product Moment correlations were carried out to determine the relationships between the variables.

Metacognition, Personality and Academic Performance

As predicted based on previous findings, a significant relationship was found between metacognition and academic performance ($r=.292$, $n=87$, $p<.01$). A similar relationship was reported between personality and academic performance. Conscientiousness was found to be significantly correlated with students' average grades from previous semesters ($r=.323$, $n=87$, $p<.01$). The table also reveals significant relationships between year of study and both metacognition and academic performance. In addition, Table 1 reveals significant correlation between personality factors – specifically, between extraversion and both agreeableness and neuroticism.

The findings demonstrated in Table 4.1 confirm that there are significant relationships between academic performance and both metacognition and one aspect of personality. More importantly, Table 1 also provides evidence for a relationship between metacognition and conscientiousness. A statistically significant positive correlation was found between metacognition and conscientiousness ($r=.504$, $n=93$, $p<.01$). In addition, as for metacognition and academic success, the personality factor of conscientiousness correlated with year of study – reflecting increases across the course of the degree. By contrast, no other significant relationships were found between metacognition and the other personality traits, or between other personality traits and year of study.

Table 5.1: Pearson Product-Moment Correlations Demonstrating Significant Relationships between, Metacognition, Big Five Personality Traits and Academic Performance.

	Mean	S.D.	1.	2.	3.	4.	5.	6.	7.
1.Metacognition	**3.66**	.40							
2.Performance	64.24	10.67	.292**						
3/Openness	47.78	6.97	.183	-.038					
4.Conscientiousness	41.38	7.72	.504**	.323**					
5.Extraversion	37.88	6.47	.132	-.032	.014	.113			
6.Agreeableness	43.06	6.28	-.102	-.062	.082	.046	.233*		
7.Neuroticism	40.51	10.08	-.023	-.201	.260*	-.153	-.431*	-.102	
8.Year of Study	-	-	.254*	.272*	.095	.222*	.114	-.043	-.012

* p significant at .05 level, ** p significant at .01 level

Regression

The findings provide clear evidence of relationships between metacognition, conscientiousness and academic performance. Our key aim was to determine whether metacognition and conscientiousness interact to influence academic performance or reflect independent sources of influence. To investigate this question, we submitted the data to a multiple regression analysis, demonstrating that the combined effect of metacognition and

conscientiousness explains a significant amount of variance in academic performance [F (2,622.737) =6.126, p=.003, R^2=.127, R^2Adjusted=.107]. Importantly, and contrary to the earlier correlation analysis, the multiple regression results also reveal that within this model, metacognition is not a significant predictor of academic performance by itself (β =.174, t=1.483, p=.142). Conscientiousness, however, was still supported as a significant predictor (β =.236, t=2.01, p=.048).

One possibility within our data is that year of study has an important influence over the pattern of results. As degrees develop and get both harder and more specialised it may be that later years provide a clearer picture of the relationship than can be seen in earlier years when many students perform well. We therefore submitted the data to an additional stepwise regression analysis, allowing us to determine whether both metacognition and conscientiousness are necessary to predict academic performance when year of study was controlled for. When broken down, conscientiousness was still found to be a significant predictor of academic performance (β =.276, t=2.674, p=.009), whilst metacognition was not found to be a significant predictor and did not enter into the second step of the equation (t=1.51, p>.05).

Finally, to further understand how conscientiousness impacts on the effectiveness of metacognition, we carried out an additional follow up analysis, examining whether the relationship between metacognition and academic performance differed as a function of the personality variable. We first separated the participants into two groups – high and low in conscientiousness – based on a median split. We then examined the relationship between metacognition and academic success using regression; for high conscientiousness participants the results revealed a significant relationship between metacognition and academic success (β=0.340, t=2.582, p=.013). By contrast, no equivalent significant effect was found in low conscientiousness participants (β=0.008, t=0.042, p=.967).

5.2.4. Discussion

In this study we explored the relationship between two putatively independent constructs; metacognition and personality. Evidence suggests that both metacognition and personality are important for academic performance – we examined whether these factors were truly independent. The findings support previous research in demonstrating a significant relationship between metacognition and academic performance. The findings also support the relationship between conscientiousness and academic performance, the only personality trait to be consistently linked with improved academic success within previous literature (Lievens et al, 2002; Bauer & Laing, 2003; Hair & Hampson, 2006). More importantly, when examined together, findings revealed a significant relationship between metacognition and conscientiousness – together these two factors account for 13% of the variance in academic outcome measured here. Whilst the contribution of these two factors is relatively high, one important observation that follows is that many other factors must also be influencing academic performance – including factors already known to be related to academic performance such as intelligence, and unknown variables such as genetic and environmental factors – all of which warrant investigation. Nonetheless, a combined effect of 13% suggests that metacognition and consciousness play an important role in academic success.

Whilst the results of our study are novel – in showing a combined effect of personality and metacognition – they also raise a significant question. When broken down in detail, the multiple regression analysis strongly suggests that conscientiousness constrains the relationship between metacognition and academic success. Whilst a significant relationship exists between metacognition and academic success when examined in isolation, the relationship was no longer significant in the context of the multiple regression model. Instead, the role that metacognition plays depends on personality: when conscientiousness is high, metacognition does predict academic success, but when conscientiousness is low, metacognition is no longer a significant predictor of academic success. In essence, our results suggest that only if someone is conscientious will they engage metacognitive behaviours

to enhance academic performance. The findings raise an interesting question about the relationship between conscientiousness and metacognition. Why do the factors interact in this way? It is possible that people who are more conscientiousness engage in metacognitive behaviours routinely (automatically or unconsciously), simply because they are an inherent part of their personality? And, by contrast, might individuals who are not as conscientious, need to engage with these behaviours more strategically (effort fully and consciously) for them to influence academic success?

Whilst the finding presented here inform our view of the relationship between metacognition and academic success, it is important to acknowledge the limited resolution of the data. Metacognition is not a unitary construct and can be divided into subcomponents – at minimum, distinguishing between knowledge and regulation (Schraw & Moshman, 1995). It remains possible, therefore, that a more detailed examination of the subcomponents of metacognition may reveal a more complex picture of the relationship between metacognition and personality. One important possibility is that students' metacognitive knowledge develops over time, but that their willingness to regulate behaviour is less malleable – and more closely related to differences in personality.

The absence of a relationship between metacognition and the other personality traits could reflect limitations in our assessment tools. The MAI focuses on study behaviours, specific to academic performance. By contrast, aspects of the Five Factor Inventory, such as extraversion or agreeableness, focus heavily on social experience. In broad terms metacognition is often linked with learning from social situations, and yet this social element cannot easily be assessed through the use of questionnaires designed to examine study behaviours within academic settings. Metacognition has already been incorporated into social constructs such as emotional and cultural intelligence (Morley & Cerdin, 2010; Ang, Dyne & Koh, 2006), suggesting that future research should not focus solely on study behaviours. Investigations of metacognition should be expanded to incorporate the role of social learning

in academic performance, including the effect of peer assisted learning on metacognitive behaviours.

5.2.5. Conclusion

This novel study investigates the relationship between metacognition, personality and academic success. Both metacognition and personality were found to be significant predictors of academic performance, consistent with previous literature. More importantly, our data showed that the role metacognition plays depends on the personality trait of conscientiousness. Put simply, conscientiousness constrains the effect that metacognition has on academic success. Whilst our findings are novel, it is important to recognise that we have only examined one small area of academic performance – individual grades. In addition, other factors such as social interaction and peer learning are not considered in the present study, which could explain the lack of correlation between metacognition and the more socially oriented personality factors. The regression also highlights that whilst the two factors were significant predictors of academic performance, a relatively small amount of the total variance in academic performance was accounted for and other factors need to be taken into consideration. As demonstrated previously, however, conscientiousness is not the only personality trait related to academic performance. Extraversion can have a detrimental effect on a student's academic success. Considering the findings in Chapter 4 that suggest attitudes towards social learning can inhibit academic performance, it is possible that there is a relationship between extraversion and metacognition that impacts on academic performance, particularly in first year students. The next study aims to address the question: does metacognition moderate the relationship between extraversion and academic performance?

5.3. Study 2: Metacognition and Personality as Predictors of Academic Success: An Analysis of Sub-Components

5.3.1. Method

Participants

One hundred and fifty-seven University of Stirling first-year undergraduate students were recruited via Psychweb (132 females). The participants were fully informed of the procedure and asked to provide consent for their participation. Participants were asked to provide additional consent to access their core grades as a measure of academic performance (See Appendix 13). The study was ethically approved by the University of Stirling Psychology Ethics Committee.

Procedure

Participants were asked to complete a questionnaire through Psychweb in exchange for tokens towards their Introductory Psychology module. The questionnaires were administered via Qualtrics (version 2009, copyright 2016 Qualtrics) and consisted of demographic information Demographic Information was requested (including the age of participant, nationality, country of previous education, current year of study and gender), the Metacognitive Awareness Inventory (Schraw & Dennison, 1994), and the NEO-Five Factor Inventory (Costa & McCrae, 1992).

Metacognitive Awareness Inventory: Similar to Study 1 (Chapter 5, section 5.2) the Metacognitive Awareness Inventory (MAI) was used to measure metacognitive awareness. In this study, however, the data was further divided in to 2 scales designed to measure the two components of metacognition; knowledge and regulation. Knowledge was divided into three subcomponents; procedural, conditional and declarative knowledge. The Cronbach's Alpha for the MAI within this population was calculated at .914.

Neo-Five Factor Inventory: The NEO-Five Factor Inventory (NEO-FFI) is a revised and shortened version of the NEO PI-R. The NEO-FFI consists of 60

items on a five-point Likert scale, used to measure the Big Five personality traits; openness to experience, conscientiousness, extraversion, agreeableness and neuroticism. The Cronbach's Alpha for the NEO-FFI was calculated at .62.

5.3.2. Results

Table 5.2 demonstrates the means and standard deviations for extraversion, metacognition and academic performance. A moderation analysis was carried out to determine whether extraversion was constraining metacognition to the point of inhibiting academic performance. In statistical terms, a moderator is a variable that can change the strength or direction of a relationship between two other variables (see Figure 5.2). In comparison, a variable is a mediator that, to some extent, explains the relationship between a predictor and outcome variable (See Figure 5.1).

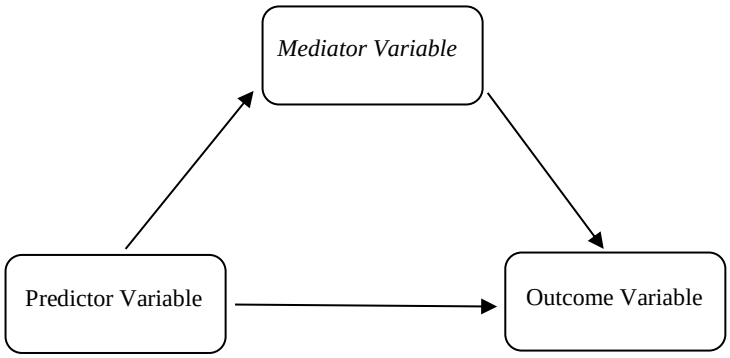


Figure 5.1: Demonstrating the effect of a mediator variable on the relationship between the predictor and outcome variable.

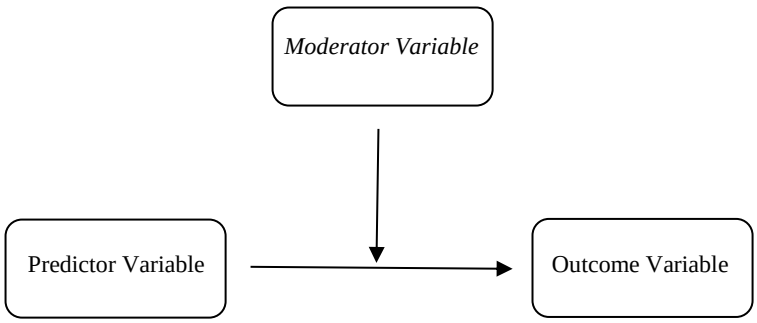


Figure 5.2: Demonstrating the effect of a moderator on the relationship between the predictor and outcome variable

When both extraversion and metacognition were entered into the moderation analysis, the overall model explained 8.3% of the variance in academic performance [F (2,141) =6.412, p=.002, R^2=.083]. Metacognition became a predictor of academic performance when extraversion was controlled for [*b*=.103, t (141) =2.446, p=.016]. Metacognition, in this instance, accounted for 10.3% of the variance in academic performance. For every one-unit increase in metacognition, there is a .103 increase in academic performance. The predictive effect of metacognitive knowledge also changed when controlling for extraversion, suggesting that extraversion acts as a moderator in this case. Another moderation analysis indicated that the overall model fit including extraversion and metacognitive knowledge was significant [F (2,141) =6.722, p=.002, R^2=.087]. When extraversion was controlled for, metacognitive knowledge was observed to be a predictor of academic performance (*b*=5.15, t (141) =2.564, p=.011) in comparison to the previous small effect (r=.143, n=144, p=.088). Once extraversion was controlled for, one unit increase in metacognitive knowledge indicated a 5.15 unit increase in academic performance. In comparison, moderation analysis including metacognitive regulation only demonstrated a 3.88 increase in academic performance when extraversion was controlled for (*b*=3.882, t (141) =1.874, p=.063).

Table 5.2: Showing the Means and Standard Deviations of Metacognition, Metacognitive Sub-Components, Personality Variables and Grades

	Mean	Std. Deviation
Metacognitive Knowledge	3.72	.425
Metacognitive Regulation	3.59	.411
Metacognition	181.54	41.45
Conscientiousness	40.58	11.38
Extraversion	37.13	10.55
Average Grade	59.58	10.06

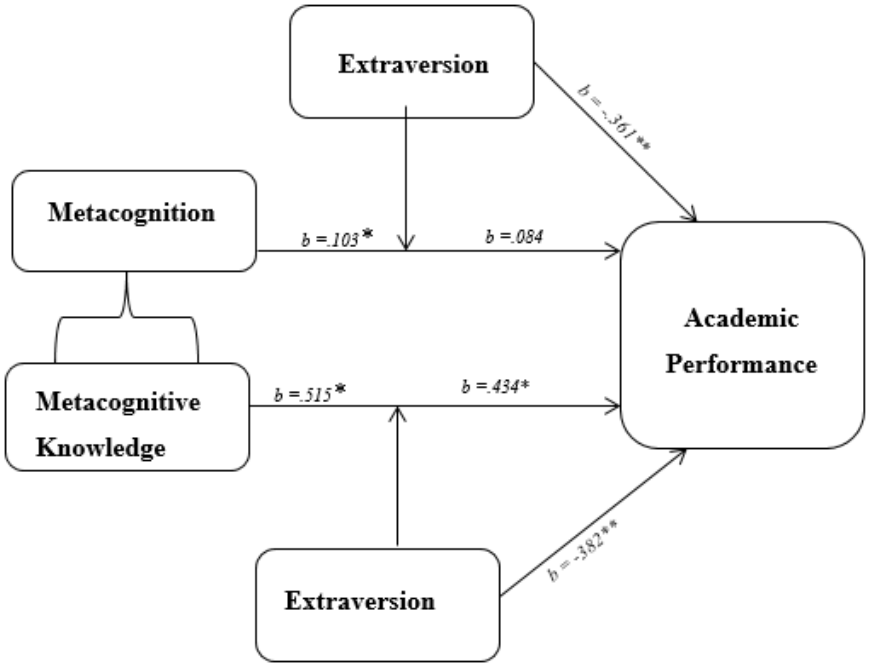


Figure 5.3: Demonstrating the significant moderation effect of extraversion on the relationship between metacognition and academic performance

Post-Hoc Analysis

The contrast between the findings within this data and the previous study suggest a fundamental difference between the data sets. One potentially important difference lies in year of study. The current sample focuses solely on first-year students, in comparison to the mixed-year cohort of the previous study. To compare the pattern of data in the previous study to the current cohort, the previous data was split by year of study (of which 31 out of 93 participants were in their first year), allowing reanalysis to be carried out and focused on the relationships in the first-year cohort.

