Dynamic testing and excellence: unfolding potential

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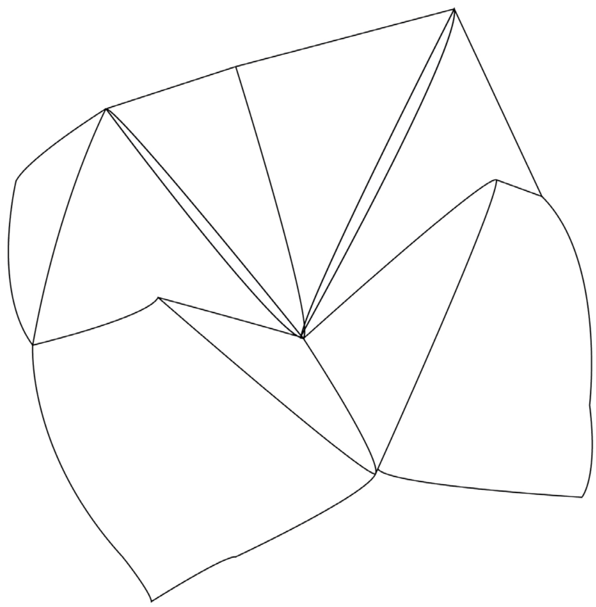
CHAPTER 1

General Introduction



In many countries, gifted and talented children have long been "forgotten" in education. Educational professionals have commonly held the view that these children would manage on their own, and would not benefit from additional help or extra attention (Persson, 2010). Recently, however, more attention is being paid to gifted learners in education, in general as well as in relation to their educational needs (Swanson, 2016; VanTassel-Baska & Stambauch, 2005). In order to be able to cater to gifted learners' educational needs, reliable and valid identification of gifted students is key. Although some researchers and practitioners have argued that static measures of intelligence are inadequate for these purposes (Lohman & Gambrell, 2012; Worrell & Erwin, 2011), shortened measures of intelligence are often used in identification of giftedness (Nisbett, 2009; Pierson, Kilmer, Rothlisberg, & McIntosh, 2012).

Conventional, static tests are, however, said to capture only part of cognitive functioning (e.g., Elliott, 2003; Lohman & Gambrell, 2012). Moreover, these tests are believed to measure previous learning experiences, which do not always correspond with children's cognitive potential (Sternberg & Grigorenko, 2002). Research has suggested that some children are disadvantaged when taking these tests, including those with a low socio economic status, a different cultural background, special needs (Robinson-Zañartu & Carlson, 2013), or test anxiety (Meijer, 1996). Moreover, static tests are primarily focused on testing outcomes, taking into account psychological processes involved in learning only indirectly (Jeltova, Birney, Fredine, Jarvin, Sternberg et al., 2007). This seems in contrast with the aim of gifted education, and education in general: unfolding and maximising talent and potential of each individual child (Nicpon & Pfeiffer, 2012). Gaining insight into how an individual (gifted) child learns, and what conditions are optimal for this child to demonstrate his or her potential therefore seem a necessity. This notion seems even more salient, as practitioners and educational professionals have voiced concerns that tailoring to the needs of gifted learners often proves difficult, which could ultimately result in loss of cognitive potential (Ryan & Coneybeare, 2013).

Different from static testing, which primarily measures previous learning, dynamic testing is focused on what children can learn in a short time-frame, by intertwining feedback and instruction in the testing process (Elliott, 2003). In that sense, it is considered to measure children's potential for learning (Elliott, Grigorenko, & Resing, 2010). As learning new skills is an important part of a dynamic test, this form of testing seems a promising tool for gaining insight into aspects and processes that play a role in learning (Resing, 2013). This thesis aimed to provide more insight into the processes and cognitive aspects playing a role in the learning process of children in general, and gifted children in particular.

