



Contents lists available at ScienceDirect

## Learning and Instruction

journal homepage: [www.elsevier.com/locate/learninstruc](http://www.elsevier.com/locate/learninstruc)

## Developmental progression in performance evaluations: Effects of children's cue-utilization and self-protection

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## ARTICLE INFO

## Article history:

Received 22 April 2016

Received in revised form

14 November 2016

Accepted 24 November 2016

Available online xxx

## Keywords:

Confidence judgments

Self-reward

Children

Development

Overconfidence

## ABSTRACT

To effectively self-regulate learning, children need to self-evaluate whether they meet learning goals. Unfortunately, self-evaluations are often inaccurate, typically, children are overconfident. We investigated two explanations for developmental progression in self-evaluations related to children's (48 5/6-year-olds and 53 7/8-year-olds) interpretations of performance: Improved reliance on item difficulty, and reduced sensitivity to self-protection biases. Self-evaluations were more accurate for 7/8-year-olds than for 5/6-year-olds. There was no developmental increase in reliance on item difficulty; even 5/6-year-olds made adaptive use of this cue. Both age groups were overconfident for incorrect responses, but were able to use performance feedback to improve confidence judgments. However, when self-rewarding, 5/6-year-olds were less likely to take negative performance feedback into account than 7/8-year-olds. The 5/6-year-olds were able to base confidence judgments on performance feedback, but did not use feedback to the same extent when self-rewarding. This may indicate that self-protective biases are an important cause of overconfidence in children.

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One of the most important developing skills in childhood is the ability to self-regulate learning (Lyons & Ghetti, 2013; McClelland & Cameron, 2012; Roebers, 2014, pp. 865–894). Adaptive self-regulation is goal-directed, that is, a person regulates learning in order to reduce the discrepancy between the learning goals and the current state of learning (Nelson & Narens, 1990). In order to adaptively self-regulate learning, a person should self-evaluate which tasks have and have not yet been mastered, plan and prioritize study tasks, differentially allocate attention and study time, use appropriate study strategies, and if needed, seek for help to complete tasks (Boekaerts, 1997; Vohs & Baumeister, 2011; Winne & Hadwin, 2008; Zimmerman & Schunk, 2001). To self-regulate learning in school, it is necessary that students can accurately self-evaluate whether they meet learning goals, whether their performance is correct or incorrect, and how many credit points they would receive for their performance from their teacher

(Schneider & Pressley, 1997). Importantly, the relation between such self-evaluations, self-regulation, and resulting performance is robust (Dunlosky & Rawson, 2012; Krebs & Roebers, 2010).

In school, children have to engage in a variety of self-regulatory actions in order to improve learning and performance. Even though the ability to adaptively self-evaluate and self-regulate learning develops until late adolescence (Steinbeis & Crone, 2016), pre-school children show emerging skills to engage in self-regulated learning such as self-evaluating which of their answers were and were not correct (Destan & Roebers, 2015, pp. 1–28; Roebers & Fernandez, 2002), and seeking help to achieve task goals (Coughlin, Hembacher, Lyons, & Ghetti, 2015). However, making accurate self-evaluations proves to be difficult for children and therefore self-regulation is often not adaptive, this has detrimental effects on academic performance (Artelt & Schneider, 2015; Hacker, Bol, & Bahbahani, 2008).

Failures with self-evaluations most often occur in the form of overconfidence when confidence is higher than justified by performance (Finn & Metcalfe, 2014). Especially young children are overconfident (Destan, Hembacher, Ghetti, & Roebers, 2014; Lipko, Dunlosky, Lipowski, & Merriman, 2012; Lipowski, Merriman, & Dunlosky, 2013). Although in general, a slight degree of

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overconfidence can improve motivation and task persistence (Shin, Bjorklund, & Beck, 2007), in education, extensive overconfidence has negative effects on the learning process. When students of various ages are overconfident, they prematurely cease studying, do not improve test items for which performance was incorrect, and choose inefficient study strategies (De Bruin, Thiede, Camp, & Redford, 2011; Destan & Roebbers, 2015, pp. 1–28; Krebs & Roebbers, 2010; Van Loon, De Bruin, Van Gog, & Van Merriënboer, 2013a). Together and consistently, overconfidence leads to less efficient self-regulation and ultimately to underachievement (Dunlosky & Rawson, 2012; Roderer & Roebbers, 2010; Serra & Metcalfe, 2009, pp. 278–298).

Most research on self-evaluation accuracy focuses on self-evaluations in adults (e.g., Dunlosky & Rawson, 2012; Griffin, Wiley, & Thiede, 2008). Unfortunately, reasons for children's inaccurate self-evaluations, and developmental factors underlying age-related differences, are yet poorly understood. With this study we aimed to shed light on the bases of children's self-evaluations, by investigating their ability to discriminate between correct and incorrect performance.