This post-hoc analysis demonstrated a similar pattern of relationships between personality, metacognition and academic performance not previously identified in first-year students. Like the current study, a large effect size was observed between conscientiousness and metacognition within the first-year population of the previous study ($r = .538$, $n = 31$, $p = .001$). The data, when divided by year, demonstrated a trend similar to the

current study (in comparison to the previously reported analysis involving all years of study). Metacognition had no real effect on academic performance, whilst a moderate correlation was observed between conscientiousness and academic success ($r = .060$, $n = 31$ and $r = .302$, $n = 31$ respectively). Extraversion was negatively related to academic performance, highlighting a similar effect size to the relationship demonstrated in the current study ($r = -.308$, $n = 31$).

5.3.3. Discussion

The current study aimed to further explore the relationship between metacognition and personality extending the findings from the previous study which demonstrated a significant relationship between the two. The current study benefitted from more power and demonstrated findings consistent with the previous study, whilst also highlighting previously unseen relationships.

The lack of significant relationship between metacognition and academic performance was surprising in comparison with previous studies (Paris & Winograd, 1990; Vrugt & Oort, 2008; Young & Fry, 2012). The regression analysis, however, identified a key point; metacognition is again being constrained by personality. Research into the impact of extraversion on academic performance is inconsistent. There are instances, however, of studies that have demonstrated extraversion as being detrimental to academic performance (Bauer & Liang, 2003; Busato et al., 2000; Goff & Ackerman, 1992). Despite inconsistencies in the reported findings between extraversion and academic success; when extraversion was controlled for metacognition was predictive of academic performance.

The effect of extraversion on academic performance raises some concern about the behaviour of first-year undergraduate students. The complex social environment of university (in comparison to school) can cause issues for some students. With the pressure of socialisation in a new environment, it is possible that this becomes the priority for new students, limiting the time for academic study. This possibility raises the question of whether new

undergraduate students, especially those with a more extraverted personality, focus more strongly on identifying a new peer group, than on their academic performance. The behaviours associated with extraversion are not entirely conducive with metacognitive ability. Whilst extraverted individuals tend to be energetic and social, they also tend to lack the introspection of more metacognitive individuals (Poropat, 2009). Yet, within higher education academic development is driven by self-awareness (Romainville, 1994; Vrugt & Oort, 2008), as demonstrated by the impact of metacognitive knowledge as a predictor of academic performance.

The division of metacognition into knowledge and regulation has key advantages; it allows us to focus on key areas of metacognitive awareness, and highlights relationships between different functions of metacognitive processes. Whilst metacognitive knowledge focuses on understanding how we learn, regulation focuses on the key skills and strategies used to efficiently achieve our goals. One important outcome of the present findings is that the data provide support for theories that argue the two sub-components are independent constructs. Whilst the two sub-components shared similarities (in that both exhibited a significant relationship with conscientiousness), the pattern of results suggested that different aspects of personality are related to the key metacognitive functions.

Surprisingly, metacognitive regulation still did not reliably predict academic performance when extraversion was controlled for, only reaching marginal significance. It is possible that, within the first year of university, students are expected to learn more about understanding their own knowledge before they can be expected to regulate it. According to this view, metacognitive regulation would only become beneficial in later years due to the need for effective strategy use to prioritise, manage and complete subscribed assessments.

Given this characterisation of the results, the following question needs to be addressed: do first-year undergraduate students understand the benefits of metacognition to their academic performance? It is possible that, by

addressing unhelpful beliefs and the attitudes of students to their first-year experience, their focus could be shifted from socialising to academic success. From this perspective, addressing the behaviours that first years have towards studying could help inform students' practice at a later stage.

Conclusion

The current study supports the presence of a relationship between metacognition and personality. The finding of a consistent relationship between the use of conscientiousness and all aspects of metacognition provide clear evidence in support of Study 1. The moderation analysis, however, demonstrates a clearer picture of the relationships between metacognition and personality in first-year students: extraversion moderates metacognition to the detriment of academic performance. The discovery of relationships with socially oriented behaviours raises the question of the influence of social interaction on metacognitive awareness and academic performance, whilst the variability between traits highlights the various functions of metacognitive subcomponents and argues against measuring metacognition as a single construct. The data also highlight concerns regarding differences in personality measurements. The next study aims to provide support for the relationships observed in Studies 1 and 2 of this Chapter by identifying whether the relationships between metacognition and personality can still be observed when different measurements of both constructs are used.

5.4. Study 3: Addressing Discrepancies between Measurements: Developing further support for relationships between metacognition and personality

5.4.1. Method

Participants

One hundred and fifty-five University of Stirling undergraduate students were recruited from an introductory psychology module (125 female). Consent was

obtained in accordance with BPS guidelines (See Appendix 14). Ethical approval was obtained through the University of Stirling Psychology Ethics Committee.

Procedure

Participants were recruited via Psychweb, which provided them with full information on the purpose and procedure of the study. If participants consented to participation, they were provided with an anonymised link to the questionnaire, provided via Qualtrics (Version 2009, copyright 2016 Qualtrics). The questionnaire consisted of demographic information, including age, gender, university, year of study and programme of study. Participants were then asked to complete the Big Five Inventory (Goldberg, 1993) and components of the Motivated Strategies for Learning Questionnaire (Pintrich & DeGroot, 1990).

The Big Five Inventory

The Big Five Inventory is a 44-item questionnaire designed to measure the Big Five Factors of personality. The Big Five factors include extraversion, agreeableness, conscientiousness, neuroticism and openness to experience. Each of the 44 items was measured on a 5-point Likert Scale, ranging from strongly disagree to strongly agree.

The Motivated Strategies for Learning Questionnaire

The MSLQ is an 81-item scale used to measure self-regulated learning. For the purposes of the current study, only the cognitive strategies, metacognitive and 2 resource management components of the questionnaire were used. These scales provide 31 items. The internal consistency of the scales (as identified by Cronbach's Alpha, see Chapter 4) are as follows: The cognitive strategies included rehearsal (α=.69), organisation (α=.64) and elaboration (α=.76). The metacognitive strategies included metacognitive self-regulation (α=.79) and critical thinking (α=.80). The resource management scales included help seeking (α=.52) and peer learning (α=.76). Like the Big Five Inventory, each item was rated on a 5-point Likert Scale, from strongly disagree to strongly agree.

5.4.2. Results

Table 5.3 below details the means and standard deviations of the metacognitive scales, extraversion scores and conscientiousness scores. The aim here was to determine whether extraversion and conscientiousness had similar effects on metacognition as those demonstrated previously. Firstly, conscientiousness was entered into a regression analysis to determine whether it would predict metacognitive regulation. Conscientiousness significantly predicted metacognitive regulation, ($\beta = .372$, 95% CI .215, .504), accounting for 13.8% of the variance in metacognitive regulation scores, [$F(1,151) = 24.23$, $p < .001$, $r^2 = .138$]. In comparison, when entered into a regression with metacognitive regulation, extraversion had no predictive effect ($\beta = .031$, 95% CI -.138, .204), only predicting 1% of the variance in metacognitive regulation [$F(1,151) = .145$, $p = .704$, $r^2 = .001$].

Extraversion did, however, predict peer learning ($\beta = .119$, 95% CI .053, .186), accounting for 7.7% of the variance [$F(1,151) = 12.66$, $p < .001$, $r^2 = .077$]. A similar predictive effect was found on help seeking ($\beta = .145$, 95% CI .053, .186) with extraversion explaining 8.3% of the variance [$F(1,151) = 13.71$, $p < .001$, $r^2 = .083$].

Table 5.3: Demonstrating the means and standard deviations of metacognitive scales, extraversion and conscientiousness scores.

Scale	Mean	S.D.
Extraversion	25.04	6.03
Conscientiousness	32.92	6.54
Metacognitive Regulation	39.42	6.35
Peer Learning	8.63	2.56
Help Seeking	11.13	2.96
Critical Thinking	16.58	3.85

The previous chapter explored the role of social context in metacognitive behaviour. To further explore the relationship, peer learning was entered into a regression analysis to determine whether it would affect critical thinking or metacognitive regulation. Peer learning was found to have a predictive effect on critical thinking (β =.264, 95% CI .119, .673), explaining 5.7% of the variance [F (1,151) = 9.065, p=.003, r^2=.057). When extraversion was entered into a stepwise regression model with peer learning, however, only peer learning was found to have a predictive effect on critical thinking (β =.265, 95% CI .155, .643). Extraversion was removed from the model, showing no predictive effect (β =-.098, 95% CI -.168, .041). Similar relationships were observed with metacognitive regulation. A predictive effect of peer learning on metacognitive regulation was observed (β =.234, 95% CI .174, .985), explaining 5% of the variance [F (1,151)=8.002, p=.005, r^2=.05]. The inclusion of extraversion only increased the variance explained by .1% [F(1,151) = 4.064, p=.019, r^2=.051]. Extraversion was again removed from the model for showing no predictive effect on metacognitive regulation (β =.-.034, 95% CI -.211, .98)

5.4.3. Discussion

The current study aimed to demonstrate that relationships between metacognition and personality could be observed across different measurements. Similar to Studies 5.1 and 5.2 in the current Chapter, metacognition was found to be significantly related to personality. Specifically, relationships were demonstrated between metacognition and conscientiousness in both cognitive strategies and self-regulation. From a conceptual standpoint, the relationship reported here is not surprising. The cognitive strategies included in the MSLQ are reminiscent of metacognitive behaviours, and there is often debate as to whether these behaviours should be classed as general cognition, or metacognition, due to their conscious nature. As previously argued in Study 1, it is possible that metacognition is a conscious process of conscientiousness, suggesting that these behaviours would fall under the definition of conscientiousness.

Conscientiousness, however, only covers one small aspect of a person's learning, and does not include the wider influence of the environment on a student's education. As we have previously discussed in this context, the social environment is particularly important to students transitioning into university. The predictive effect of peer learning on metacognitive regulation demonstrates the impact of social metacognition: our metacognitive abilities are improved through interaction with others. It is possible that students who are high in metacognitive ability are likely to understand the processes of peer learning and the benefits they may provide, but these benefits may also be influenced by other factors, such as personality.

The relationships found between extraversion, peer learning and help seeking provide evidence of mediated social metacognition. The previous studies demonstrated that extraversion can mediate the relationship between metacognition and academic performance. Complementing the previous results, the current findings suggest that the mediation effect could be a consequence of impaired social metacognitive behaviours, such as peer learning.

The relationship found between critical thinking and peer learning could also be considered a matter for concern, especially given the possibility of peer learning being impacted by personality. Critical thinking is a core skill that is often related to success at university level (Gellin, 2003; Giancarlo & Facione, 2001). Should these skills be mediated in some way, care must be taken to ensure that students are developing them in other, more creative ways.

Critical thinking is often encouraged through team working and collaborative learning (McInerney & Fink, 2003; Quitadamo, Brahler & Crouch, 2009). For example, Gokhale (1995) investigated the improvement of critical thinking skills through collaborative learning groups by providing 48 participants (placed either in an individual learning group or a collaborative learning group) with a pretest and posttest of a critical thinking task. Statistical analysis demonstrated that the mean posttest score for the critical thinking

task was significantly higher for those in the collaborative learning condition than in the individual condition. These findings suggest that working collaboratively has the potential to improve our critical analysis skills.

Gokhale's (1995) research suggests that it is possible to improve critical analysis skills through working with others. It is possible, however, that students are simply not acquiring effective collaborative skills before reaching higher education, and therefore struggle to engage with peer learning at an early stage. If this view is correct, it raises the possibility that by providing students with the skills necessary to engage with collaborative learning at an early stage, we may be able minimise the effect that personality has on the relationship between metacognition and academic performance before there is an adverse effect on their grades.

Conclusion

The current study provides further support for the view that significant relationships exist between metacognition and personality. Once again, we find that social interaction can play a large part in metacognitive processes. With that in mind, it seems that not only does individual metacognition need further examination, but social metacognition warrants further investigation. Without fully understanding these processes, it seems unlikely that metacognitive improvement programmes currently being used to support and enhance student learning will be effective.

5.5. Chapter Summary

The current Chapter provides an initial exploration into the relationship between metacognition, personality and academic success. All of the studies outlined here provide evidence in support of the view that personality does have an impact on metacognitive ability, with both advantages and disadvantages for academic success. The initial investigation into personality through a university cohort demonstrated that, not only were personality and metacognition related, but personality constrained the effect of metacognition

on academic performance. The year of undergraduate study, however, was deemed to be a confounding variable on the relationships found.

Within Study 1, conscientiousness was found to constrain the relationship between metacognition and academic performance. Conscientious behaviours focus on diligence, organisation and motivation, all key factors associated with academic performance. The reasoning behind the relationship between metacognition and conscientiousness is also transparent, with conscientious behaviours mapping well onto metacognitive ones. Understanding how conscientiousness moderates metacognition, however, is less clear. We have suggested that metacognition reflects the expression of conscientiousness at the level of conscious behaviour associated with the specific goal of learning.

Study 1 demonstrated a relationship between personality and metacognition that is easily explained in terms of behaviour. Study 2, however, provided a more complex relationship to explain. The second study supported the outcomes of the first, in that metacognition was found to be constrained by personality. The role of personality in metacognitive awareness, however, was found to be drastically different in first-year students. In first-year undergraduates, extraversion was observed as the personality factor constraining metacognition and, in turn, academic performance. The findings mimic previous research into the role of extraversion in education. For example, as previously mentioned in Chapter 3, O'Connor and Paunonen's (2006) observations of the relationships between extraversion and academic performance were mixed. At times, extraversion was observed to be a positive predictor of performance, whilst in other instances extraversion was found to have a significantly negative effect on academic success. Poropat's (2009) review also provides support for the present finding that the effect of extraversion was moderated by academic level. In practice, extraversion can be beneficial to a student transitioning to university, allowing for easier social interaction with new acquaintances. At the same time, however, more extraverted students may be more likely to become embroiled in the social aspects of student life, neglecting their academic responsibilities.

The current Chapter drastically changes the understanding of how personality and metacognition interact in terms of academic performance from a theoretical perspective. Whilst both studies demonstrated significant effects of the relationship between metacognition and academic performance, these effects were moderated through different personality variables. Critically, the data suggests that year of study determines which personality trait impacts on the relationship between metacognition and academic performance is year of study. To be clear, as Figure 5.2 illustrates, in effect year of study serves as a meta-moderator of the role that personality plays when it moderates the relationship between metacognition and academic performance.

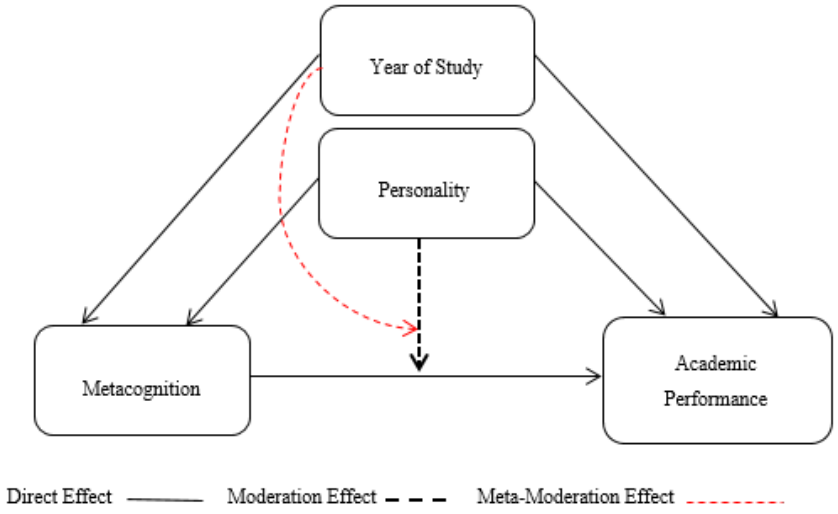


Figure 5.4: Conceptual Diagram of the Moderating Relationship between Personality, Year of Study, Metacognition and Academic Performance.