Dynamic testing

Dynamic tests exist in many different forms, but they all have in common that they provide instruction, help, or feedback as part of the testing procedures, and, in doing so, are aimed at structured measuring of children's progression in learning (Sternberg & Grigorenko, 2002). This is one of the main objectives of dynamic testing, while providing insight into the type of help a child needs in order to learn is another key objective (Resing, 2013). Generally speaking, there are two dynamic testing formats: the cake, and the sandwich format (Sternberg & Grigorenko, 2001). As part of the cake format, a child is offered help, item by item, as soon as he or she experiences a substantial difficulty in solving a task. The sandwich format, also known as the pre-test-training-post-test design, is used in the current thesis.

Whereas some dynamic tests offer tailored, individual prompts, help, or feedback, other tests provide standardised instruction. In this thesis, children were provided with standardised prompts during the training phase based on graduated prompting principles. Graduated prompting has repeatedly shown to lead to progression in learning (Bosma & Resing, 2006; Ferrara, Brown, & Campione, 1986; Resing, 2013; Resing & Elliott, 2011). Graduated prompting refers to a form of training as a part of which children are provided with a prompt as soon as they experience a significant difficulty in solving a task (Campione & Brown, 1987; Resing & Elliott, 2011). In the studies that are part of this thesis, prompts were tailored to each test item, and provided hierarchically; ranging from very general metacognitive prompts, to task-specific cognitive prompts, to modelling (Resing, 2000). Providing these prompts in a hierarchic fashion enables measuring of different degrees of help each individual child needs in order to demonstrate learning.

Different measures are used as potential for learning measures, including the amount and the type of feedback received during training, performance after training, the change in performance from the pre-training to the post-training stage, and the transfer of learned skills (Elliott et al., 2010; Sternberg & Grigorenko, 2002). Examination of these different dynamic measures has revealed that there is great variability between, but also within, children in relation to their instructional needs (e.g., Bosma & Resing, 2006; Jeltova, Birney, Fredine, Jarvin, Sternberg et al., 2011), their level of improvement (e.g., Fabio, 2005; Resing & Elliott, 2011), and the degree to which they could transfer their learned skills (e.g., Resing, Bakker, Pronk, & Elliott, 2016; Tzuriel, 2007).

Dynamic testing of analogical reasoning

Many dynamic tests employ inductive reasoning tasks (e.g., Ferrara et al., 1986; Resing, 2013). Inductive reasoning has been noted for its central role in a variety of cognitive skills and processes (Csapó, 1997), such as general intelligence (Klauer & Phye, 2008), problem-solving (Richland & Burchinal, 2012), and acquisition and application of knowledge (Goswami, 2012). Inductive reasoning has been found to develop throughout childhood, during primary and secondary school (Csapó, 1997; Molnár, Greiff, & Csapó, 2013). In the studies part of this thesis, visuo-spatial analogical reasoning matrices were employed of the type A:B::C:?. These tasks were utilised, as opposed to more traditional scholastic tasks, for example in the domains of reading or maths, as these skills are often taught in several gradations with differences between schools being apparent. Measuring these skills would, therefore, require using a multitude of different dynamic tests. Analogical reasoning, a subtype of inductive reasoning, is said to play an important role in children's everyday learning (Richland, Morrison, & Holyoak, 2006). Moreover, research has shown that performance on analogical reasoning matrices, such as those used in the current thesis, is associated with scholastic achievement (Balboni, Naglieri, & Cubelli, 2010), as well as individual differences in IQ scores, as well as in fluid intelligence (Caropreso & White, 1994; Vendetti, Wu, & Holyoak, 2014).

Giftedness

Dynamic testing has originally been developed as a response to the fact that the cognitive abilities of children with special educational needs, or those with disadvantaged educational experiences, were not captured adequately by traditional testing instruments (Sternberg & Grigorenko, 2002). It is, therefore, not surprising that the vast majority of studies into dynamic testing have focused on such special groups of children. Over the past few decades, however, a few studies have been conducted in which dynamic testing was utilised to assess the cognitive abilities of gifted children. The focus of most of these studies was on identification of giftedness in ethnic and linguistically diverse populations for participation in gifted programmes (e.g., Lidz & Macrine, 2001; Matthews & Foster, 2005). Research further suggests that gifted children have a broader zone of proximal development, and demonstrate higher transfer rates (Calero, García-Martín, & Robles, 2011; Kanevsky, 1995, 2000). Moreover, Kanevsky (2000) concluded that the learning of gifted children was characterised by high levels of motivation, metacognition, self-regulation, and cognitive flexibility. Studies that systematically compare the cognitive abilities of gifted and typically developing children by means of dynamic testing are, however, scarce.

