Consciousness and Cognition 22 (2013) 264–271

Contents lists available at SciVerse ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Short Communication

The development of metacognitive ability in adolescence

Leonora G. Weil [a,1], Stephen M. Fleming [c,d,1], Iroise Dumontheil [a,1], Emma J. Kilford [a], Rimona S. Weil [a,b], Geraint Rees [a,b], Raymond J. Dolan [b], Sarah-Jayne Blakemore [a,*]

[a] Institute of Cognitive Neuroscience, University College London, UK
[b] Wellcome Trust Centre for Neuroimaging, University College London, UK
[c] Center for Neural Science, New York University, USA
[d] Department of Experimental Psychology, University of Oxford, UK

ARTICLE INFO

Article history:
Received 24 September 2012
Available online 30 January 2013

Keywords:
Adolescence
Metacognition
Cognitive development
Self-awareness
Introspection

ABSTRACT

Introspection, or metacognition, is the capacity to reflect on our own thoughts and behaviours. Here, we investigated how one specific metacognitive ability (the relationship between task performance and confidence) develops in adolescence, a period of life associated with the emergence of self-concept and enhanced self-awareness. We employed a task that dissociates objective performance on a visual task from metacognitive ability in a group of 56 participants aged between 11 and 41 years. Metacognitive ability improved significantly with age during adolescence, was highest in late adolescence and plateaued going into adulthood. Our results suggest that awareness of one's own perceptual decisions shows a prolonged developmental trajectory during adolescence.

© 2013 Elsevier Inc. All rights reserved.

1. Introduction

The ability to reflect upon our own thoughts and behaviour, known as metacognition or introspection, pervades many aspects of experience (Metcalfe, 1996), and is particularly well developed in humans (see Frith (2012), Smith, Shields, and Washburn (2003), Terrace and Son (2009) for discussion of comparative studies). Early research on metacognition distinguished between metacognitive knowledge (knowledge about our own and other people's cognitive processes) and metacognitive experiences (conscious cognitive or affective experiences that accompany current behaviour; Flavell, 1979). Subsequently, an additional "monitoring" component was proposed, corresponding to the use of metacognitive knowledge and experiences to guide behaviour (Nelson & Narens, 1990). This monitoring process is linked to self-regulation and executive control skills associated with prefrontal cortex (Fernandez-Duque, Baird, & Posner, 2000; Fleming & Dolan, 2012; Frith, 2012; Schneider, 2008; Shimamura, 2000). Research in the field of executive functions has mainly focused on a more implicit system of conflict and error monitoring supported by the posterior medial prefrontal cortex (PFC) (e.g. Ridderinkhof, van den Wildenberg, Segalowitz, & Carter, 2004), rather than the explicit monitoring and control associated with metacognition (see Fleming and Dolan (2012) for a review).

Metacognition is important in decision-making. For example, a meta-level of modulation and coordination between memory retrieval and problem-solving processes is involved in the generation of plans and the evaluation of options, in particular in situations where the solution is not obvious (e.g. Zysset, Huber, Ferstl, & von Cramon, 2002), or when decisions are made jointly between two people (Bahrami et al., 2010; Frith, 2012). More generally, every decision is associated with a degree of confidence, and assessments of confidence can be used to guide current and future decisions (see Kepecs and Mainen

* Corresponding author. Address: UCL Institute of Cognitive Neuroscience, 17 Queen Square, London WC1N 3AR, UK.
E-mail address: s.blakemore@ucl.ac.uk (S.-J. Blakemore).
[1] Joint first authors.

1053-8100/$ - see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.concog.2013.01.004

(2012) for a review). Thus, knowing what we do not know can motivate us to seek out new information (Metcalfe & Finn, 2008) and communicate our uncertainty to others (Bahrami et al., 2010).

A complementary perspective on metacognition is that it is tightly related to theory of mind (also referred to as mentalising or mindreading), the ability to attribute mental states to other people (Carruthers, 2009; Efklides, 2008; Kuhn, 2000; Schneider, 2008). One view is that mentalising and metacognition represent two different kinds of access to one metarepresentational faculty: mentalising involves the perception of others' behaviour; metacognition involves introspecting about one's own behaviour (Frith & Happe, 1999). Another view is that the attribution of mental states to others depends on inference about, or simulation of, one's own mental states, so introspection about one's own mental states occurs developmentally prior to mentalising about other people (Goldman, 2006). A third proposal is that introspection about one's own mental states involves turning mindreading capacities to one's own behaviour. Unlike other theories, which assume that mentalising and metacognition involve different mechanisms, this view assumes that mentalising and metacognition involve identical mechanisms and inputs (perception and inner speech respectively; Carruthers, 2009; Schneider, 2008). Finally, other theorists consider mentalising about others' mental states and metacognition to be independent processes (Nichols & Stich, 2003).

