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**This is the author version of article published as:**

Gilmore, Linda A. and Cuskelly, Monica (2005) The Measurement of Self-Regulation from Ages 2 to 8. In Gilmore, Linda A. and Cuskelly, Monica, Eds. *Proceedings 40th APS Annual Conference*, Melbourne, Australia.

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# The Measurement of Self-Regulation from Ages 2 to 8

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## Abstract

The development of the capacity for self-regulation represents a major achievement of childhood that is associated with social, behavioural and academic competence. Most research has focused on self-regulated academic learning in school-aged children and adolescents, neglecting developmental aspects of self-regulation. This paper reports a longitudinal study of 44 children from early to middle childhood. At age 2, the Goodman Lock Box provided information about the extent to which children's approaches were systematic and planful, as opposed to random, impulsive and disorganised. The same measure was used in a modified form at age 8, and two additional measures of planning and self-control were added: the Porteus Maze Test and the Grocery Shopping Task. At both ages, Lock Box competence was related to planfulness, and there was a significant correlation of Lock Box competence across the two ages. However, the various measures of self-regulation were unrelated. Several measurement issues are highlighted, in particular the difficulties associated with making assumptions about the intent and meaning of children's task behaviours.

## Introduction

Self-regulation has enduring implications for a range of cognitive, social and behavioural outcomes across the lifespan (Raffaelli, Crockett & Shen, 2005). Deficits in self-regulatory skills underlie, or contribute to, a diverse range of developmental problems and disorders including substance misuse (Dawes et al., 1999), eating disorders (Attie & Brooks-Gunn, 1995; Pelletier, Dion & Reid, 2004), attention deficit hyperactivity disorder (Barkley, 1997; Douglas, 2005; Kalff, de Sonnevill & Hurks, 2003), externalising behaviour (Caspi et al., 1995), and risk-taking behaviour (Cantor & Sanderson, 1998; Eisenberg et al., 2005). The benefits of effective self-regulation have been demonstrated consistently for successful learning outcomes (Cleary & Zimmerman, 2004; Eilam & Aharon, 2003; Howse, Lange et al., 2003), even in preschool children (Howse, Calkins et al., 2003). Social-emotional outcomes, such as coping and adjustment, are also enhanced by the capacity for self-regulation (Lengua & Long, 2002). One of the distinguishing characteristics of young people who demonstrate resilience in adverse circumstances is their better self-regulatory skills (Buckner, Mezzacappa & Beardslee, 2003).

The wide range of applications and the complexity of the concept of self-regulation mean that definitions are diverse. Common to most of them, however, are the core elements of control, reflection and planning. Diaz, Neal and Amaya-Williams (1990), for instance, refer to "the child's capacity to plan, guide and monitor his or her behaviour from within and flexibly according to changing circumstances" (p.130) while Raffaelli et al. (2005) define self-regulation as "the internally-directed capacity to regulate affect, attention, and behavior to respond effectively to both internal and environmental demands" (p.54).

While the importance of self-regulation for competence has been recognised and much research has focused on academic self-regulation in school-aged children and adolescents, less attention has been given to cognitive, behavioural and emotional self-regulation in younger children. Yet the development of self-regulation has been described as a cornerstone of early childhood development (Shonkoff & Phillips, 2000). During these early years, children's capacity for self-regulation is reflected in their implementation of strategies for waiting and for delaying gratification, in their use of private speech to guide actions, in their planning and problem solving activities, and in their attempts to control impulsive behaviours and emotions. Research has documented developmental progressions and individual differences in these areas (Berk, 1992; Bridges & Grolnick, 1995; Jones, Rothbart & Posner, 2003; Lawson & Ruff, 2004; Vaughn, Kopp & Krakow, 1984) and in some cases has shown relationships between early skills and later self-regulation and competence (Raffaelli et al., 2005; Silverman & Ragusa, 1992).

One of the most frequently researched measures of self-regulation in early childhood, delay of gratification, has been associated with later developmental outcomes including cognitive and academic competence (Shoda, Mischel & Peake, 1990). Although the ability to plan and to organise information is an essential component of self-regulation (Ellis & Siegler, 1994; Mischel & Patterson, 1978) and young children are capable of the sequential acts that form an important component of mature planning (Kopp, 1997), few studies have used the paradigm of planfulness to assess self-regulation in younger children. Planfulness refers to an individual's propensity to make and use plans to guide behaviour.