Although increasingly more attention is currently being paid to gifted children (see Dai, Swanson, & Cheng, 2011 for an overview), generalising research findings to practical solutions for identification and education of gifted children has revealed to be challenging (VanTassel-Baska, 2006). Researchers and practitioners alike have voiced their concerns in relation to the fact that there is no consensus on a definition of giftedness (Dai & Chen, 2013; Nicpon & Pfeiffer, 2011). Over the past century, there has been a shift in the general view that giftedness is not a unidimensional, but rather a multidimensional construct. While in one of the first definitions, giftedness was equalled by an IQ of at least 140 (Terman, 1925), already in the 1970s, although expanded on in more recent years (e.g., Renzulli, 2005; Renzulli & D'Souza, 2014; Renzulli & Sytsma, 2008), Renzulli (1978) noted that giftedness occurs in the interplay of above average cognitive capacities, creativity and task persistence.

At the beginning of the 21st century, definitions of giftedness started to emerge that also took into account interaction with the environment, and sociocultural content (Barab & Plucker, 2002). One of the most recent developments in the conceptualisation of giftedness is the model posited by Subotnik, Olzewski-Kubilius, and Worrell (2012) who define giftedness as

"performance that is clearly at the upper end of the distribution in a specific talent domain even relative to other high-functioning individuals in that domain. Further, giftedness can be viewed as developmental in that in the beginning stages, potential is the key variable; in later stages, achievement is the measure of giftedness; and in fully developed talents, eminence is the basis on which this label is granted" (p. 176).

As stated above, there is a gap between practice and research in relation to the identification and conceptualisation of giftedness (see e.g., Nicpon & Pfeiffer, 2011). In the USA, for instance, in most states giftedness is identified by an IQ test score only, and cut-off scores of at least the 90th or 95th percentile are common (McClain & Pfeiffer, 2012). The American National Association for Gifted Children (NAGC) considers individuals as gifted when they demonstrate outstanding reasoning and learning abilities or competence, operationalised as performance in – at least – the top 10% region, in one or more domains (NAGC, 2010). In addition, teacher nominations are frequently used to determine whether a child is gifted and should be placed in special settings for the gifted (Kornmann, Zettler, Kammerer, Gerjets, & Trautwein, 2015; Threlfall & Hargreaves, 2008). Participants in the studies in this thesis were selected randomly from primary schools in the western part of the Netherlands. Gifted children were oversampled, and were all enrolled in special settings for gifted and talented children in the western part of the Netherlands. The selection criteria for participating in the studies in this thesis consisted of parents' and teachers' nominations, in addition to their enrolment in these settings. In addition, the children participating in the studies described in Chapters 3, 4, and 5, in accordance with the NAGC, were found to have a percentile score of at least 90 of the Raven Standard Progressive Matrices Test (Raven, 1981). As described above, although various factors play a role in the conceptualisation of giftedness, in this thesis only cognitive factors are considered.

Developing Expertise Model

An alternative view on giftedness was posited by Sternberg (1999, 2001; Sternberg, Jarvin, & Grigorenko, 2011), who views giftedness as developing expertise. In his model of developing expertise, which links the measurement of potential for learning with giftedness, learning new abilities is similar to the development of expertise. Sternberg's model posits that five elements, metacognition, motivation, knowledge, thinking, and learning itself, play a role in becoming an expert. These elements are interactive, influencing each other both directly and indirectly. Through practice, a novice can become an expert in a specific learning context. Sternberg (2001) further proposed that giftedness equals an exceptional ability to develop expertise, within a zone of proximal development, on the basis of existing or developing abilities and skills. In his view, gifted children have greater potential for developing expertise, they develop expertise at a faster rate, to higher levels, or to qualitatively different levels than non-gifted children.

