THE ROLE OF COGNITIVE-AFFECTIVE FACTORS IN UNDERACHIEVEMENT

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There is converging evidence on the strong relationship between working memory capacity and mathematical performance. Test anxiety is a potential moderating factor involved in the relationship between working memory and academic performance. Based on Eysenck and Calvo’s (1992) Processing Efficiency Theory the present study investigated whether associations between working memory and educational achievement in mathematics were moderated by test anxiety. 624 children aged 9-10 years completed verbal, spatial, and complex working memory tasks. Test anxiety was measured using the Children’s Test Anxiety Scale (Wren & Benson, 2004). Mathematical performance was assessed using the Swedish national test in mathematics.

INTRODUCTION

Working memory (WM) skills are positively associated with academic performance (Gathercole et al., 2006). In contrast, high levels of test anxiety (TA) are linked with educational underachievement (Owens et al., 2008). The Processing Efficiency Theory (PET), revised and updated within the more recent Attentional Control Theory (ACT) (Eysenck et al., 2007) have been put forward to explain the relationship between anxiety and performance. PET draws on two major components to explain the effects of anxiety on performance. The first relates to the role of worry in the interference of cognitive functions, and the second relates to the mechanisms of WM affected by anxiety. ACT assumes that anxiety impairs attentional control, a key function of the central executive.

TA is believed to be a learned condition, evoked early on in educational settings (Pekrun, 2000). It is a very circumscribed condition (Rothman, 2004) that may be a major factor weakening academic performance at all levels (Birenbaum & Gutvirtz, 1993). The construct of TA can be conceptualised as multi-dimensional, and test-anxious individuals characterised by their thoughts, somatic reactions, feelings, and observable behaviours in evaluative situations (Zeidner, 2007). Even if a certain level of TA most likely improves one’s academic performance through increased focus, motivation and preparedness (Gregor, 2005), in too high levels it affects a pupil’s result of academic performance in a negative way (Zeidner, 2007), especially in mathematics (e.g. Putwain, 2008).

WM is a significant factor in academic performance and development in both children and adults (Menon, 2010). The majority of pupils with learning difficulties in school seem to have poor WM skills (Gathercole et al., 2006). Mathematics includes domains that depend upon different intellectual abilities (e.g. calculation, problem solving), which in turn relate to separate components of the WM
Despite substantial investigation into the relationship between subcomponents of the WM and academic ability, there is no consensus in research on which of the subcomponents that is most active in mathematical achievement in general or in different mathematical subareas (Kyttälä et al., 2010).

The most influential theory of WM is Baddeley’s multi-component model. Of significance for this model is the existence of specialised components for dealing with different aspects of WM activity. At the centre of the model is the master module, the central executive (CE), which is responsible for overall control, the monitoring of information processing across informational domains and functions that include the retrieval of information from long-term memory and attention control. The CE is supported by two active storage systems that are utilised in the retention and manipulation of modality-specific information. The visuospatial sketchpad (VSSP) supports visual and spatial material and the phonological loop (PL) is utilised for non-spatial, mainly linguistic, material (Baddeley, 1986).

The effects of TA are indirect, i.e. it only affects by impairing the cognition processes involved. Cognitive interference, thus, can be said to be symptomatic of TA (Swanson & Howell, 1996). A key commonality between ACT and PET is the assumption that the effects of anxiety on cognitive processing center on the CE component (Eysenck et al., 2007). However, which requiring resource (i.e. CE, VSSP, PL) being particularly impaired by anxiety is not fully established (cf. Miller & Bichsel, 2004).

In accordance with Ashcraft and Kirk (2001) the model attend to in present study is more simplified and based on the overall model of the anxiety-performance relationship in cognitive tasks, accordingly we assess the more general prediction that test anxiety disrupts WM processing that is crucial in mathematical performance. The theoretical component in PET is worry but since TA is believed to be the product of a dynamic interplay among worry and emotionality (Rothman, 2004), additionally worry might not be the major component in children’s experience of TA (e.g. Nyroos et al., 2012), thus the moderating factor in the model used here is not restricted to the worry subcomponent but include autonomic reactions and off-task behaviours. Further, when it comes to children it is unclear how the components of the WM contribute to different operations in mathematics (Raghubar et al., 2010).

We hypothesise that TA will moderate the relationship between WM and math performance, i.e. this relationship will vary as a function of TA. We will utilise structural equation modeling techniques to test our hypothesis.

624 Swedish children aged 9-10 years were administrated a WM assessment comprised of three tests: (forward- and backwards digit span; tapping the PL/CE), spatial (Corsi blocks; tapping the VSSP/CE), and complex (storage, recall, and processing; WM capacity); and the Children’s Test Anxiety Scale (Wren & Benson, 2004). The results for these children in the national examination in mathematics will be collected this Spring. Preliminary analyses of the WM and TA measures indicate
that a model consisting of a general Working Memory Capacity (WMC) factor and a
general Test Anxiety (TA) factor fit the data very well, $\chi^2(19)=21.669, p=.30;$
CFI=.997; TLI=.996; RMSEA=.015. As expected the correlation between the TA-
factor and WMC-factor is negative ($r=-.22$). In NORSMA7 we will present results
based on the full model where math performance is predicted by WMC, TA and a
latent interaction variable (to test the moderating effect).

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