In the current study, we investigated the development of metacognitive ability for performance during a perceptual task during adolescence. Specifically, we tested the relationship between confidence and task performance across development, which we refer to as metacognitive ability (although note that we do not test how this corresponds to other forms of metacognition or mentalising). We hypothesised that metacognitive ability would show developmental changes during adolescence, a period of life characterised by changes in mentalising (Dumontheil, Apperly, & Blakemore, 2010), the emergence of self-identity (Sebastian, Burnett, & Blakemore, 2008), and maturation of online performance monitoring visible in particular in response inhibition tasks (Luna, Padmanabhan, & O'Hearn, 2010). There are changes during early and late childhood for several aspects of metamemory, including improvements in the estimation of memory ability and increased use of strategies (Ghetti, Castelli, & Lyons, 2010; Karably & Zabrucky, 2009). Some studies investigating the development of metacognitive monitoring have shown that confidence judgements about memory retrieval of individual items, and more specifically uncertainty monitoring, improve during late childhood (age 7–12 years; Ghetti, Lyons, Lazzarin, & Cornoldi, 2008; Krebs & Roebers, 2010; Roderer & Roebers, 2010; von der Linden & Roebers, 2006). During adulthood, metamemory skills decrease between young (20s) and older ages (70s) (Souchay & Isingrini, 2004). A second area of developmental research has linked the self-regulation aspect of metacognition abilities, in particular the processes of monitoring and control, to executive functions and their development (Fernandez-Duque et al., 2000; Lyons & Zelazo, 2011; Schneider, 2008; Shimamura, 2000). Fewer studies have investigated the development of metacognition following performance on experimental tasks during adolescence. In one study, adolescents (aged 13–15 years) and adults evaluated their performance on propositional, spatial and social reasoning tasks and self-evaluation improved between adolescence and adulthood (Demetriou & Bakracevic, 2009).

Importantly, previous developmental studies of metacognitive ability have not employed tasks in which task performance can be dissociated from metacognitive judgments, a critical issue when studying development. Indeed, a central methodological problem with studying any metacognitive process arises from the tight relationship between awareness and performance (Galvin, Podd, Drga, & Whitmore, 2003). In other words, when a participant knows the answer to a question, they tend to know they know the answer. Recently, we described a psychophysical procedure to dissociate objective performance from adult participants' evaluation of their performance (Fleming, Weil, Nagy, Dolan, & Rees, 2010). Using this approach, together with structural Magnetic Resonance Imaging (MRI), metacognitive ability in adults, defined here as how accurately participants' confidence in their performance tracks their actual performance, was shown to correlate positively with grey matter volume in the right rostrolateral prefrontal cortex (RLPFC or Brodmann area 10). This brain region undergoes protracted structural and functional development during adolescence (Giedd et al., 1999; Giedd & Rapoport, 2010; Gogtay et al., 2004). In the current study, we employed a similar behavioural paradigm to characterise metacognitive ability independently from objective performance in a new sample of adolescents and adults (aged between 11 and 41 years) in a visual perceptual task. Our aim was to examine how metacognitive ability changes during development. Based on previous studies of metamemory and mentalising in adolescence, we predicted that metacognitive ability on this perceptual task would show developmental change during this period of life.

2. Materials and methods

2.1. Participants

Data from 28 healthy adults (10 males; age range 19–41 years; mean age 25.7; SD 4.9), and 28 healthy adolescents (10 males; age range 11–17 years; mean age 14.90; SD 2.00), were included in the analysis. Four additional participants were tested but excluded from the analysis: one had a new epileptic seizure 1 month after testing; the data from one participant were excluded as she never stabilised on the staircase in the perceptual task (see below; Levitt, 1971); and demographic data from two participants were missing. Note that there was no overlap between participants tested in the current study and those tested in our previous study (Fleming et al., 2010). Adult participants gave written consent to participate, while consent was given by the parent/guardian of the adolescent participants. The study was approved by the local Research Ethics Committee.

Download English Version:

https://daneshyari.com/en/article/10458395

Download Persian Version:

https://daneshyari.com/article/10458395

Daneshyari.com