From a theoretical perspective, the combination of findings from the previous literature and the observed relationships between metacognition and personality reported in the current chapter distinctly changes how we understand academic performance. Practically, taken together, the findings presented here demonstrate the differing educational needs of first-year students in comparison to more advanced years. Given the structure of university degrees, in more advanced years, it can be suggested that academic performance is irreversibly at the forefront of the students' minds. As a result, conscious engagement with learning becomes much more beneficial to them. In the first years of their degree, however, students are more likely to be

concerned with adapting to a new social environment. The priority for many students is more likely to be finding a new group of peers in an unfamiliar environment. In this context, it is unclear if students can be encouraged to engage with their academic responsibilities at an early stage.

The relationship between metacognitive knowledge and academic performance shown here suggests that understanding our own cognition is more important than understanding how to regulate it, at least when beginning a degree. Encouraging critical thinking and self-reflection at an early stage could therefore be the key to improving academic performance in undergraduate student. Encouraging self-reflection is not, however, an easy task. Providing students with the skills necessary to promote their own reflection is only useful if students decide to engage with these behaviours. Nonetheless, there have been efforts to encourage students to engage with these behaviours. For example, Quinton and Smallbone (2010) suggested that student reflection could be promoted through feedback. Second and third year students were provided with an exercise designed to encourage reflection on the feedback provided on assignments. Students were encouraged to consider their emotional response to the comments. The exercise also contained questions to encourage the students to be analytical about the feedback they had received (e.g., what do I think about this feedback?). A third question was designed with the purpose of promoting reflective practice, such as encouraging self-development and better understanding. Qualitative analysis of student responses demonstrated that both questions on analysing the feedback and questions regarding self-development promoted self-reflection and active learning. Quinton and Smallbone (2010), however, also suggested that not all students engaged with the reflection, preferring to repeat recurring themes in the feedback, but never adapting the feedback into useful strategies. The question then remains, why do some students engage with metacognitive behaviours, whilst others do not?

To answer the question posed above, there first needs to be an understanding of social learning within first-year undergraduates. It is possible that extraverts are attempting to learn through contact with others and failing

because they lack a clear understanding of social learning processes. By providing students with a framework to work from, is it possible that we can help extraverts learn from their peers more effectively?

The discussion surrounding peer learning provides another important point to consider. Higher education relies strongly on peer engagement, with limited teaching support available to students. Undergraduates, however, seem to be unaware of alternative learning methods other than teacher-based learning. With a strong onus on independent study in higher education, students would benefit from being made aware of the vast array of ways to acquire and retain knowledge, including through their peers.

Despite the importance of peer learning generally, the role of social interaction in metacognition is not particularly well documented. The current findings are therefore novel in revealing that a socially oriented personality trait (extraversion) has the potential to moderate metacognition to the detriment of academic success. The findings suggest that, in terms of academic performance, the role of social interaction in metacognitive ability and development should be recognised as a priority.

The role of personality in academic performance also provides a problem for educational practitioners. To cater for each specific person according to their individual personality would take resources that are not available to practitioners with large class sizes. Promoting metacognition at a younger age could therefore provide an alternative route and help students adapt to learning environments according to their own strengths and weaknesses. For introverted individuals, this may mean being more self-reliant, whilst for more extraverted individuals this may mean finding methods of learning from social situations. For highly conscientious individuals, engaging with metacognitive behaviours is commonplace. For less conscientious individuals, however, there may need to be more consideration of how to prioritise and manage their workload.

The findings of Studies 1 and 2, whilst theoretically significant, must be approached with caution. Whilst the reliability of personality measurements has been robustly tested, there remains a serious point of contention surrounding the use of self-report measures in metacognitive measurement. Good metacognition relies upon being consciously self-aware, which includes being explicitly aware of the behaviours employed. The use of self-report measures, therefore, may be more a telling sign of metacognitive awareness than reflecting actual relationships in practice.

The other key point of concern is the well-documented issue of social desirability (Fisher, 1993; King & Bruner, 2000; Nederhof, 1985). Participants may answer in a way they think will be perceived more favourably. There is little known, however, about how highly metacognitive people understand the perspective of their peers, and whether this would impact on their reactions to self-report. The lack of understanding surrounding the relationship between social interaction and metacognition, as mentioned previously, is a key area of research that warrants further investigation. Understanding how people with high metacognition interact socially may be the key to understanding the presence and variability of relationships between socially oriented personality traits and metacognitive ability.

Finally, the demonstration of a reliable role of personality in metacognition highlights the need for metacognitive training. Whilst metacognition is constrained by personality, research has demonstrated that metacognitive improvement is possible and should be encouraged. Personality does not necessarily dictate academic performance, but rather can lead to a predisposition towards ineffective learning behaviours. Engaging with metacognitive training could help students to consciously rectify these behaviours and help individuals to improve their learning at any level of education.

Conclusion

The findings reported within this chapter support the presence of a relationship between metacognition and personality. Despite the differences between Studies 1 and 2, they both support the same premise; personality constrains the effect of metacognition in academic performance. Whilst the relationships between conscientiousness, metacognition and academic performance is transparent behaviourally, the relationship determined between extraversion, metacognition and academic performance is much less so. Regardless of the explanations behind the relationships, the key message is evident: personality influences the relationship between metacognition and academic performance.

What does this mean for educational practice? It is unlikely that truly bespoke individually tailored learning will become commonplace in classrooms (simply because of the resources required to make this type of teaching a reality). Nonetheless, the impact of individual differences such as intelligence, motivation and personality in academic performance cannot be ignored. Metacognition could provide a useful mechanism for teachers to help students in their development of self-awareness and independence to effectively understand their learning. In addition, the relationship between metacognition and personality promotes an important message in terms of educational practice: a 'one size fits all' education system does not work.

Yet, the relationship between metacognition and extraversion suggests that the problems associated with peer learning are more to do with a lack of understanding of how to work with others, rather than an unwillingness to do so. Extraverts are likely to seek out new relationships and peer groups, suggesting that the problem is not a lack of interaction, but rather a misunderstanding of how to use said interaction. So, could we teach students to use collaborative learning environments as a way of improving metacognition? The next chapter implements a metacognitive intervention in a high school environment to promote collaborative metacognition and enhance transitions into university learning.

6. USING METACOGNITION AS A TOOL FOR ENHANCING STUDENT TRANSITIONS.

6.1.1. Introduction

The abrupt transition between secondary school and University level education can be challenging for students, resulting in huge personal and societal cost, as well as undesirably high drop-out rates (6.4% of UK first-year entrants discontinue their studies, Higher Education Statistics Agency, 2018, based on 2016/2017 data). To some extent the difficulties are unsurprising - first-year University students must adapt from predominantly teacher-led learning to a largely self-directed learning, whilst also adjusting to the novel demands and distractions of independent living (e.g., balancing finances and navigating a new social environment). Nonetheless, it remains important to understand the nature of the changes that students must undergo. With this aim in mind, the present chapter asks: How can school leavers best be prepared for this key educational transition?

In Scotland, education policy is driven by the National Curriculum for Excellence (NCE), which is designed to enhance students' skills, whilst preparing them for lifelong learning. One of the key factors identified by the NCE is independent learning, supported by metacognitive processes. Metacognition (i.e., thinking about thinking) refers to our ability to engage with our knowledge, whilst using this knowledge to define and employ more

effective learning strategies. The list of metacognitive behaviours within the psychology literature is extensive. Here, we focus on three key elements that are recognised as being essential for academic success, namely, problem solving, self-reflection and critical thinking. As discussed in Chapter Two, the implementation of these behaviours by students has a significant impact on academic success (Pintrich & DeGroot, 1990; Vrugt & Oort, 2008; Young & Fry, 2008; Zimmerman, 1990). More importantly, the impact of metacognition on academic performance has been found to be at least partly independent of intelligence (Minnaert & Janssen, 1998; Veenman, Kok & Blote, 2005; Veenman & Spaans, 2005). Therefore, a focus on improving metacognitive abilities has the potential to improve academic achievement regardless of intellectual ability.

Can metacognition be taught?

Considering the role of metacognition in academic performance, it is reasonable to assume that there have been many interventions designed to improve metacognition in the classroom. These interventions take many different forms. Calender, Franco-Watkins and Roberts (2014), for example, aimed to improve metacognition through feedback and training in undergraduates. One hundred and twenty-seven undergraduate students from a decision-making course were recruited. Within the course, students were introduced to concepts such as overconfidence. Students also received training on making accurate judgements about their performance. Students were given an exam approximately two weeks after training consisting of multiple choice questions, matching and short-answer questions. After completing the exam, students were asked to rate their performance on the exam. Should they rate their performance accurately (within 0-15 points of their actual score), students would receive additional points incrementally. The process was repeated with two additional cohorts in the following semester, however one of the cohorts did not receive feedback on their performance. Across all cohorts, researchers saw significant improvements in judgement accuracy, but only for the students who received feedback.

Not all interventions, however, focus on face-to-face teaching practices to improve metacognition. Over a three-year study, Meyer, Abrami, Wade, Aslan and Deault (2010) explored the use of e-portfolios in improving metacognition. The research took place over three Canadian provinces. Thirty-two teachers and their 388 students (grades four to six) were recruited from nine elementary schools. Teachers were provided with training on E-Pearl, portfolio software designed to support self-regulated learning strategies. The system is designed at three different levels for different educational ages: early elementary, late elementary and secondary. The portfolio is designed for students to set themselves goals, reflect on their work, document their goals and set up learning tasks. At two points during the year, teachers were asked to complete a questionnaire documenting the length of time they had spent using E-Pearl, and any challenges they were having with the system. The data were organized according to implementation (whether the program was implemented at a low, medium or high level). Analysis of variance demonstrated that students who used E-Pearl demonstrated high levels of self-regulating behavior, including goal-setting, using feedback and listing strategies.

The studies discussed above are both examples of interventions designed to improve metacognition. Like most interventions, however, there is clearly an individualistic element to both. Neither intervention asked students to work collaboratively or discuss their thoughts with others. As suggested in Chapters Four and Five, improvements in metacognitive ability should influence more than just academic achievement. Whist being academically successful is important for ensuring a smooth transition between secondary and higher education, navigating through the transition effectively requires more than just academic ability. Harvey, Drew and Smith (2006) highlighted three key themes emerging from a meta-analysis examining 1st year undergraduate transition experiences. These themes included academic performance, but also identified first-year support, learning and teaching as key factors in student transitions. In a similar vein, Crissman-Ishler and Schreiber (2002) referred to a major problem of transitions as ‘friendsickness’, a loss of friendship groups when making the transition between school and

university. Overall, therefore, existing evidence suggests that both individual and social factors can have a strong impact on a student's transitional experience.

From an educational perspective, the beliefs a student holds about their abilities can have an impact on their confidence and drive to succeed. The influence of self-efficacy has significant implications for education, with a direct relationship being observed between self-efficacy and academic performance (Lane & Lane, 2001; Lent, Brown & Larkin, 1984). A students' perception of their capabilities to succeed can, however, have both detrimental and advantageous effects on motivations (Schunk, 1991). For example, Zimmerman, Bandura and Martinez-Pons (1992) found that the perceptions of students' capabilities were much more complex than just belief in academic ability. In essence, students' self-belief about their ability to self-regulate learning behaviours affected the individual's perceived self-belief regarding academic performance. Moreover, beliefs surrounding students' academic performance then, in turn, impacted on actual academic achievement.

The previous chapters have demonstrated two key points. First, whilst students often demonstrate an understanding of the importance of learning socially, the same students also struggle with the practical implementation of cooperative learning. Second, students' individual personalities have an impact on academic performance and learning approach generally. More importantly, perhaps, without the necessary skills to learn from others, students may actually be engaging with social behaviours that are detrimental to their academic performance.

What makes a successful learner?

Despite the in-depth research into transitions, the majority of interventions are only put in place once students reach university. To be completely effective, however, there is a need to encourage these behaviours in secondary education before students reach university. The need for pre-university intervention is highlighted by consideration of the attitudes to learning

expressed by high school students. During a Widening Participation event at the University of Stirling, 40 students from a local high school (aged between 14 and 15) were asked to discuss what they thought made a successful learner. Students identified key skills they thought were necessary to succeed. These skills included motivation, determination, resilience, and a growth mind-set. Whilst students identified a growth mind-set as important, they struggled to articulate what they thought having a growth mind-set meant to them. Moreover, of the nine groups that completed the activity, only three suggested that environment and working with others had an impact on being a successful learner.

Figure 6.1 Example of What Makes a Successful Learner Activity

The student views highlight key issues for secondary education. First, not all students are aware of the necessity of peer learning. Students did not completely understand the complexities of working with others or the benefits that peer learning could have for their own learning. Second, students often retain information regarding skills, such as a growth mind-set, but they do not necessarily understand what is required to engage with these skills. The gap between students' knowledge of learning terminology and knowledge of implementation highlights a missing link between policy and practice. Whilst

policy suggests practitioners should be encouraging students to engage with the skills necessary to succeed, practitioners are not necessarily equipped to teach these skills to their students.

The aim of the current chapter is to examine whether direct intervention can provide students with some of the cooperative learning skills necessary to succeed in higher education, specifically focused around problem solving and critical analysis skills through peer interaction. The intervention aims to provide teachers with a resource light method of facilitating metacognitive and cooperative learning skills to students. These skills, as highlighted previously, are highly influential on an individual's educational performance at undergraduate level.

6.1.2. Method

Participants

Twenty Scottish Higher students were recruited from a biology tutorial class in a local secondary school. Individual and parental consent were obtained for all participants (See Appendix 15). Ethical approval was obtained through the University of Stirling Division Of Psychology Ethics Committee.

Ethical Considerations

To address the issue of informed consent from school children, both individual consent was obtained from both students and parents. Both parents and students were advised of the purpose of the study, and contact details were provided should they have required any further information. Everyone involved was advised that participation in the intervention was completely voluntary. As part of the intervention involved audio-recording the students' sessions, participants and parents were separately asked to consent to audio-recording. The data from these recordings were destroyed once transcriptions were completed. All data collected for the duration of the study was anonymised. For child protection purposes, the researcher was accompanied

by a teacher at all sessions. Following completion of the study, parents were invited for a face to face debrief with the students. Parents unable to attend were forwarded a written debrief, detailing the purpose and evaluation details of the study.

Justification for Using the Action Learning Cycle

The findings produced throughout the present thesis provide theoretical advancements in understanding how metacognition works. There are, however, more consistent practical models of metacognition in educational literature. These models use differing terminologies but focus on the improvement of metacognitive behaviours. The developed intervention was based on one such model; the Action Learning Set. Proposed by Beaty (2003), the Action Learning Set focuses on learning through reflection, a key metacognitive behaviour. The process is also facilitated through group interaction.

The process incorporated into the intervention was designed to encourage students to reflect and consider alternative and more effective solutions. The students recruited for the intervention were divided into groups of three. Beaty (2003) originally suggested that groups should meet regularly for three to four hours over four to six weeks for a period of up to 12 months. The constraints of working with a secondary school population however, meant that these criteria could not realistically be met. Instead, the students attended one session a week, for 1 hour, lasting 8 weeks. During the first session, ground rules for the groups were discussed such as confidentiality, respect for other participants and engagement with the project.