Planning involves a variety of cognitive, motivational and self-regulatory processes including task representation, working memory, focused attention, sequencing skills, monitoring and impulse control (Friedman & Scholnick, 1997). Despite evidence that planful behaviour is displayed by children as young as two years and improves with age (Cocking & Copple, 1987; DeLoache, Sugarman & Brown, 1985; Kopp, 1991), there are few established paradigms for studying young children's planning and organising abilities (Benson, 1997). During the preschool years, the main measures have been adapted versions of the Tower of Hanoi (e.g., Klahr & Robinson, 1981; Welsh, 1991) and variations of the shopping task (e.g., Gauvain & Rogoff, 1989; Hudson & Fivush, 1991). Both tasks evaluate children's ability to plan an organised sequence of moves in order to attain a goal. The Goodman Lock Box (Goodman, 1981) has also been used previously to provide information about young children's planning and organisation of an unstructured task. Difficulties with self-regulation are displayed in random, repetitive and purposeless movements with the Lock Box (Goodman & Field, 1991; Goodman, Fox & Glutting, 1986).

The current paper reports findings from a longitudinal study of children's self-regulation from early to middle childhood using multiple measures of planfulness. The specific aim was to investigate concurrent and predictive relationships of competence and self-regulation at ages 2 and 8.

## Method

### Participants

The participants were 44 typically developing children (20 girls) who were aged between 2 and 3 years (mean CA = 2 years 6 months) in the first phase of the study. All children were located when they were around 8 years of age (mean CA = 8 years 2 months, range 7 years 6 months to almost 9 years) and all children and their parents agreed to take part in the second phase of the study. At this later time, the children were in either grade 2 or grade 3 at school. The sample represented a range of levels of parent education. On an 8-point scale (1 = grade 10 and 8 = postgraduate study) mothers and fathers had mean education levels of 4.09 (SD = 2.56) and 5.10 (SD = 2.46), respectively.

### Measures

The *Goodman Lock Box* (Goodman, 1981) is a wooden box containing 10 compartments with hinged doors, each fitted with a different locking device (such as a sliding bolt, a latch and a belt buckle) which children unfasten to discover toys. The task has been used with children between 2 and 5½ years of age to provide information about the extent to which their task approach is systematic and planful, as opposed to random, impulsive and disorganised. Children are introduced to the task with the instruction "Here's a surprise box with doors to open and toys to play with". Behaviours such as sequential progression across the doors and use of a consistent pattern of moves are then coded over a 6½ minute trial. Goodman (1981) reported good inter-rater reliability (ranging from .74 to .99) and estimates for variables in the current study ranged from .81 to 1.00.

In order to provide a level of challenge appropriate for older children, the original Lock Box was modified in the second phase of the study by replacing the simpler locking devices with 10 identical padlocks, each of which could only be opened with its own unique key. This adaptation of the task enabled the child's planfulness to be observed in behaviours such as attempting each key with a single lock until successful, following an orderly sequence across the doors and separating keys that had already been tried on a particular lock from those not yet used. The Lock Box also provided competence measures (the number of doors successfully unlocked) at the two ages.

Two additional measures of self-regulation were used in the second phase of the study. The *Porteus Maze Test* (Porteus, 1965) is a well-established neuro-psychological measure of planning and self-control. The *Grocery Shopping Task* (Gauvain & Rogoff, 1989) consists of a roofless model supermarket with aisles containing grocery items. Following a trial run, children are given a list of items which they have to collect using the shortest possible route. Planning skills are assessed by their organisation of the shopping list (which consists of a set of individual picture cards identical to items on the shelves) and the efficiency of their route around the supermarket.

Cognitive competence was measured with the *Bayley Scales of Infant Development – Second Edition* (BSID-II) (Bayley, 1993) Mental Development Index (MDI) at age 2 and the Full Scale IQ (FSIQ) from the *Wechsler Abbreviated Scale of Intelligence* (WASI) (Psychological Corporation, 1999) at age 8.

### Procedure

At age 2, children attended the university where they completed the Goodman Lock Box task and the BSID assessment. At age 8, they returned for a session that began with the WASI, followed by the Lock Box, the Porteus Maze Task and the Grocery Shopping Task. All tasks were videotaped for later coding.