### 1. Self-evaluating performance in childhood

In the preschool years, children start to acquire insights into their own learning, and they begin to differentiate between items for which they are able and items for which they are unable to provide a response, suggesting an early but dichotomous concept of evaluating performance (Lyons & Ghetti, 2011, 2013). During the kindergarten years, the magnitude of overconfidence declines steadily (Lipko, Dunlosky, & Merriman, 2009; Roebbers, 2014), because children increasingly learn to be “less-than-absolutely certain” concerning incorrect performance. Age differences are most pronounced when self-evaluating uncertainty, suggesting that children learn to increasingly differentiate on a certain-uncertain continuum (Flavell, 2000). In the present study, we included kindergartners (5/6-year-olds) and 2nd graders (7/8-year-olds) to address the effects of development on self-evaluations. Children studied associated images, took a test, and after test-taking they self-evaluated their test performance by making confidence judgments (CJs), with which they indicated how sure they were that their response was correct. In line with research on children's self-evaluations (e.g., Destan et al., 2014), we expected that for both age groups, self-evaluations about the correctness of their answers would discriminate between correct and incorrect performance (Hypothesis 1a). Furthermore, we know that within the tested age range, strong developmental changes in accuracy of self-evaluations are observed (Roebbers, 2014; Schneider, Vise, Lockl, & Nelson, 2000). Therefore, older children were expected to discriminate more accurately than younger children when making self-evaluations (Hypothesis 1b). Moreover, after taking the test and giving CJs for each test response, children received objective feedback about the accuracy of their performance, and they gave Confidence Judgments when facing Feedback (hereafter CJ-FBs). Kindergartners are already able to take performance feedback into account; standards that show actual performance accuracy help them to improve self-evaluations and learning (Muis, Ranellucci, Trevors, & Duffy, 2015). Therefore, in the present study, feedback about performance accuracy was expected to improve self-evaluations for both age groups (Hypothesis 1c).

Importantly, besides investigating effects of development on self-evaluations, we aimed to address underlying reasons for this developmental progression. Self-evaluations are to a large extent determined by learners' interpretations of the difficulty of the task and invested effort (Koriat & Nussinson, 2009). Decreasing overconfidence might be due – at least to some extent – to children's

understanding that performance depends on the difficulty of the task. Further, it is important to note that young children may not yet understand the difference between effort and ability (Folmer et al., 2008; Nicholls, 1978); children younger than 8 years of age seem to be self-protective and base their self-evaluations more on the desire to be rewarded for their effort than on their evaluations of true ability and actual performance, and this may cause overconfidence (Folmer et al., 2008; Kurtz-Costes, McCall, Kinlaw, Wiesen, & Joyner, 2005; Miele, Son, & Metcalfe, 2013; Nicholls, 1978; Ruble, Eisenberg, & Higgins, 1994). Older children may have an increasing understanding that effort is not a sufficient prerequisite for correct performance. In the present study, we investigate to what extent developmental differences in self-evaluations are due to age differences in interpretations of item difficulty and effects of self-protective biases, by addressing these two distinct, but not mutually exclusive explanations.

### 2. Item difficulty cue-utilization in children

With the cue-utilization framework, Koriat (1997) has put forward the idea that accurate self-evaluating relies on the use of valid cues or heuristics, as for example fluency of memory retrieval (“The answer came quickly to my mind, so I am sure about the correct answer”) or the perceived ease of learning (“I have easily learned this material, so I will easily remember it, too”). In adults, valid cues have consistently been found to yield a strong influence on the accuracy of self-evaluations; at the same time, the use of invalid cues (such as using font size as a basis for judgments, Mueller, Dunlosky, Tauber, & Rhodes, 2014) plays a major role for explaining adults' failures in self-evaluations (Griffin et al., 2008).

According to the cue-utilization explanation, young children's self-evaluations are inaccurate because they do not consider the most valid task cues. Research on children's cue use is still in its early stages; the few existing studies suggest that the degree to which they rely on valid cues increases over the elementary school years. For example, there is an inverted relationship between retrieval fluency and confidence in children (the longer it takes children to come up with an answer, the less confident they are; Koriat & Ackerman, 2010), but this association is stronger in older compared to younger children. Similarly, the “easily-learned-easily-remembered” heuristic is present in children, but tends to be more influential for self-evaluations in older compared to younger children (Hoffmann-Biencourt, Lockl, Schneider, Ackerman, & Koriat, 2010). Thus, younger children may not yet be able to take valid cues into account, at least not to the same extent as older children and adults, and this may constitute a major reason for younger children's inaccurate self-evaluations.

For adults, awareness of the feeling of difficulty, an indicator of study effort due to the intrinsic cognitive load imposed by the task, is an important cue that gives an indication about whether performance might or might not be correct (DeLeeuw & Mayer, 2008). Older elementary school children, like adults, clearly base their self-evaluations on item difficulty. Koriat, Ackerman, Lockl, and Schneider (2009a,b) showed with word-learning and general knowledge learning tasks that reliance on study time, a cue indicating encoding effort, affected self-evaluations for children older than 8 years. The easier it felt to process new information, the more confident children were. In contrast, younger elementary school children (6- and 7-year olds) did not yet seem to use perceived item difficulty as a cue, suggesting that children's reliance on item difficulty cues develops around the age of 8–9 years. However, evidence on younger children's item difficulty cue use is inconsistent; some research shows that kindergartners do not yet discriminate between easy and difficult task items (Dufresne & Kobasigawa, 1989; Koriat et al., 2009a,b; Paulus, Tsalas, Proust, & Sodian, 2014). When image

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