Beaty (2003) also suggested that participants present each week with their own problem to solve. To encourage engagement, however, the current intervention provided students with problems relevant to their subject to work through. The provision of work provided students with relevant problems to solve, whilst still increasing their confidence in their own independent learning.

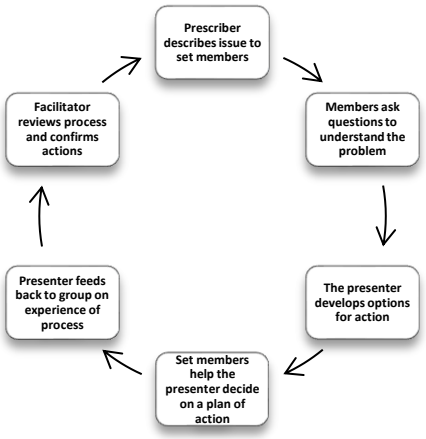
Procedure

The students recruited were divided into pairs. The students attended one session a week for 40 minutes lasting 8 weeks (excluding school holidays and in-service days). During the session in week 1, ground rules for the groups were discussed including confidentiality, respect for other participants and engagement with the project. During the following 6 sessions, in their pairs students were asked to work through questions based on their curriculum. The questions provided were based on exam past papers but relied on problem solving ability rather than previous knowledge. During each of the 6 sessions, the students were then asked to work through the Action Learning Cycle (Beaty, 2003). The final session of the project was used to fully debrief participants on the purpose of the study.

Action Learning Cycle

The Action Learning Cycle (ALC) is a well-documented method of improving communication, teamwork and problem-solving skills. The cycle is used for different purposes in many different environments and has been introduced to education to increase students' confidence and their awareness of their own problem-solving ability. The stages of the action cycle are as follows:

Figure 6.2: Action Learning Set (Adapted from Beaty, 2003)



1. Prescriber describes issue to set members: During the first stage of the ALC, the student presenting the problem describes their chosen problem to the other members of the group.

2. Members ask questions to understand the problem: The other members of the group then ask questions to help them understand the problem. For example, "what other activities do you do that may take up your time? From this, the other members of the group also can reflect and develop their own problem-solving skills.

3. The presenter develops options for action: From the questions posed by other members, the student then develops plans to help deal with the problem, for example, cutting down on extra-curricular activities, planning study time more effectively, etc.

4. *Set members help the presenter decide on a plan of action:* The other members then help the presenter decide which one of these plans would be most effective. The other members are not allowed to provide an answer, but simply ask questions to help the presenter decide for themselves.

5. *Presenter then feeds back to group on experience of process*: Did the presenter find it helpful? Did they come to a solution they see as feasible?

6. *Facilitator reviews process and confirms actions*: The facilitator then goes through the process with the student and ensures that the plan of action decided upon is suitable.

A teacher was present at each session to ensure that students had accurate information, should they require it. Importantly, however, the teacher was instructed not to intervene or direction the group. Each week, the discussions between pairs of participants were recorded, to allow researchers to analyse the problem-solving processes students were engaging in. These Think-Aloud Protocols were used to determine whether problem solving ability was improving as the intervention progressed.

6.1.3. Coding Framework

The coding framework designed to assess the intervention was developed according to the issues identified in study 4.3. The main issues that affected metacognitive performance in the previous study could be evaluated using

three key themes: problem solving, communication and negative self-belief. Table 6.1 below demonstrates the themes and examples of how these areas were coded for within the transcriptions. Similar to the framework created for study 4.3, the framework was designed ad-hoc, and focused on broader instances of the decided themes, rather than trying to identify exact key words. Again, like study 4.3, participants' Think-Aloud Protocols were transcribed verbatim and coded to determine whether problem solving ability, communication and self-belief were improving over time.

Table 6.1: Demonstrating the ad-hoc qualitative coding framework for the Think-Aloud Protocols

Theme	Definition	Transcription Example
Problem Solving	Evidence of critically analysing the question, evidence of considering alternative solutions to a problem. Evidence of using appropriate prompts to encourage peers.	Participant 1"Well, the answer's not D. Participant 2: Why is it not D? Participant 1: Because the height of the seeding's reported after 6 weeks"
Communication	Evidence of enhanced discussion within the groups. Evidence of using peers effectively to solve the problem. Evidence of peers engaging with members of the group to enhance reflection.	Participant 2: Right, what's the normal equation we use all the time in biology? Participant 1: Change over additional x100, so it would be… Participant 2: Are we actually changing anything or does it tell us how much we're giving it?"
Self-Belief	Evidence of improved self-belief. Reduction of negative statements related to self-belief.	"I don't know how to do this…" "I'm not very good at this…"

6.1.4. Reflexivity Statement

In comparison to the qualitative frameworks designed in previous studies, the framework here was designed in response to the findings presented in Chapter Four of the thesis. Whilst it would have been possible to code for metacognitive behaviours as done previously (see section 4.3.2), the researcher aimed to provide an intervention that addressed deficiencies in collaborative learning. It was decided that, by addressing broader deficiencies such as communication and self-belief, metacognitive behaviours within the domain of problem solving would also be addressed.

The researcher also needed to be aware of the difference in undergraduate and high school environments. Undergraduates that took part in the previous studies presented in the thesis were likely to perceive the researcher only in that capacity. In comparison, the cohort of students here were likely to view the researcher as an authority figure. The difference could be found in how the high school students addressed the researcher. Students tended to use the title 'Miss' instead of the researcher's name. It was therefore decided that, within the classroom, the teacher would be more involved in the facilitation of the intervention once they understood the process. The decision had added benefit as the teacher had knowledge of the actual content of the topic, whilst the researcher did not. It also allowed the researcher to spend more time observing the students.

Additionally, the researcher's previous experience may have impacted expectations regarding the high school students' abilities. The researcher had previously spent the majority of their time researching in postgraduate and undergraduate populations. The researcher had to be aware that the skills of the high school students was likely to differ from undergraduates. Again, the role of the teacher became key here. The researcher spent time discussing the dynamic between students and the content of the module before beginning the intervention. The aim here was to provide an understanding of how the intervention was likely to be undertaken by the students, providing a change in expectations for the researcher.

As highlighted in the ethical considerations section of the method (section 6.1.2), the researcher also had to be aware of the age of the participants in comparison to an undergraduate population. The dynamic between researcher and participant was very different in comparison to the previous studies. In comparison to studies carried out with undergraduates, it was important to ensure that students met and were comfortable with the researcher before the beginning of the intervention. The researcher therefore visited the cohort before the intervention had been introduced. This allowed the researcher to explain their role, and allowed the students to ask any questions before providing consent.

6.1.5. Results

The transcribed Think-aloud Protocols were transcribed for every group each week. The findings below represent illustrative quotes taken from each group, evidencing changes in problem-solving, communication and self-belief throughout the programme.

Week 1

In the first session, students were provided with formulaic problem-solving questions based on biology past papers. Student discussion provided limited evidence of engagement with metacognition. Students demonstrated a lack of proactive behaviours when approaching problem solving. For example, Participant One in Group Two asked another participant to provide the answer for them, rather than proactively addressing the problem and applying strategies to try and solve the problem at hand. There was also a distinct issue of self-awareness and lack of self-efficacy evident in the communications. For example, Participant One in the first group demonstrated a lack of self-belief in their own ability. Rather than attempt the problem, Participant One simply stated that they did not know how to do the problem and asked for the answer.

Example One:

Participant 1: "I don't know how to do this…so what would it be?" (Group 1)

Example Two:

Participant 1: "How do you do that?

Participant 2: I'm not meant to do it for you." (Group 2)

Consistent across the majority of the groups, the data indicated a distinct lack of independent problem-solving behaviour. In example one, Group One demonstrated a preference to rely on their peers to provide answers before trying to independently work through the problem. Similarly, Participant One

in example four stated that they did not know how to 'do it', so asked a peer for the answer.

Example Three:

Participant 1: "I'm not very good at problem solving so…" (Group 3)

Example Four:

Participant 1: "I don't know how to do this…what would it be?" (Group 4)

The data also reveal consistent evidence of a lack of self-efficacy in academic ability. Students lacked the confidence to engage independently with their work, often relying on the teacher to provide them with answers rather than work through the problem themselves. For example, members of Groups Three and Four spontaneously resorted to announcing their negative self-belief in their own problem-solving ability to the rest of the group (e.g. I don't know how to do this, see examples three & four). The lack of readiness towards engaging with the material provided indicates a deeper issue of deficient confidence in their ability.

Week 2

Data from the second week demonstrated a successful change in communication. In comparison to week one, students were engaged with the task at hand almost immediately from the start of recording. There were, however, still some limitations expressed about the students' abilities to engage with the essential aspect of questioning their peers. Rather than students providing their peers with questions to successfully answer the questions independently, individuals appeared to struggle with finding appropriate questions, or preferred to provide reassurance that the answer provided was correct. For example, Participants one and two were discussing a problem. Rather than prompting Participant One with questions to help them reach the answer, Participant Two preferred to provide confirmatory statements such as "that's what I'm saying" (see example five).

Example Five:

Participant 1: "What was that like a ratio?

Participant 2: It might be 1:2

Participant 1: Can they not go into each other?

Participant 2: Aye, that's what I'm saying" (Group 1)

Whilst the communication within week two had exhibited more evidence of engagement with the task, there was still evidence that participants were struggling to question their peers. Rather than struggling with not providing the answers, students seemed to struggle with the formation of relevant and appropriate questions, often resorting to prompts rather than questions regarding information. These prompts do not necessarily demonstrate critical analysis but were still of use to the group member attempting to answer the question. For example, Participants One and Two in Group Three were discussing a problem regarding heart rate. Whilst there was more explicit evidence of communication, Participant two still struggled to form questions to help Participant One reach an answer regarding stroke volume. Many of the questions started with "do you think you could?" which provided Participant One with ideas for strategies that they could use, rather than formulating strategies for themselves.

Like week 1, examples of negative self-belief were demonstrated. There was, however, evidence of other students mitigating these beliefs by supporting the student through the question. Rather than accepting that the individual was incapable, other students often provided reassurance that the individual had the ability to complete the problem with help. Whilst reassuring statements did not necessarily follow the pattern suggested by the Action Learning Cycle, statements such as "that's what I'm saying" provided reassurance to the other participants that they were performing adequately.

Example Six:

Participant 1: "Ok the stroke volume keeps increasing but the heart rate increases to work level five then it starts to even out…if that's right?

Participant 2: Erm…do you think you could maybe include…what's the numbers on the side?

Participant 1: Oh…right, I don't know what I'm looking at…ok stroke volume starts at…89…is it going up in twos...88 and it stops increasing at 140." (Group 3)

Example Seven:

Participant 1: "Ok so the 2.2 and 4.4, what do you do about this? If you're putting it in the simplest form?

Participant 2: You could divide it by 2? Actually multiply by 10 first?

Participant 1: And that would give you…?

Participant 2: 22 and 44?" (Group 4)

Week Three

At this stage a new type of problem was presented to the students: they were provided with past essay questions and asked to create a perfect marking scheme. An initial analysis of week three data provided evidence of engagement with the project. Importantly, however, in-depth consideration of the data suggests that the questions asked still demonstrated a lack of critical analysis in the students' learning methods. Participants preferred to read the questions to the rest of the group verbatim, rather than to consider alternative questions. Some students struggled with the overall concept of the 'perfect marking scheme', struggling to apply problem solving strategies out-with more formulaic questions.

Example 8:

Participant 1: "So the nucleotides…what's in that?" (Group 1)

Example 9:

Participant 1: "What are the similarities between bacteria and yeast cells?" (Group 3)

Qualitative analysis of the data across all groups indicated that, whilst there was a level of improvement in engaging with metacognitive behaviours and the project overall, the students were still limited in their ability to apply these behaviours in new contexts. Example 10 illustrates students' explanations of their limits.

Example 10:

Participant 1: "I don't understand how we're supposed to do this with marking schemes" (Group 4).

Week Four

The change in the previous week from problem-based questions to essay based questions caused some discontent amongst the groups. Many students felt that the skills being taught were not applicable to essay questions. Week four, however, demonstrated a change in the thought processes expressed by the groups. Students were beginning to engage with the process again and using critical analysis to identify questions that could benefit their peer trying to answer the questions. Participant One in Group Three, for example, read the question to be answered, and decided to provide Participant Two with a concise question from the problem; "what is an advantage of genetic engineering?" When Participant Two voices their concern over their memory of the topic, Participant One provides prompts relevant to the topic to help Participant Two remember information (see example 11).

Example 11:

Participant 1: "Bacteria can be used in genetic engineering. Describe the stages used in this process, state one advantage and one disadvantage of genetic engineering"

Participant 1: "What is an advantage of genetic engineering?

Participant 2: I don't know, I haven't done this stuff in ages

Participant 1: Rice…Crops of rice

Participant 2: It helps crop growth?" (Group 3)

Data from week 4 also demonstrated a new skill in critical analysis for some participants. Example 12 illustrates a conversation between two participants, one of which demonstrates a more creative approach to questioning. The more creative approach highlights two key changes. The first is a confidence in the process previously unseen. The second is an example of more complex critical analysis. The student uses a method of questioning that is relevant to the subject, but also more beneficial to the peer answering the question. Rather than just considering generic questions, the student considers both the problem and their peer in designing appropriate questions. Participant One in Group Four discusses the structure of cells with Participant Two.

Example 12:

Participant 1: "Name two structures within all cells.

Participant 2: Ribosomes…

Participant 1: Uh huh and?

Participant 2: The ribosomes and the mitochondria?

Participant 1: No.

Participant 2: Ribosomes and…

Participant 1: What's the gooey stuff the ribosomes float in?

Participant 2: Cytoplasm" (Group 4)

Not all groups effectively engaged with the project within week 4. Group 2 still demonstrated behaviours detrimental to learning. For example, one participant of the group still demonstrated negative beliefs regarding their abilities. Participant Two was struggling with naming the types of mutations. Rather than attempting to get the answer through regulating their knowledge,

the reverted back to negative belief schemas, explicitly stating "I'm really bad at this". Rather than correcting the belief, another student within the group preferred to provide the answer.

Example 13:

Participant 1: "Do you know the kinds of mutations?

Participant 2: Natural and…is it genetically altered?

Participant 1: Not quite…it's…they both start with r?

Participant 2: Reproduction?

Participant 1: No

Participant 2: Sorry I'm really bad at this.

Participant 1: Rare and random" (Group 2)

Week Four demonstrated a key change in the groups from week Three. Some groups began to adapt to the change in question format, changing their perspective on the questions being asked. The change demonstrated engagement with metacognitive regulation, adapting previous knowledge into new strategies to perform more effectively. Other students demonstrated a clear engagement with the project, implementing more creative approaches to questioning relevant to their peers, again regulating key knowledge into metacognitive strategies. There were, however, some groups that still struggled with questioning their peers rather than providing the answers. Week Five marked a return to the problem-solving question format.

<u>Week 5</u>

There was an increase in communication again in week 5, most likely as a consequence of returning to the problem-solving format. Groups appeared to demonstrate a clearer understanding of the process when engaging with problem solving questions. At this stage the data reveal evidence of critical analysis and evaluation of a problem, key metacognitive regulation behaviours. Moreover, there was reduced evidence of negative self-belief. Critically, students were refusing to provide answers, but rather supported

their peers in reaching a conclusion independently. For example, Participants One and Two in Group One were working on answering questions using a graph. Participant One continued to prompt Participant Two, providing questions to help Participant Two find the information they needed (see example 14).

Example 14:

Participant 1: "How many units of activity were recorded when the cell was at 50% of its maximum? Ok so cell number what axis are we looking at?

Participant 2: That one up the side

Participant 1: The top value is?