In this thesis, the relationship between a number of the factors described in the Developing Expertise Model and dynamic testing outcomes were examined; specifically two aspects of executive functioning, cognitive flexibility and metacognition, as well as the ability to generalise knowledge and skills (transfer). Moreover, it was investigated whether test anxiety would be related to these test outcomes.

Executive functioning

Executive functioning plays a central role in developing expertise, as posited in Sternberg's Developing Expertise Model. In line with his model, gifted children are often said to have an executive functioning advantage (Arffa, 2007). Executive functioning is an umbrella term used to refer to a number of complex cognitive processes enabling conscious control of thought and action that are critical to purposeful, goal-directed behavior (Monette, Bigras, & Guay, 2011). Executive functioning is deemed important when learning new skills (e.g., Diamond, 2013) and has been found to be a predictor of academic success (Viterbori, Usai, Traverso, & De Franchis, 2015).

Measuring executive functioning is often considered as challenging (e.g., Miyake et al., 2000; Viterbori et al., 2015). In general, two types of instruments are used to obtain measures of executive functioning: (self and informant) rating scales and performance-based tasks. A difficulty of measuring executive functioning is that most performance-based tasks have originally been developed for adults (Isquith, Crawford, Andrews Espy, & Gioia, 2005). Using these instruments for children has several implications, particularly when taking into account the developmental nature of executive functions. Studies have indicated that executive functions develop throughout childhood until late adolescence (Gathercole, Pickering, Ambridge, & Wearing, 2004; Huizinga, Dolan, & Van der Molen, 2006). In addition, some researchers have also noted that rating scales do not always fully capture children's executive functioning (e.g., Sadeh, Burns, & Sullivan, 2012). Due to these reasons, researchers recommend the use of various instruments when assessing executive functions (Toplak, West, & Stanovich, 2013). In the present thesis, the influence of cognitive flexibility, the ability to be flexible in adjusting thinking to meet changing demands (Diamond, 2013), measured by means of a performance-based task, and metacognition in general, measured by a teacher rating scale, was examined in relation to static versus dynamic measures of analogy problem-solving.

Test anxiety

In addition to elements that facilitate learning and the development of expertise, there are also factors that may hinder learning. One of these factors is test anxiety. The adverse effects of test anxiety on cognitive performance have been well-documented, ranging from, for instance, scholastic achievement (e.g., Segool, Carlson, Goforth, Von der Embse, & Barterian, 2013), to intelligence testing (e.g., Hopko, Crittendon, Grant, & Wilson, 2005; Meijer, 1996, 2001). Test anxiety has even been described as one of the causes of underperformance of various learners, including gifted children (e.g., Reis & McCoach, 2010). It is estimated that 10 to 40 per cent of all students have experienced clinical levels of test anxiety (Segool et al., 2013). It has been stated in the literature that in the gifted population, test anxiety is less prevalent; these children are assumed to have higher intellectual coping resources that may lead to them coping better in stressful academic situations (Zeidner & Shani-Zinovich, 2011).

Test anxiety is commonly measured by means of self or informant report scales (e.g., Wren & Benson, 2004). Some research, using self-report measures, has suggested that testing children dynamically rather than statically resulted in lower test anxiety levels in primary school children (Bethge, Carlson, & Wiedl, 1982). These researchers found that amongst third grade children, test anxiety seems to be diminished when children's ability to solve analogies was assessed dynamically. Research into the relationship between test anxiety and dynamic testing in gifted children, however, is scarce (for studies on test anxiety and dynamic testing, in general, see e.g., Bethge et al., 1982; Meijer, 1996; 2001). In this thesis, it was examined whether test anxiety, as measured by a self-report questionnaire, has a differential influence on static and dynamic measures of analogy problem-solving.