## Results

In preliminary analyses, gender differences and relationships with parent education were considered. At age 2, girls had significantly higher MDIs than boys,  $t = 4.36$ ,  $df = 42$ ,  $p < .001$ , but there were no gender differences on FSIQ at age 8. Neither were there gender differences on Lock Box competence or any of the measures of planfulness. With the exception of general competence, none of the measures was related to parent education. Father education

was significantly associated with MDI,  $r = .34, p < .05$ , and FSIQ,  $r = .36, p < .01$ , while mother education was significant only for MDI,  $r = .31, p < .05$ .

### **Concurrent relationships**

At both ages, planfulness on the Lock Box was significantly correlated with task competence,  $r = .39, p < .01$ , at age 2 and  $r = .46, p < .01$  at age 8. However, Lock Box competence and planfulness were unrelated to general competence MDI at age 2, FSIQ at age 8. At age 8, the Porteus Maze Task and the Grocery Shopping Task measures were unrelated to other concurrent measures. There were no other significant associations.

### **Predictive relationships**

Measures of general cognitive ability were significantly correlated across the two ages,  $r = .43, p < .01$ . In addition, competence on the Lock Box at age 2 was associated with later competence on the adapted Lock Box,  $r = .39, p < .01$ . Age 2 Lock Box planfulness was unrelated to all three measures of planfulness (Lock Box, Porteus Maze Task, Grocery Shopping Task) at age 8. No other significant correlations were found.

## **Discussion**

The findings of the present study suggest that planfulness is important for task competence, even in the early years of childhood and the first grades of schooling. Children who were more systematic in their approach to the Lock Box achieved greater success in unlocking the doors. By contrast, those who displayed a more haphazard style managed to open fewer locks. These children appeared to have difficulty imposing structure on the task. For instance, at the younger age they tended to move impulsively from one door to another with little sustained effort and, on the adapted Lock Box, they often failed to organise the keys efficiently to prevent the same ones being tried repeatedly in the same padlocks.

Although competence with the Lock Box was correlated at the two ages, the planning measures were unrelated. In addition, there was no consistency with the other measures of planfulness used at age 8. It is possible that planfulness is not a unitary trait and that young children are not equally planful in their approach to different types of tasks. It is also possible that the various measures of planfulness used in this study were tapping different, and relatively independent, aspects of self-regulation, or that various aspects of the task confounded the measurement of planfulness. For instance, the Porteus Maze Task requires fine motor skills and response inhibition, while the Grocery Shopping Task involves visual matching skills and spatial representation, as well as sequencing skills. It is possible, of course, that children *were* using a planful approach, but that their approach did not coincide with the one determined as optimum by the experimenters. Interpretations of particular task behaviours from an adult framework may at times misrepresent their intent and function for children. This measurement issue presents a significant challenge for researchers working with young children who are unable to explain the basis for their task approach. Methods that encourage children to talk aloud as they go about a task or that incorporate questioning about planning and decision making after the fact may address some of these concerns with older children but are unlikely to be effective with very young children.

The low correlations of the Grocery Shopping Task with other planning tasks at age 8 are likely to be related to the fact that very few children reordered their shopping lists when directed to choose the shortest route around the supermarket. This is surprising since Gauvain and Rogoff (1989) found that more planful children adopted a reordering strategy. However, their study differed from the present one in that the children worked collaboratively on the task with peers or adults. Perhaps such support is necessary for these more planful behaviours to emerge in young children. In the current study, most of the children who achieved higher scores for planfulness followed the order in which the shopping list was given. Lower scores resulted when children moved their shoppers up and down the aisles in search of a grocery item, rather than scanning the shelves for the correct location before moving. In retrospect, the addition of an initial instruction which pointed out that it was acceptable to rearrange the order of the items might have elicited more planful approaches.

The current study is limited by the measurement issues that were raised, and by the use of only one measure of self-regulation in the first phase. Lack of established methods for measuring self-regulation in this age group is a difficulty for this area of study, thus, developing effective measures of planning in early childhood is a priority for future research in this area. Some studies have used only a single questionnaire measure of self-regulation in early childhood (e.g., Raffaelli et al., 2005) but tasks such as the Lock Box and the Grocery Shopping Task appear to have the potential to provide meaningful insights into young children's self-regulatory skills. Both tasks are interesting for young children, and both offer researchers the opportunity to vary the task demands in various ways, for instance by including caregivers in order to examine the influence of scaffolding on children's planfulness. In particular, longitudinal studies have the potential to contribute valuable data to the growing knowledge base about the development of self-regulation across the early and middle years of childhood and its contribution to subsequent competence.

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