Participant 2: The top value is here.

Participant 1: So if its 50% it'll be?

Participant 2: 4" (Group 1)

The data from week Five also highlights that some students still demonstrated frustration when working with others. In Group Four, a participant demonstrated annoyance at a peer that refused to provide the answer. The participant themselves refused to answer the questions posed by the group, preferring to just provide an answer in the hope that reassurance for the answer would be provided.

Example 15:

Participant 1: "Is it not 11i?

Participant 2: Do you understand what 11i is telling you?

Participant 1: Is it A?

Participant 2: If you think that, put it down," (Group 4)

Week Six

In week six, the students demonstrated a significant level of increased metacognitive behaviours in their communications. The students focused on asking questions to prompt reflection and memory retrieval, rather than repeating questions verbatim. For example, Participants One and Two were working on a problem regarding seed growth. Participant One provided an answer. Participant Two then prompted Participant One to provide justification for the answer provided, ensuring that Participant One was using the correct strategy to answer the question (see example 16).

Example 16:

Participant 1: "Well, the answer's not D.

Participant 2: Why is it not D?

Participant 1: Because the height of the seeding's reported after 6 (Group 3)

In comparison to previous weeks, data from week 6 demonstrated that students were more engaged in working through problems independently, using peers to help prompt critical reflection. Each of the groups provided similar data, engaging with critical analysis and creative thinking to prompt each other with questions designed to encourage reflection. In Group Two, for example, Participants One and Two were working on a biology problem focusing on equations. Participant One could not apply the previous knowledge required to answer the question. Participant Two prompted Participant One to help them find the equation they needed, ensuring that Participant One had the information required to apply the right strategy (see example 17).

Example 17:

Participant 1: "There are two numbers there

Participant 2: How much have you got in total?

Participant 1: 2800

Participant 2: Right, what's the normal equation we use all the time in biology?

Participant 1: Change over additional x100, so it would be…

Participant 2: Are we actually changing anything or does it tell us how much we're giving it?" (Group 2)

The examples provide evidence of improved problem-solving behaviours. In addition, the frequency of asking the teacher for a solution also decreased. There was also a notable increase in communications from week six protocols. The students refrained from using negative self-belief schemas as reasons for poor performance. Moreover, by week six there were no instances of students claiming to be incapable of answering the questions.

6.1.6. Discussion

The current chapter examined an intervention designed to encourage the development of metacognitive abilities in high school learners – with the long term aim of enhancing student transitions to higher education. Here we presented results from two aspects of the initial intervention: Think-Aloud Protocols and self-report measures. Qualitative analysis of the protocols reveals a clear pattern of changing behaviour, providing evidence that the intervention had a positive impact on student metacognitive behaviours overall. The findings also demonstrated increased self-awareness, evidence of previously unseen problem-solving behaviour, and evidence of creativity and critical analysis.

As students progressed from weeks 1 to 6, there was significant evidence of improved communication across all groups. Students began to discuss problems further, providing justifications for their answers rather than waiting for reassurance from their peers. Students also demonstrated a clear increased engagement with the process by week 6, reducing hesitation between

questions and expressing increased confidence both in providing appropriate prompts and answering questions themselves.

As might be expected given the complexities of metacognition, the observed development differed between individuals. The critical analysis skills of some participants were significantly improved. Certain students demonstrated that they could apply other skills to their critical analysis (e.g. creativity) to help them to develop more relevant questions to support their peers learning. Conversely, however, some students were still struggling with the process by week 5. Nonetheless, even for these students, there was evidence of solving problems more effectively than previously, with support from their peers.

Despite the evidence of metacognitive improvement, the skills gained by the students seemed to be missing one key factor: cross-contextual ability. The transfer of skills from one domain to another is an important part of metacognitive ability (Georghiades, 2000, see Chapter 2). Critically, failure to generalise learning was also evident in the Think Aloud data – when the task changed from problem solving to essay questions in week three students could not apply their previous learning to the new context. Whilst students did not seem to consider the skills they were acquiring as transferable to different contexts, the intervention was carried out over a limited time. It is possible, therefore, that with more time and broader experience in applying these skills, and students would become more confident in applying metacognitive behaviours across domains.

Despite the lack of evidence supporting domain general metacognition in the present results, the findings still provide support for the link between self-efficacy and task performance (Pajare & Kranzler, 1995; Pajare & Miller; 1994). The findings are consistent with Bouffard-Bouchard's work (1990), for example, which manipulated the self-efficacy of 64 undergraduate students. Each of the students was placed in one of two conditions; they were either manipulated to promote perceptions of high self-efficacy or low self-efficacy through feedback. Whether students perceived themselves as high or

low in self-efficacy was found to be significantly related to their performance on cognitive tasks.

The present findings are also consistent with previous research demonstrating the impact of peer interaction on problem solving (Xun & Land, 2004; Phelps & Damon, 1989). Despite data from Chapter 6 detailing that undergraduate students struggle with learning from others, Azmita (1988) demonstrated that children tend to gain problem solving skills from observing and imitating their peers. In conjunction with the findings reported in Chapter 6, the results would suggest that children may lose these skills as they get older. If this is the case. It suggests that implementing metacognitive interventions at an even younger age may reduce the loss of these skills as children get older.

The current intervention highlights two novel points. First, the intervention provides qualitative support for relationships between peer interaction, problem solving and self-reflection. Second, whilst the intervention is based on previous empirical research, it is the first intervention of its kind to merge self-efficacy, metacognition and social interaction for the purposes of improving education. Clearly, further support for the impact of the intervention on transitions would require longitudinal data (e.g., tracking progress through university). Nonetheless, the findings presented here provide us with a promising starting point. Whilst changing the classroom environment completely may not be feasible, the introduction of the intervention outlined here to secondary education could improve students' academic self-concept and metacognitive awareness, helping them to identify the most appropriate methods of learning for them as individuals.

6.1.7. Conclusion

The transition from secondary school to high school requires students to have a strong academic self-concept. Consistent with this, the poor initial self-beliefs demonstrated by the students within the current study serve to highlight the benefits of metacognitive improvement programmes in secondary education. Importantly, the current intervention appears to have been successful in encouraging students to be more positive about their own

problem-solving ability, whilst also prompting them to learn more independently. By focusing on peer-led learning, our intervention aimed to better prepare students for entry into the more self-directed educational environment that is present in Universities. Whilst the intervention improved performance in the immediate problem-solving context, we have not been able to provide evidence that domain general metacognitive skills were improved *per se*. It remains possible, however, that providing students with an improved self-perception will, over the long term, motivate them to adopt the metacognitive behaviours they have acquired in all contexts. Overall, the presenting findings have suggested that a relatively simple intervention can be used to support the improvement of metacognitive behaviours in secondary education – providing teachers with a resource-light method for enhancing academic performance as students' transition from secondary school into higher education.

7. CONCLUSION

7.1.1. Overview and Conclusions

The thesis addressed three key research questions drawn from the literature. Firstly, how do the skills of undergraduate and postgraduate students differ? Secondly, is there a relationship between social context and metacognition? Thirdly, does personality play a part in the relationship between social context and metacognition? The key difference here lies in the role of peer learning. Doctoral students understand that peer support can be advantageous both academically and emotionally. Yet, some doctoral students seem to struggle to form a peer group and use these relationships effectively. In comparison, undergraduate students do not seem to have an awareness of the benefits of peer learning. Rather, normative beliefs regarding peer performance influence students' abilities to use the information from others. Additionally, the findings from Chapter Four suggest that students who have positive attitudes towards social learning behaviours perform poorer academically than those with negative attitudes.

The relationship, in part, could be because the influence of personality on metacognitive processes. Chapter Five supports previous research in that metacognition predicted academic performance (See Section 2.6). The difference here, however, lies in the moderation of said relationship by personality. With an incremental increase in metacognition and conscientiousness over 4 years of study, students' metacognitive behaviours were constrained by their level of conscientiousness. Considering students engage more consciously with appropriate learning behaviours when they enter their final year of study, the findings are feasible. The findings also quantify relationships between year of study, personality, metacognition and academic performance as argued by Poropat (2009, See section 5.1). The findings from Chapter Five suggest that year of study acts a meta-moderator

within the moderating relationship between personality, metacognition and academic success.

The comparison of behaviours between final year and first-year students, however, demonstrate the concerning attitudes of new university entrants. Whilst personality still constrains metacognition, the relationship is very different. Metacognition is only predictive of academic performance when extraversion is controlled for. The concentration of first-year entrants on adapting to a new complex social environment could be hindering their academic performance and development of their self-awareness. The concern from this data takes two forms; the first is the lack of metacognitive awareness in first-year students. The second is the adaptation to a new social context to the detriment of academic performance. Whilst students in secondary education can perform academically to an extent without requiring metacognitive knowledge, higher education focuses predominantly on self-directed learning. Without metacognitive awareness, university students struggle to succeed academically.

The finding also provides support for the theory that first year students struggle to benefit from peer learning. Extraverts would be more likely to engage with others and seek out new interactions, spending more time trying to learn from others. If students are unaware of appropriate methods of peer learning, it seems unlikely that collaborative learning would be effective. These skills may be developed throughout undergraduate education.

The impact of personality on the relationship between metacognition and academic performance only encourages the necessity for students to take responsibility for their learning at an early stage. Universities often have large numbers of students with limited resources or teaching staff (Toth & Montagna, 2002). An individualised method of teaching, therefore, is often not feasible. Students need to be aware of their own individual learning approaches, and the methods that best suit their individual needs without the explicit guidance of teaching staff.

The other area of concern is the lack of social awareness in undergraduate students. The data would suggest that undergraduates lack an awareness of the cognitive diversity amongst individuals, preferring to impose their own normative beliefs on their peers. Rather than engaging with effective social learning behaviours, students prefer to assume that if they do not have the capability to solve a problem, students at a similar competency level will suffer from the same deficiencies.

As demonstrated in Chapter Three, however, social awareness becomes key to improving metacognition as students transition into postgraduate education. Doctoral students become heavily reliant on their peers to encourage reflection, provide emotional support and supplement their confidence in their ability. The improved social awareness could be due to a general change in educational achievement. Whilst undergraduates commonly compare themselves to others through academic performance as they receive standardised grades, postgraduate students struggle with this process as each project is inherently unique. The findings of Chapter Three reflect previous findings of the effect of Imposter Syndrome in doctoral education, specifically how peer support can influence the effects of Imposter Syndrome on performance. Parkman's (2016) review of Imposter Syndrome in higher education suggests that, whilst researchers and institutions are aware of Imposter Syndrome, there is still a culture of conflict and competitiveness that influences students' ability to internalise success. Encouraging reflection through peer support and increasing metacognition can combat the described 'higher education culture'.

Parkman also highlighted that the Imposter Syndrome is not just present in doctoral students. The effect has a lasting impact on university staff. Hutchins (2015) explored the Imposter Syndrome in university faculty, the majority of which were from 4-year institutions. Participants completed a 78-item questionnaire consisting of demographic information, questions regarding Imposter Syndrome, burnout and coping strategies. The findings highlighted a positive relationship between emotional exhaustion and Imposter Syndrome, demonstrating that there is also an effect on the physical health of

staff members. The research above in addition to the findings reported in Chapter Three suggests that addressing Imposter Syndrome at an early stage of students' doctoral careers will promote a more supportive culture and a healthier faculty.

Addressing social learning awareness is important to promoting educational attainment. The thesis, however, demonstrates that whilst undergraduates at this stage do not demonstrate an understanding of social learning processes, the understanding of peer learning can be fostered at an earlier stage of education. Providing students with metacognitive improvement programmes at high school level, specifically designed around peer learning, has the potential to provide students with social skills before they reach undergraduate education, improving academic performance at all levels of education. Before the practical implications are discussed however, the chapter will examine the theoretical contributions made by the current thesis in terms of social metacognition.

7.1.2. Theoretical Implications

The thesis aimed to provide a more comprehensive understanding of metacognitive processes in education. Current metacognitive theory is highly divisive. Whilst individual metacognitive theories focus on the cognitive underpinnings of metacognition, social metacognitive models focus on individual and social metacognition as separate entities (See Chapter Four). The research here, however, suggests that neither of these models are comprehensive in their understanding, nor are they separate processes.

Socially shared metacognition does have its merits. Considering the idea of joint cognitions fills a previous gap in metacognitive literature, merging cognitions and the more historical views of learning as a social behaviour. The problem, like so many other social learning theories, is the conceptualisation of social metacognition as a separate entity. When examining concepts such as collaborative learning, however, there are more complex processes in place than just working with others. A person's understanding of their individual metacognition, and a willingness to be

flexible in their role within a group, are important in effective social learning (Goos, Galbraith & Renshaw, 2002). In comparison to socially shared metacognition, socially mediated metacognition considers the effect of social context on metacognitive processes. Whilst socially mediated metacognition does again provide a novel look at metacognitive processes, there is again a lack of understanding in how the social and individual factors merge into learning. Ideally, these two models would be integrated to understand that there is a more complex process at work, incorporating the individual differences, social context and joint cognitions that impact metacognitive processes.

Figure 7.1 below amalgamates both individual and social metacognitive processes. Rather than providing an in-depth look at the metacognitive processes, the figure demonstrates relationships observed both in previous literature and in the current thesis. The figure highlights key relationships. The first relationship is that of individual differences and individual metacognition. Chapter two details several individual factors linked with metacognition such as motivation, self-belief schemas and approaches to learning (Heikkila & Lonka, 2006; Minnaert & Janssen, 1999; Zimmerman, 2002). Chapter Five, however, detailed a more novel understanding that the relationship between metacognition and personality should also be considered when addressing the impact of individual differences on metacognition. Chapter Four also introduced the role of normative beliefs on metacognition and collaborative learning. Normative beliefs contain both an element of individual belief schemas and social norms, indicating a relationship between the social and individual aspects of metacognition.