Transfer

Transfer is the ability to apply and adapt knowledge to a new context, and is an important goal of education (Day & Goldstone, 2012). In spite of the fact that transfer has been examined for more than a century (Engle, 2012), eliciting transfer of learning has proven to be difficult (Day & Goldstone, 2012). It is assumed that two specific factors are important in the effectiveness of transfer: the content and the context. The content refers to the actual content being transferred (Barnett & Ceci, 2002), whereas the context is used to denote the different domains from and to which transfer takes place (Klahr & Chen, 2011). Different types of transfer have been proposed, which are based on the extent to which the base and target problem share similarities (Barnett & Ceci, 2002). Often, transfer is classified in terms of near versus far transfer (Mestre, 2005), and surface versus deep transfer (Forbus, Gentner, & Law, 1995).

Although the underlying processes of transfer are still not fully understood, research suggests that successful transfer is associated with the extent to which an individual child mastered the task to be transferred (Siegler, 2006). Expertise, and a deep understanding of the task at hand seems to be required in order for deep transfer to be successful (Barnett & Ceci, 2002). Some studies suggested that gifted children outperform their average-ability peers with regard to the extent to which they demonstrate successful transfer (e.g., Klavir & Gorodetksy, 2001), but other studies have supported this conclusion only partially; on near transfer tasks gifted and average-ability children show similar rates of transfer (Carr, Alexander, & Schwanenflugel, 1996), while in other studies on far transfer tasks gifted children demonstrated superior transfer rates (Geake, 2008; Kanevsky, 2000). In the current thesis, transfer was investigated by utilising a 'reversal' procedure, in the form of an analogy construction task (e.g., Bosma & Resing, 2006; Harpaz-Itay, Kaniel, & Ben-Amran, 2006). The potential role of training on transfer success and effectiveness was investigated, as well as the roles of giftedness, and mastery of analogy problem-solving.

Outline of this thesis

The current thesis utilised dynamic testing principles to investigate potential differences between gifted and average-ability children in relation to their potential for learning, instructional needs, and their ability to transfer learned skills. A number of factors described in Sternberg's (1999; 2001; Sternberg et al., 2011)

Developing Expertise Model that possibly influence dynamic testing outcomes were examined, with a specific focus on executive functioning. Children's progressions in analogy problem-solving and analogy construction were considered, taking into account the roles that age, ability, executive functioning, and test anxiety played.

In Chapter 1, the studies that are part of this thesis were introduced, and a theoretical background for these studies was provided. In Chapter 2, dynamic testing principles were employed to examine potential differences in progression of analogy problem-solving of gifted and average-ability children of 5-8 years old. Taking into account age, it was investigated whether gifted and average-ability children demonstrated differential progression in analogy problem-solving, benefitted differentially from a dynamic training procedure, and showed differential instructional needs.

In Chapters 3 and 4, we further examined 7 and 8 year old gifted and average-ability children's progression in analogy problem-solving, using Linear Mixed Modeling analysis with a multilevel approach. In both chapters, the growth trajectories of children in the various conditions were investigated. In Chapter 3, the potential role of test anxiety was examined in relation to static and dynamic progression in analogy problem-solving. In Chapter 4, analogy problem-solving was examined in relation to two aspects of executive functioning: cognitive flexibility, as measured by a performance-based task, and metacognition in general, as measured by a teacher rating scale. Potential differences in instructional needs of gifted and average-ability children were further explored in this chapter.

In Chapter 5, the main focus was on children's transfer of analogy problem-solving, which was examined by means of an analogy construction task. Potential differences in transfer performance and the degree of transfer of analogy problem-solving of 9 to 10 year old gifted and average-ability children were examined. It was investigated whether ability, training and analogy problem-solving performance were associated with rates of transfer. In Chapter 6, the results of the studies part of this thesis were discussed, as well as the implications of the key findings for research, assessment and education, in particular in relation to gifted children.