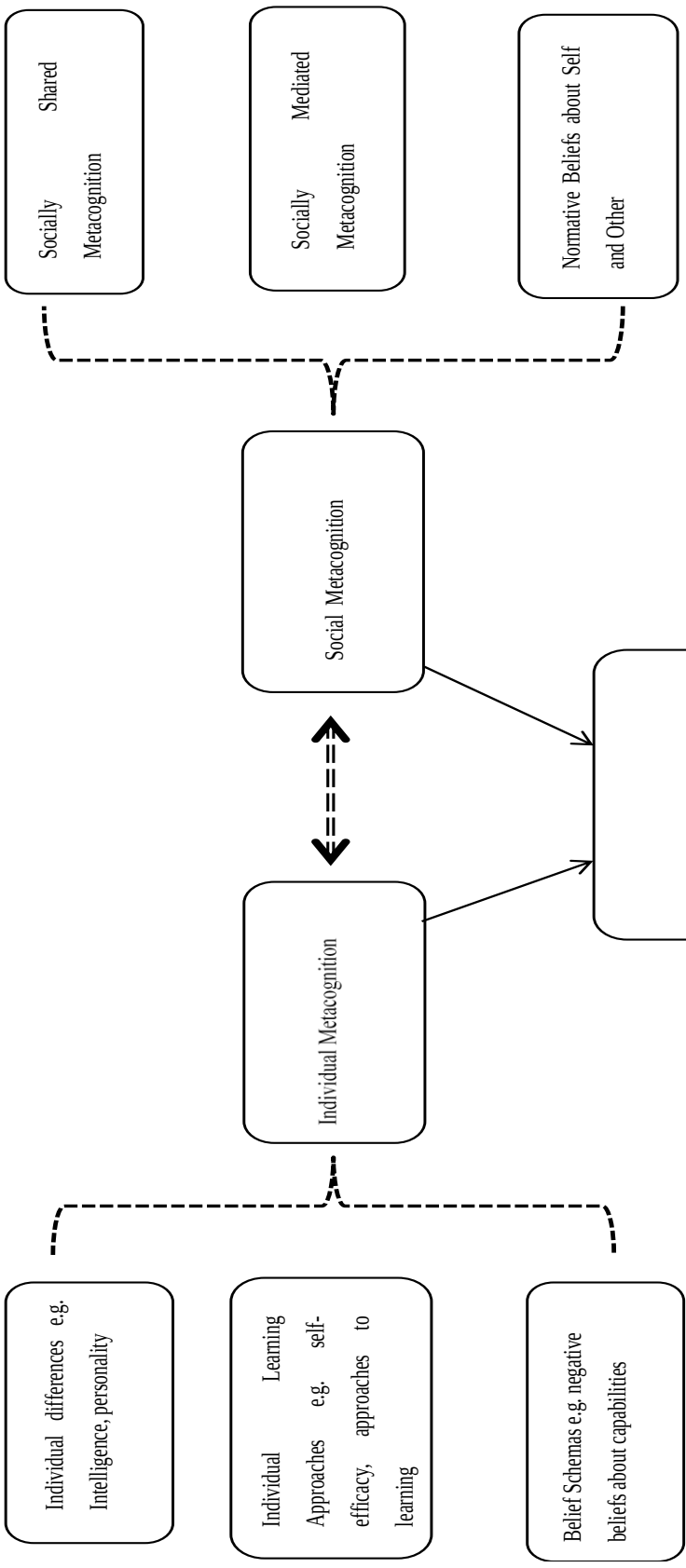


Figure 7.1: A Comprehensive Look at Metacognitive Processes in Education

As identified by the impact of normative beliefs on metacognition, individual and social metacognition cannot be classified as separate entities. Importantly, the key relationship of note within Figure 7.1 is the interactive relationship between individual and social metacognition. Individual metacognition can influence a person's engagement with social metacognition and vice versa. Whilst individual differences impact on individual metacognition, the impact further influences the relationship between social metacognition and academic performance. Social metacognition can also have an impact on a person's self-belief, as demonstrated within a postgraduate sample in Chapter Three. The relationship between social context and self-belief is supported by Marsh, Trautwein, Ludtke and Koller's (2008) review of social comparison and self-concept, which highlights the potential negative effects of social comparison on self-belief, consistent with theories of Imposter Syndrome.

The interaction between individual and social metacognition is an important distinction from previous models, incorporating cognitive, behavioural and social processes into a more comprehensive model of learning. The comprehensive model identified in Figure 7.1 highlights that socially shared and socially mediated metacognition are not mutually exclusive. Rather, the two models explain separate aspects of social metacognition: the impact of joint cognitions and social context on learning processes. The question now remains: what do the theoretical implications discussed here mean for metacognition in practice?

7.1.3. Practical Implications

Figure 7.1 demonstrates a novel theoretical approach to metacognition. But what does this mean for educational practice. The complexity of the model reflects the recommendations of current literature surrounding inclusive learning and teaching. Hart, Dixon, Drummond and McIntyre (2004), for example, designed a model describing the concept of transformability; that is, all children's learning capacity can be changed for better or worse dependent on their environment and the people surrounding them. Hart and colleagues further describe that transformability can be improved through affective,

social and intellectual purposes. Despite the differences in age category (Figure 7.1 is developed from undergraduate populations, whilst Hart and colleagues' work focuses on secondary school learners), similar concepts are reflected in Figure 7.1.

Affective purposes include improving confidence and competence. These are core ideals of individual metacognition, improving someone's self-awareness of their own capabilities and improving the regulation of their own cognitions to improve their competence. Social purposes include increasing acceptance, belonging and community. Within Figure 7.1, these purposes could align with the factors that influence social metacognition, including normative beliefs about self and others. Intellectual purposes could align with the outcomes of Figure 7.1. Whilst Figure 7.1 does not necessarily address the issue of ensuring access to education for everyone, intellectual purposes also include enhancing meaning and reasoning, both of which can be linked to improved metacognition and are supported to improve problem solving and understanding knowledge.

Hart and colleagues (2004) also make recommendations for practice. Hart and colleagues suggest that three key pedagogical principles can address transformability; 'co-agency', 'everybody' and 'trust'. Co-agency suggests that the responsibility for learning is shared between the individual and the teacher. Teachers should also recognise students can tell teachers how they learn best, categorised under the pedagogical principle of trust. Finally, inclusive learning encapsulates all students, and teachers have the responsibility to work to enhance the learning of everyone.

Whilst the pedagogical principles detailed above are key to inclusive teaching, the principles are much more focused on the responsibilities of the teacher. Metacognition, in comparison, could influence the principle of co-agency on the part of the student. According to Hart and Colleagues (2004), teachers should trust that students can inform them of how they learn best. The pedagogical principles detailed outline the relationship between teaching and learning. Metacognition becomes key to mediating this relationship. For students to be aware of how best they learn, their metacognitive ability needs

to be developed. The intervention proposed in Chapter Six could help promote inclusive pedagogy by helping students to understand their own approach to learning when coupled with teachers' willingness to trust their students' awareness. Practically, the teachers in secondary education here can encourage independence through implementing similar interventions to the one detailed in Chapter Six, improving problem solving behaviours and self-awareness.

7.1.4. Further Recommendations for Teaching Practice

There are recognised limitations in teaching practice in secondary education because of the focus on 'teaching to the test' (York, Gibson & Rankin, 2015). Many secondary schools focus on teaching information for students to achieve their grades, however this teaching method comes at a cost: students focus on short-term acquisition, and rarely retain information after they have passed their exams (Jensen, McDaniel, Woodard & Krummer, 2014). The short-term acquisition of knowledge can cause problems later in students' educational careers, when they are no longer provided information for the sole purpose of achieving good grades.

The findings presented in the current thesis reflect issues of memorising information rather than higher order thinking, particularly for first year undergraduate students. Students are unaware of how to acquire and regulate their knowledge, particularly when accounting for their own individual differences. Gregory and Chapman (2012) came to a similar conclusion. The researchers carried out reviews of the current teaching approaches across levels of education, introducing the concept of Differentiated Instructional Strategies. Gregory and Chapman highlight that, whilst each student has a different personality, different experiences and different attitudes, teachers still develop lesson plans with the intent of teaching each student in the same way, following a 'one size fits all' approach to education. Gregory and Chapman advocate for a Differentiated Instructional Approach, in which teachers respond to the individual needs of the student. Within this account, however, there is limited consideration of the reality of large class sizes, especially within higher education. Resources, however, are a major

limitation of the Differentiated Instructional Approach. If limited resources are available, metacognition becomes a key factor in improving academic success (as highlighted in Section 2.6.2). By encouraging students to be more aware of their own skills from an early age, students can take control of their own learning.

Jensen, McDaniel, Woodard and Kummer (2014), however, argue that not all methods of current teaching practice need to be changed. Rather, the content of the practice could be changed to reflect the preferred outcomes. In Jensen and colleagues' study specifically, they focused on how exams could be designed to promote a higher order level of thinking (or metacognition). Undergraduate students on two sections of a biology course that were taught identically (90 in each). For each section, students were either given 14 low level format quizzes (focusing on remembering information) or high level format quizzes (focusing on understanding, analysing and evaluating) throughout the semester. A mixed-model ANCOVA suggested that students who completed the high level format assessments achieved higher final exam scores.

Jensen and colleagues' findings reflect those in Chapter Six. When encouraged to engage with metacognition on a frequent basis, there seems to be an overall change in students' willingness to use the appropriate skills. Whilst the intervention in Chapter Six provides a small introduction into how we can aim to improve metacognition through collaborative methods, there needs to be a much larger scale implementation of metacognitive development techniques if we are to improve educational outcomes. It is possible that by implementing methods of encouraging students to understand, analyse and evaluate, metacognition will generally improve. Importantly, these methods could be incorporated into both teaching approaches and assessment. The key differences between Jensen and colleagues' work and the research in Chapter Six, however, are the methods of metacognitive development (assessment vs teaching) and the environment. Firstly, whilst Jensen and colleagues' study focused on learning through assessment, Chapter Six focuses on learning in the classroom. Secondly, Jensen and colleagues focus on individual higher order cognitions, whilst

Chapter Six focuses on learning collaboratively. As highlighted in Chapter Four, some researchers have already suggested methods of improving metacognition through peer learning. These suggestions include implementing collaborative learning in teaching (Collings, Swanson & Watkins, 2015; Elliot et al, 2016), feedback (Nicol, Thomson & Breslin, 2014) and assessment (Reinholz, 2016).

The issue with peer learning and assessment is that, as identified in Chapter Four, students are not necessarily willing to promote effective peer learning, especially when giving critique is a necessary factor. Figure 7.1 identifies the need for both individual and social metacognition to improve academic outcomes. In addition, Hart and colleagues' (2004) proposed pedagogical principles suggest that 'co-agency', 'trust' and 'everybody' are key to inclusive learning. It may be the case, therefore, that there is no one method of teaching and assessment that will address the final pedagogical principle of everybody above.

It is possible, however, that providing students with a scaffolding method of understanding their own learning at an early stage of their undergraduate career may be key to improving metacognition and, in turn, independent learning (Duffy & Azevedo, 2015). Instructional scaffolding in terms of teaching refers to the relationship between a learner and facilitator that helps the learner achieve goals which would be otherwise unobtainable (Delen, Liew & Wilson, 2014). Whilst scaffolding can be in place between a student and teacher, scaffolding has also been used to improve social metacognitive processes in groups (Frey, Iwa & Mikroyannidis, 2017; Molenaar, Sleegers & Boxtel, 2014). Scaffolding can be a useful method of providing instruction to students in a new environment, but there must also be a point when scaffolding becomes less prevalent in a student's learning, and they become more independent. At the early stages of a university career, however, scaffolding to improve metacognition could be very beneficial. Additionally, another key factor to consider here is how students can be aware of their preferred learning approach if they have not been exposed to different learning methods.

Providing students with access to different teaching methods, different assessment types and different types of feedback early in their undergraduate career may allow students the opportunity to figure out what works best for them, with guidance from academic staff. Removing the 'scaffolding' and reducing input incrementally from year one in undergraduate study to the final year may be more effective in improving metacognitive development. The implementation of both individual and peer learning methods using a scaffolding approach could potentially be of benefit to students who then enter graduate education, providing them with additional skills necessary to succeed in doctoral study.

7.1.5. Limitations

The current thesis has the advantage of using mixed methods. There are, however, certain limitations to consider when discussing these findings from the perspective of the general undergraduate population. Chapter Four aimed to examine the relationship between personality, metacognition and academic performance. For the relationship to be analysed effectively, there needed to be a standardised measure of academic performance. For these purposes, University of Stirling students were recruited only. To recruit from other university samples would have limited our ability to compare academic performance effectively, especially considering the numerous methods of standardised marking across different universities. The same limitation was applicable in Chapter Four, in which students were recruited from one university as, to have an effective understanding of both academic performance and normative beliefs, only one student population could be recruited. It would be possible to replicate the studies in other universities; however, it seems unlikely that, without somehow standardising measures of academic performance, the findings could be comparable with those reported within the current thesis.

Again, there is a similar limitation observed in the postgraduate sample used within Chapter Three. Postgraduate samples used in research do tend to be smaller, simply due to a smaller population of postgraduates available generally. Evaluating the Learning Process had a similar issue, in that many

of the previous participants had already finished their degree and were no longer contactable through the university. There were, however, enough participants to provide an in-depth evaluation using qualitative methods. Again, the postgraduate community in Stirling University may differ significantly from communities in other universities across the UK. For an accurate comparison with other doctoral communities, the Learning Process would need to be implemented in other higher education institutions.

There also needs to be consideration for social desirability when using self-report measures. Whilst all the questionnaires used throughout the thesis demonstrated high internal consistency, there still needs to be an awareness that findings may in some way have been affected by social desirability. Experimental methods were also employed in Chapter Four, and the tasks used (specifically the ToH and the TSP) were chosen because they did not require domain specific knowledge to complete the tasks effectively. There is the possibility, however, that the tasks used similar strategies in their solutions. To thoroughly address collaborative learning processes, the studies would benefit from repetition with additional tasks that require different strategies.

Despite these limitations, the findings reported throughout the thesis present novel ways of viewing the relationships between individual and social metacognition. The next section will address future directions for research, taking into consideration the conclusions drawn within this thesis.

7.1.6. Further Investigations

The thesis came to a few key conclusions. Chapter Three detailed the benefits of metacognitive improvement programmes for postgraduate students. The Chapter demonstrated the importance of peer learning and support in doctoral study, improving Imposter Syndrome by discussing perceptions and challenges with others. The culture of Imposter Syndrome, however reaches beyond postgraduate study. It is possible that The Learning Process, previously designed for postgraduate students, would also benefit early career

researchers and academic staff struggling with their metacognitive awareness. Further evaluation in different contexts would be advantageous.

The thesis also explored how metacognition differs between postgraduate and undergraduate populations. Specifically, the impact of attitudes in metacognitive engagement and peer learning is demonstrated in Chapter Four. Practically, there needs to be consideration of how to change normative beliefs to promote more effective learning in undergraduates. An intervention could be developed in earlier years of education to promote a better understanding of what makes a 'good student', encouraging an understanding of the importance of metacognition and promoting positive attitudes towards engaging with metacognitive behaviours. Changing attitudes can encourage good metacognition, but teaching metacognitive skills is also beneficial. Whilst the intervention discussed in Chapter Six demonstrated improved problem-solving behaviours, however, there would be benefit to following previous participants into university, determining the longitudinal effects of the intervention on undergraduate success. Students could also be evaluated once they reach postgraduate education to determine whether these effects could have a life-long impact.

The relationship between metacognition and academic performance is moderated by personality. There were, however, other meta-moderation effects to consider. In this case, year of study acted as a meta-moderator within the previously identified moderation relationship. There is the possibility that these effects are present in the relationships between metacognition and other individual differences, such as intelligence or approaches to learning. In addition, the relationship between normative beliefs and metacognition could be further constrained by personality. For example, the attitudes towards metacognition and social learning behaviours could possibly be constrained by extraversion, as demonstrated in Chapter Five. Further explanations of the relationships between normative beliefs, metacognition and personality could help promote more effective collaborative learning.

These explanations could be explored through the model presented in Figure 7.1. The model details numerous relationships between individual differences, social interactions, metacognition and academic performance. The model has been synthesised from current metacognitive literature and thesis findings. There would be benefit, however, to developing the model further and extending our understanding of how these factors interact. The model also has implications for educational practice. Developing practical toolkits to incorporate all the factors mentioned above would be beneficial to practitioners, especially when trying to develop independent and collaborative learning skills at a younger age.

7.1.7. Conclusion

The thesis aimed to address the individual and social complexities of metacognition in educational environments, both at a theoretical and practical level. Initially, the thesis aimed to explore how postgraduate metacognition differed from undergraduates. Comparing the two groups, it would seem that postgraduates are adept at using metacognitive skills, particularly when working with peers. Doctoral students' metacognitive awareness, however, is less developed. In comparison, undergraduates are unable to use their peers effectively, preferring to work individually even when there may be benefit to working with others. The reluctance seems, in part, to be due to normative beliefs. Undergraduates are unaware of how a peer's cognitions may differ from their own.

Chapter Five also suggested that the lack of ability to work with others could be influenced by a person's personality. There is the possibility that extraversion influenced metacognition at undergraduate level extraverted students are more likely to seek out peers to work with. These students, however, are not aware of how to effectively learn from others. As a response to the findings presented here, the thesis has synthesised a new theoretical model (Fig. 7.1) incorporating both individual and social accounts of metacognition, accounting for other psychological constructs that may impact academic performance.

The theoretical model aimed to contribute to our broader understanding of metacognition. Practically, these contributions also instigated an intervention based on improving metacognition through collaborative means. The piloted intervention was introduced to high school students, and participants demonstrated a marked difference in problem-solving ability and their communication skills. The intervention is only a small part of how metacognition could be implemented into teaching practice, however. Whilst it is necessary to encourage independent learning from an early stage, it is possible that by introducing metacognitive interventions which also provide scaffolding during transitional points and collaborative elements, students can become more effective learners. In sum, there are many individual and social complexities of metacognition that need to be accounted for in educational practice. A more comprehensive account of factors that may influence metacognitive development need to be taken into account when deciding how best to improve metacognition at all levels of education.

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9. APPENDICES

Appendix 1: Metacognitive Awareness Inventory

Please read each statement carefully. On a scale of 1(strongly disagree) to 5 (strongly agree), please rate how strongly you feel each statement applies to you. Please answer as honestly as possible. There are no right or wrong answers.

1. I ask myself periodically if I am meeting my goals.
2. I consider several alternatives to a problem before I answer.
3. I try to use strategies that have worked in the past.
4. I pace myself while learning in order to have enough time.
5. I understand my intellectual strengths and weaknesses.
6. I think about what I really need to learn before I begin a task
7. I know how well I did once I finish a test.
8. I set specific goals before I begin a task.
9. I slow down when I encounter important information.
10. I know what kind of information is most important to learn.
11. I ask myself if I have considered all options when solving a problem.
12. I am good at organizing information.
13. I consciously focus my attention on important information.
14. I have a specific purpose for each strategy I use.
15. I learn best when I know something about the topic.
16. I know what the teacher expects me to learn.
17. I am good at remembering information.
18. I use different learning strategies depending on the situation.
19. I ask myself if there was an easier way to do things after I finish a task.
20. I have control over how well I learn.
21. I periodically review to help me understand important relationships.
22. I ask myself questions about the material before I begin.
23. I think of several ways to solve a problem and choose the best one.

24. I summarize what I've learned after I finish.
25. I ask others for help when I don't understand something.
26. I can motivate myself to learn when I need to
27. I am aware of what strategies I use when I study.
28. I find myself analysing the usefulness of strategies while I study.
29. I use my intellectual strengths to compensate for my weaknesses.
30. I focus on the meaning and significance of new information.
31. I create my own examples to make information more meaningful.
32. I am a good judge of how well I understand something.
33. I find myself using helpful learning strategies automatically.
34. I find myself pausing regularly to check my comprehension.
35. I know when each strategy I use will be most effective.
36. I ask myself how well I accomplish my goals once I'm finished.
37. I draw pictures or diagrams to help me understand while learning.
38. I ask myself if I have considered all options after I solve a problem.
39. I try to translate new information into my own words.
40. I change strategies when I fail to understand.
41. I use the organizational structure of the text to help me learn.
42. I read instructions carefully before I begin a task.
43. I ask myself if what I'm reading is related to what I already know.
44. I re-evaluate my assumptions when I get confused.
45. I organize my time to best accomplish my goals.
46. I learn more when I am interested in the topic.
47. I try to break studying down into smaller steps.
48. I focus on overall meaning rather than specifics.
49. I ask myself questions about how well I am doing while I am learning something new.
50. I ask myself if I learned as much as I could have once I finish a task.
51. I stop and go back over new information that is not clear.
52. I stop and reread when I get confused.

Appendix 2: NEO-Five Factor Inventory

This questionnaire wants to know more about your personality. Please rate the statements according to how closely they relate to you on a scale of 1 to 5 (strongly disagree to strongly agree). Please answer as honestly as possible. There are no right or wrong answers.

1. I am not a worrier.
2. I like to have a lot of people around me.
3. I don't like to waste my time daydreaming.
4. I try to be courteous to everyone I meet.
5. I keep my belongings clean and neat.
6. I often feel inferior to others.
7. I laugh easily.
8. Once I find the right way to do something, I stick to it.
9. I often get into arguments with my family and co-workers.
10. I'm pretty good about pacing myself as to get things done on time.
11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
12. I don't consider myself especially "light hearted".
13. I am intrigued by the patterns I find in art and nature.
14. Some people think I'm selfish and egotistical.
15. I am not a very methodical person.
16. I rarely feel alone or blue.
17. I really enjoy talking to people.
18. I believe letting students hear controversial speakers can only confuse and mislead them.
19. I would rather cooperate with others than compete with them.
20. I try to perform all the tasks assigned to me conscientiously.
21. I often feel tense or jittery.
22. I like to be where the action is.
23. Poetry has little or no effect on me.
24. I tend to be cynical or sceptical of others intentions.
25. I have a clear set of goals and work toward them in an orderly fashion.
26. Sometimes I feel completely worthless.

27. I usually prefer to do things alone.
28. I often try new and foreign foods.
29. I believe that most people will take advantage of you if you let them.
30. I waste a lot of time before settling down to work.
31. I rarely feel fearful or anxious.
32. I often feel as if I'm bursting with energy.
33. I seldom notice the moods or feelings that different environments produce.
34. Most people I know like me.
35. I work hard to accomplish my goals.
36. I often get angry at the way people treat me.
37. I am a cheerful, high spirited person.
38. I believe we should look to our religious authorities for decisions on moral issues.
39. Some people think of me as cold and calculating.
40. When I make a commitment, I can always be counted on to follow through.
41. Too often, when things go wrong, I get discouraged and feel like giving up.
42. I am not a cheerful optimist.
43. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.
44. I'm hard headed and tough minded in my attitudes.
45. Sometimes I'm not as dependable or reliable as I should be.
46. I'm seldom sad or depressed.
47. My life is fast paced.
48. I have little interest in speculating on the nature of the universe or the human condition
49. I generally try to be thoughtful and considerate.
50. I am a productive person who always gets the job done.
51. I often feel helpless and want someone else to solve my problems.
52. I am a very active person.
53. I have a lot of intellectual curiosity.
54. If I don't like people, I let them know it.
55. I never seem to be able to get organised.

56. At times I have been so ashamed I just wanted to hide.
57. I would rather go my own way than be a leader of others.
58. I often enjoy playing with theories or abstract ideas.
59. If necessary, I am willing to manipulate people to get what I want.
60. I strive for excellence in everything I do.

Appendix 3: Interpersonal Perception Method

For each statement, please provide an answer for all three conditions: What you think, what you think your peers think, and what you think your peers think you think. |For each condition, please rate on a scale of 1(strongly disagree) to 5 (strongly agree).

1. To be a good learner you need to be aware of your own strengths and weaknesses.
2. Learning is much better when tutors give you all the information required to pass the exam.
3. Studying is much more effective when working with peers.
4. Tutors encourage students to think critically.
5. Discussions with peers about topics being studied can hinder learning rather than help it.
6. Working through problems with peers is much easier than working through them with tutors.
7. Watching a peer challenge a tutor in class is unsettling.
8. It is much more difficult to solve a problem when you need to work with someone else.
9. You only need to consider one solution to a problem.
10. It is easier for tutors to give students information rather than expect students to find it for themselves.
11. Feedback given to students about their assignments should always be read and considered, regardless of their grade.
12. Taking tutors opinions as fact is important to do well.
13. Comparing yourself to your peers does not motivate you do well academically.
14. Students get discouraged when tutors expect them to know about the topic.
15. You need to be aware of strategies you use to learn to be academically successful.
16. You can’t expect to solve a problem without understanding all the information first.

17. People who tend to challenge tutors are not popular within the classroom.
18. Students' opinions on topics are respected by tutors.
19. Remembering information to pass an exam is not the same as learning.
20. Students feel uncomfortable when tutors challenge their opinions.
21. Lectures are much more interesting when students are expected to interact with the lecturer.
22. Time management is easier when working in groups.
23. Students should be expected to find information for themselves rather than rely on tutors to provide it for them.
24. Lecturers understand that students don't have time to find information out for themselves.
25. Remembering information is an important part of learning.
26. Reflecting on previous work will help you improve on future assignments.
27. Discussions with peers about you work can help you reflect on your own academic practice.
28. It is preferable for peers to ask you questions to work out your problems rather than just offering solutions.
29. Understanding other people's perspectives is an important part of learning.
30. Working with peers makes it much easier to consider alternative explanations to a problem.

Appendix 4: Big Five Inventory

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement from 1 (strongly disagree) to 5(strongly agree).

I see Myself as Someone Who...

1. Is talkative
2. Tends to find fault with others
3. Does a thorough job
4. Is depressed, blue
5. Is original, comes up with new ideas
6. Is reserved
7. Is helpful and unselfish with others
8. Can be somewhat careless
9. Is relaxed, handles stress well
10. Is curious about many different things
11. Is full of energy
12. Starts quarrels with others
13. Is a reliable worker
14. Can be tense
15. Is ingenious, a deep thinker
16. Generates a lot of enthusiasm
17. Has a forgiving nature
18. Tends to be disorganized
19. Worries a lot
20. Has an active imagination
21. Tends to be quiet
22. Is generally trusting
23. Tends to be lazy
24. Is emotionally stable, not easily upset

25. Is inventive
26. Has an assertive personality
27. Can be cold and aloof
28. Perseveres until the task is finished
29. Can be moody
30. Values artistic, aesthetic experiences
31. Is sometimes shy, inhibited
32. Is considerate and kind to almost everyone
33. Does things efficiently
34. Remains calm in tense situations
35. Prefers work that is routine
36. Is outgoing, sociable
37. Is sometimes rude to others
38. Makes plans and follows through with them
39. Gets nervous easily
40. Likes to reflect, play with ideas
41. Has few artistic interests
42. Likes to cooperate with others
43. Is easily distracted
44. Is sophisticated in art, music, or literature

Appendix 5: Chosen Items from the Motivated Strategies for Learning Questionnaire

1. When I study the readings for a course, I outline the material to help me organize my thoughts.
2. During class time I often miss important points because I'm thinking of other things.
3. When studying for this course, I often try to explain the material to a classmate or friend.
4. When reading for a course I make up questions to help focus my reading.
5. I often find myself questioning things I hear or read in a course to decide if I find them convincing.
6. When I study for a class, I practice saying the material to myself over and over.
7. Even if I have trouble learning the material in a class, I try to do the work on my own without help from anyone.
8. When I become confused about something I'm reading for a class, I go back and try to figure it out.
9. When I study for a course, I go through the readings and my class note and try to find the most important ideas.
10. If course readings are difficult to understand, I change the way I read the material.
11. I try to work with other students from my class to complete the course assignments.
12. When studying for a course, I read my class notes and the course readings over and over again.
13. When a theory, interpretation or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.
14. I make simple charts, diagrams or tables to help me organize course material.
15. When studying for this course I often set aside time to discuss course material with a group of students from the class.
16. I treat the course material as a starting point and try to develop my own ideas about it.

17. When I study for a class, I pull together information from different sources, such as lectures, readings and discussions
18. Before I study new course material thoroughly, I often skim it to see how it is organised.
19. I ask myself questions to make sure I understand the material I have been studying in class.
20. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
21. I often find that I have been reading for a class but don't know what it was all about.
22. I ask the instructor to clarify concepts I don't understand well.
23. I memorize key words to remind me of important concepts in this class.
24. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for a course.
25. I try to relate ideas in a subject to those in other courses whenever possible.
26. When I study for a course, I go over my class notes and make an outline of important concepts.
27. When reading for a class, I try to relate the material to what I already know.
28. I try to play around with ideas of my own related to what I am learning for a course.
29. When I study for a course, I write brief summaries of the main ideas from the readings and my class notes.
30. When I can't understand the material in a course, I ask another student in the class for help.
31. I try to understand the material in a class by making connections between the readings and the concepts from the lectures.
32. Whenever I read or hear an assertion or conclusion in a class, I think about possible alternatives.
33. I make lists of important items for this course and memorize the lists.
34. I try to identify students in my class whom I can ask for help if necessary.
35. When studying for my course I try to determine which concepts I don't understand well.

36. When I study for a class, I set goals for myself in order to direct my activities in each study period.
37. If I get confused taking notes in class, I make sure I sort it out afterwards.
38. I try to apply ideas from course readings in other class activities such as lecture and discussion.

Appendix 6: Learning Process Interview guide

Learning Process Topic Guide

How do you find the Learning Process overall?

How do you feel that the Learning Process has changed how you identify individual academic challenges, if at all?

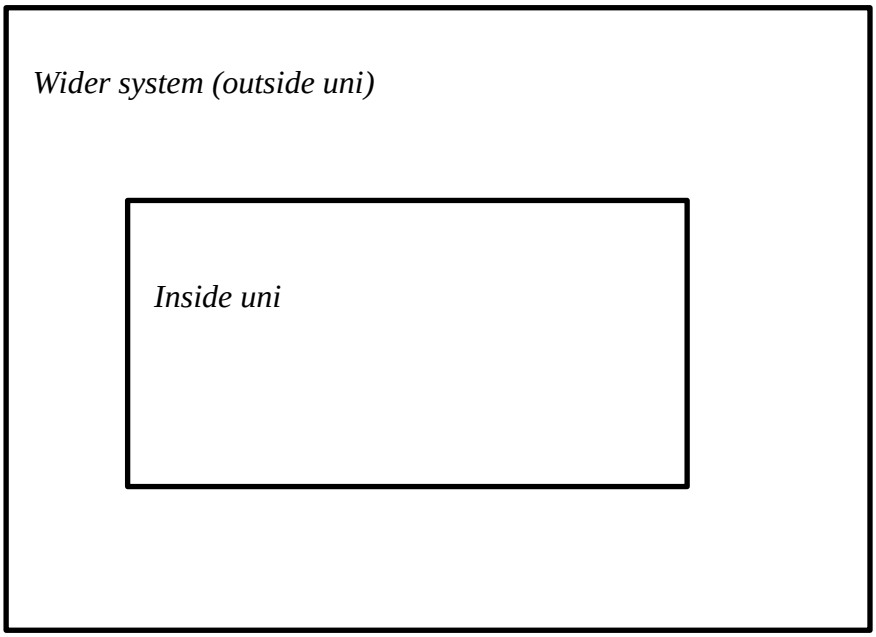
Can you tell me more about how you thought the Learning Process influenced how you view your own approach to learning?

Tell me more about the Learning Process' influence on your views around feedback to yourself and feedback you give to others.

Do you feel the Learning Process has influenced your reflective abilities?

-If so, how?

Relationships – Social Networking Map



Thinking about the networking map you just completed, how do you think the Learning Process has influenced your ability to identify key professional relationships, if at all?

Do you think the Learning Process has impacted on how you present yourself in an academic environment?

-If so, how?

How has the Learning Process influenced how you monitor your career progress over time?

Do you think the Learning Process has changed the way you learn?

Can you give an example?

With what effect has the Learning Process influenced your confidence?

Could you give an example of how the Learning Process can be used in other areas of your life outside academia?

Are there any skills/strategies you would like to gain from the Learning Process, but do not feel are developed? Can you give examples?

Are there any other comments you would like to add about the Learning Process in general?

Appendix 7: Learning Process Control Interview Guide

How has your PhD experience been overall?

Learning Process Attributed Skills

How do you find your relationship with your supervisor?

How important do you think personality is to your PhD?

How have you considered your career progress during your studies?

How do you find you deal with feedback?

Metacognitive Development

What kind of learning strategies have you used during the course of your PhD?

How do you feel about your capability to finish your PhD?

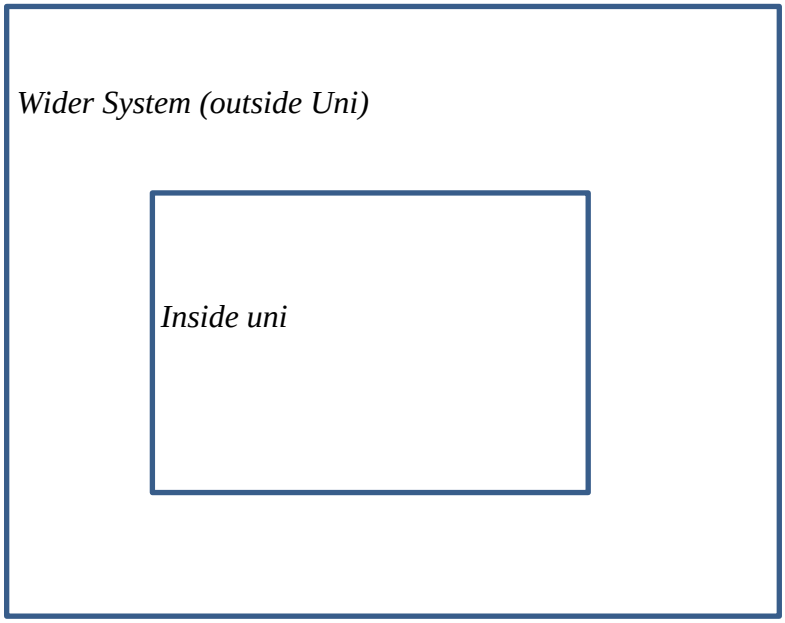
How would you deal with challenges arising from your studies?

Would you say that you spend time reflecting on your studies?

What skills do you think you are developing that can be used outside academia?

Social Support

Social Networking Map



How did you find completing the social networking map?

What kind of relationship do you have with your peers?

How do you feel interacting with peers impacts on your academic life?

How do you feel about the support you have received during the course of your PhD?

Health and Wellbeing

Would you say you have maintained a work-life balance?

How do you feel completing a PhD impacts on your health and wellbeing?

Appendix 8: Participant Information and Consent LP and Control

Participant Information and Consent

Background

Metacognition can be defined as "thinking about thinking", the awareness and regulation of our cognitive processes. Metacognition has been strongly supported as a key contributor to academic performance. It is no surprise, therefore, that metacognitive improvement programmes are being increasingly common. There are limitations, however, in the level of education these programmes are designed for. This study aims to examine the student experience of doctoral students and the impact of metacognitive awareness on their studies. The study aims to explore the role metacognitive improvement programmes can play in improving academic performance in postgraduate education.

Procedure

Participants will complete a semi-structured interview with the researcher. The interview will take place within the University of Stirling Psychology department. The interviews are expected to last between 30 minutes and 1 hour. The interview will be audio recorded with the participant's consent. Interview data will be transcribed. All data will be completely confidential and, should the study be published, the data will be anonymised. Participation is completely voluntary, and you have the right to withdraw from the study at any time. You have the right to refuse to answer any questions; however, it would be most beneficial to the study if you could answer all questions as honestly as possible.

Please read the statements below carefully. If you consent to participation in this study, please sign below.

1. My participation is voluntary, and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.
3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.
5. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read the statements above and consent to participation in this study.

Signature _____ Date _____

Counter-signature _____ Date _____

Appendix 9: Participant Information and Consent, Problem Solving in Peer Groups

Background

Metacognition can be loosely defined as "thinking about thinking", the self-regulation and awareness of one's cognitive processes. The role of metacognition in academic performance has been supported through an abundance of literature, suggesting that metacognition is key to independent learning. However, the current literature only examines metacognition from an individualistic perspective, ignoring the prevalence of social learning in our ability to problem solve. This study aims to examine how social interaction impacts on problem solving ability.

Procedure

You as the participant will be asked to complete the Tower of Hanoi task. Participants are presented with a puzzle consisting of three pegs with 7 disks on one of the pegs. The participants must transfer all of the disks from a source peg to a goal peg. However, there are 2 rules; only one disk can be moved at a time, and a larger disk cannot be placed on a smaller one. The time taken and the number of moves taken to complete the puzzle will be recorded. You will be asked to speak aloud during the session, talking through the decisions you make to complete the puzzle. The session will be recorded with your permission.

Participants have the freedom to withdraw at any point during the study. Any questions regarding the study will be answered prior to commencement. Should this study be published, all data will remain anonymous and confidential.

Consent

Please read the following statements carefully and sign below if you consent to participation in this study.

1. My participation is voluntary and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.
3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.

5. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read the above statement and consent to the participation of this study

Signature _____ Date _____

Countersignature _____ Date _____

Appendix 10: Participant Information and Consent Identifying the Appropriate Other

Researcher Information

My name is Danielle Kelly and I am a PhD candidate within the Division of Psychology, University of Stirling. My research focuses on problem solving and how we learn from others.

Aim of the Proposed Research

The research aims to determine whether we can identify the errors of others in problem solving tasks. By identifying how we learn, we aim to implement this into teaching practices to help undergraduates be able to identify their own errors more effectively, and become more academically successful.

Procedure

Within this study, you will be first be asked to complete 2 questionnaires; one measuring learning strategies and another measuring personality traits. You can omit any questions you do not wish to answer, however it would be most beneficial to the study if you could answer as many as possible. You will then be asked to view a set of route planning exercises completed by someone else. During the exercise, the person is asked to find the most efficient route from the first point through all other points, ending back at the initial point. We would like you to tell us when you think the student has made a mistake (when they could have chosen a more efficient route) by clicking on the key identified by the researcher. The study should take roughly 45 minutes. Once you have finished, please advise the researcher. Your participation in this study is completely voluntary. You have the right to withdraw at any time. You do not have to answer anything you do not wish to answer. If you are a psychology student that requires psychweb credits, you will be awarded 1 psychweb credit for your participation.

Should you have any further questions, please feel free to ask the researcher before beginning the study. Please read the statements below and sign to consent to your participation if you are happy to continue.

1. My participation is voluntary and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.

3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.
5. I am aware that the study will be video recorded for transcription purposes only.
6. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read and understood the above statements. I consent to participate in this study.

Participant Signature _____ Date _____

Countersignature _____ Date _____

Appendix 11: Participant Information and Consent Metacognition and Perspective Taking (Online)

Metacognition and Perspective Taking: Do you Know What Your Friend is Thinking?

Metacognition is known as "thinking about thinking", the awareness and regulation of our basic cognitive processes. Metacognition has been significantly linked to improved academic performance through a number of behaviours including problem solving, task perception and perspective taking. The majority of these behaviours, however, have only been looked at from an individualistic perspective. Relatively little is known about how social processes impact on these behaviours.

This study aims to look at how undergraduates understand the perspectives of their peers. You will be asked to answer a questionnaire consisting of 34 statements. The first 4 statements are practice questions. For each statement, you will be asked to provide three answers; what you think, what you think your peer group thinks, and what you think they think you think. The questionnaire will take roughly 30 minutes to complete. You will be debriefed in your pairs after you have finished the questionnaires. 1.5 Psychweb credits will be awarded for completion should you require them.

Participation in this study is completely voluntary. You can withdraw at any time. You do not have to answer all questions, however it would be most beneficial to the study if you could do so. All data will remain completely confidential.

Please read the following statements. Please tick the box below and provide your signature if you understand them and consent to your participation.

1. My participation is voluntary and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.

3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.
5. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read the above statement and consent to the participation of this study

_____ ☐

The researcher would also like permission to access programme grades for the participants to allow comparison with questionnaire data. Again, this information will remain strictly confidential and, in the instance of publishing, only group data will be reported on. No individual will be identified. If you will consent to the researcher accessing your grades, please tick the box below;

I agree to allow the university to provide the researcher with my name, contact details and grades for my programme of study. I also agree that this information, and the data collected from me, may be held and processed by the research/ supervisory team for the purposes of research ☐

Appendix 12: Participant Information and Consent for Investigating the Complexities of Academic Success; Personality and Metacognition as Predictors of Academic Success (online)

This project aims to examine the role of metacognition in enhancing academic success, and how metacognitive development could assist in improving academic performance. Metacognition can be defined as "thinking about thinking", and previous research has suggested that metacognitive ability is a strong predictor of academic success. The study also aims to determine whether personality can mediate the relationship between metacognition and academic performance.

The following questionnaire attempts to gather data on demographic information such as age, gender, year and programme of study. Data on metacognitive ability and personality factors will also be collected. The following information could help influence policy and help develop metacognitive training in academia to promote academic success.

Please read the following statements. Please tick the box below if you understand them and consent to your participation.

1. My participation is voluntary and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.
3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.
5. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read the above statement and consent to the participation of this study ☐

The researcher would also like permission to access programme grades for the participants to allow comparison with questionnaire data. Again, this information will remain strictly confidential and, in the instance of publishing, only group data will be reported on. No individual will be identified. If you will consent to the researcher accessing your grades, please tick the box below;

I agree to allow the university to provide the researcher with my name, contact details and grades for my programme of study. I also agree that this information, and the data collected from me, may be held and processed by the research/ supervisory team for the purposes of research ☐

Appendix 13: Participant Information and Consent: Measuring Discrepancies in Measurement

This project aims to examine the relationship between metacognition and personality. Metacognition can be defined as "thinking about thinking", and previous research has suggested that there is an existing relationship between our personality and our metacognitive ability. The current research aims to determine whether the previous findings are a result of an existing relationship between the two factors, or whether the reliability of the measurements used should be in question.

The following questionnaire attempts to gather data on demographic information such as age, gender, year and programme of study. You will be required to complete two questionnaires. The first questionnaire focuses on cognitive and metacognitive strategies used to learn, the second questionnaire will focus on your personality.

Your participation in this study is completely voluntary. You have the right to withdraw at any point. You have the right to omit from answering any questions you do not wish to answer. Should this data be published, all data will be anonymised and completely confidential.

Please read the following statements. Please tick the box below if you understand them and consent to your participation.

1. My participation is voluntary and I may cease to take part in this study at any time, without penalty.
2. I am aware of what my participation involves.
3. There are no risks involved in the participation of this study.
4. All of my questions about the study have been satisfactorily answered.
5. Should this study be published, all data will be treated with full confidentiality and participants shall remain anonymous.

I have read the above statement and consent to the participation of this study ☐

Appendix 14: Participant Information and Consent Using Metacognition as a Tool for Student Transitions

Metacognition as a Tool for Successful Learning: Improving Student Transitions between Secondary and Higher Education.

Researcher Information

My name is Danielle Kelly. I am a PhD candidate within the Psychology department of Stirling University examining the role of metacognition in enhancing academic success within higher education. I would like to invite you to take part in a study evaluating a proposed intervention to help enhance metacognitive ability for secondary school students. This leaflet will explain the research to help you and the students decide if you would like to participate.

Background

The Scottish National Curriculum for Excellence in Scotland identifies four key capacities: students should be 1) successful learners, 2) confident individuals, 3) responsible citizens and 4) effective contributors. The initiative suggests that these capacities are necessary for children to be successful in life, not just in education. One key factor linked to successful independent learning that is identified by the National Curriculum for Excellence is metacognition. Metacognition is defined as "thinking about thinking", the awareness and regulation of our thinking to become more efficient learners. Research has demonstrated the importance of metacognition in improved academic performance for all levels of education. Currently, students are finding the process of transitioning between secondary and higher education difficult. This is partially because of the drastic change in environments. Students are moving from a classroom-based environment in high schools to an environment much more focused on independent

learning. Secondary school students find the change difficult because they do not necessarily have the skills essential to do well at university. By improving metacognition, we help students learn to adapt to a new environment with the skills necessary to perform well at undergraduate level.

Aims

This study aims to improve three metacognitive behaviours in secondary school students key to academic success in higher education; self-reflection, self-awareness and problem solving. The project also aims to determine whether the proposed intervention will improve students' experiences of transitioning into university.

Method

The purpose of this study is to introduce an intervention designed to help students improve their problem solving skills, enhance self-reflection, and encourage students to further develop their self-awareness. The intervention is based on the action learning cycle, a process designed to encourage people to reflect on their problems and consider alternative and more effective solutions. The full The study will consist of an experimental group, which will take part in the initial stage of the intervention, and a control group, which will provide information as a comparison to the academic performance of the experimental group.

Your child has been chosen to be part of the experimental group, and therefore will be asked to take part in the initial stage of the intervention. The students recruited for the project will be divided into groups of 5. The students will attend one session a week for 40 minutes for 8 weeks (15th September to 24th November, excluding school holidays and in-service days). Students will take part in these sessions during tutorials designed to help improve on their weakest subject. During the first session, ground rules for the groups will be discussed such as confidentiality, respect for other participants and engagement with the project. During the following 6 sessions, students will be asked to present with a problem they need to work through. The problem could be relevant to their topics as they will be arranged by class, or a more general problem such as time management. The students will then be asked to work through the Action Learning Cycle (Beaty, 2003). Details on this process are provided on an additional sheet. Please read through this carefully.

A teacher will be present at each session to ensure that students have accurate information, should it be required.

The 8th session of the project will be used to collect data on the experiences of the students and debrief them fully on the purpose of the study. The students will also be asked to complete an anonymised questionnaire to allow them to voice their opinions honestly without worrying about identification.

The purpose of the study is to determine the impact of this intervention on students' academic performance. Therefore, the researcher asks for consent to access students' grades from their previous exams (National 5s), their predictive grades for their preliminary Highers, and the actual grades for their preliminary Highers once these become available. Again, this data will be used for analysis only and will be completely confidential and anonymised.

Outcomes

The intervention aims to develop enhanced problem-solving skills which will help students transition more smoothly into higher education. The study also aims to encourage students to take responsibility for their own learning. The intervention should improve students' self-awareness of their own strengths and weaknesses, and also improve their confidence in dealing with future problems. By improving these skills, their academic performance should also improve.

Ethical Implications

Every precaution will be taken when working with the students. The study will be ethically approved by Stirling University Ethics Committee prior to commencement. Students should be aware that participation is not compulsory and that they can withdraw at any time. The students will be fully informed of what participation requires. Participants will be asked to consent to the audio-recording of their sessions. The data from these recordings will be destroyed once transcriptions are completed. All data collected for the duration of the study will be completely confidential and anonymised. Should the data be published, group data only will be reported on. No individual student shall be identified. Data will only be stored until analysis is complete, at which point it will be destroyed.

Contact

Should you have any questions regarding the study, please feel free to contact the researcher, Danielle Kelly, on the email address dk29@stir.ac.uk at any time, or on the number 01786466853 Monday to Friday 9am-5pm.

Consent

Please read the following statements carefully and sign below of you consent to your child's participation in this study.

1. I am aware that participation in this intervention is voluntary and that my child may cease to take part in this study at any time, without penalty.
2. I am aware of what my child's participation involves.
3. All of my questions about the study have been satisfactorily answered.
4. Should any study based on this intervention be published, all data will be treated with full confidentiality and will be anonymised.
5. I am happy for the intervention to be audio-recorded
6. All recorded data will be destroyed once the data has been transcribed and anonymised.

Parent/ Guardian consent

I consent to my child's participation in this study

Print Name _____

Signature _____ Date _____

Student Consent

I consent to my participation in this study

Print Name _____

Signature _____ Date _____

Access to Grades

We would also like consent to access your child's grades as a measurement of academic performance as mentioned above. If you consent to researchers accessing your child's grades, please sign below. **Your child can still participate in the intervention should they choose to refuse access to their grades.**

Parent/Guardian consent

I consent to allowing the researchers access to my child's grades

Print Name _____

Signature _____ Date _____

Student Consent

I consent to allowing the researchers access to my grades

Print Name _____

Signature _____ Date _____

We would like to thank you for your time. We hope that your participation in this study will provide students with the necessary skills to succeed at an academic and a personal level. We look forward to working with you.

Yours sincerely,

Danielle Kelly,

PhD Candidate,

Psychology Department, School of Natural Sciences,

University of Stirling, FK9 4LA.

Email: dk29@stir.ac.uk

Phone: 01786466853