



Self-perception, self-regulation and metacognition in adolescents with intellectual disability



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ABSTRACT

This study compares self-perception of competences in 28 typically developing children (TD) aged 7–9 years and 32 adolescents with intellectual disability (ID) aged 11–16 years in special school, matched for mental age (MA). The links between self-perception, self-regulation in problem-solving and metacognition are investigated. Overall self-perception and self-perception of competences by domain do not differ significantly between the two groups. Self-perception of competences in specific domains, self-regulation and metacognition vary depending on MA and verbal comprehension in the two groups. ID adolescents attribute more importance to social acceptance than TD children. In both groups, positive links are identified between self-perception and importance attributed to domains. Performance, self-regulation and metacognition are lower in ID adolescents than in TD children. Positive links are obtained between self-perception of competences in specific domains and certain self-regulatory and metacognitive strategies, although these links differ in the two groups.

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1. Introduction

Developmental psychology and psychopathology regard the self-concept, contributing to the quality of social relationships (Cadieux, 2003; Duclos, 2004; Harter, 2003, 2006, 2012; Orth, Robins, & Widaman, 2012), self-perception of competences and self-regulation, which is favourable to autonomy in learning and in goal-oriented daily life activities (Bronson, 2000; Nader-Grosbois, 2007) as key factors of development. Metacognition, corresponding to a self-reflective cognitive process, is useful for self-regulation and the development of new competences (Boekaerts, 1999; Efklides, 2008, 2011; Flavell, 1987). In view of the inclusion of self-perception, self-regulation and metacognition in recent theories of development and of learning, they have generated various studies of typically developing (TD) children and adolescents, and those presenting learning disabilities (LD) or intellectual disability (ID). However, studies investigating the interrelations between these processes in children and adolescents with ID are still rare. The present study examines whether adolescents with ID perceive their competences, self-regulate and use their metacognition in ways which are similar to or different from TD children presenting the same mental age (MA), and considers bidirectional links between these processes in the two groups.

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1.1. From self-esteem to self-perception and self-perceived competences

1.1.1. Multidimensional self-perception

The concept of self-esteem is defined as a person's perception of his or her own value (Rosenberg, 1979). Influenced by individual and environmental factors, self-esteem is a psychological construct and contains four components: (1) the feeling of confidence developed thanks to parents' support, (2) the feeling of belonging to groups supported by social skills, (3) the feeling of self-knowledge or the awareness of personal skills and qualities, and (4) self-perceived competences in reference to personal objectives and successes (Duclos, 2004). Thanks to the influence of Bandura (1977), who introduced the notion of perceived self-efficacy, the self-esteem concept has evolved and multidimensional conceptions of self-perception have been developed: a person perceives his or her own value by self-evaluating in a differentiated way in specific domains of competences (Harter & Pike, 1984; Harter, 1982, 2006, 2012; Marsh & Shavelson, 1985). In the course of development, the differentiation and the realism of self-perception improve. In preschoolers, self-perception is overoptimistic and relatively general. From 7 to 8 years old, the child becomes able to evaluate his or her competences by social comparison with peers, distinguishing cognitive, social and physical dimensions, and he or she gradually begins to develop a more realistic perception of competences (Harter, 2012; Ruble, Boggiano, Fedman, & Loeb, 1980). During the transition to school, as a result of the acquisition of new skills, the perception of cognitive competences increases and self-perceived social competences slightly decrease (Harter, 2012; Mantzicopoulos, 2006; Marsh & Ayotte, 2003; Marsh, Ellis, & Craven, 2002). Although the child has better cognitive or academic self-perception in early school years, this is only loosely linked with academic performance (Marsh et al., 2002). This overestimation by the child may play an adaptive or protective role, helping him or her to stay motivated in the event of failure to master tasks (Bjorklund & Bering, 2002; Shin, Bjorklund, & Beck, 2007). In addition, for the child's self-perceptions during the early school years, the importance of parents' perceptions decreases while the importance of teachers' evaluations increases (Spinath & Spinath, 2005). For measuring individual variability of self-perceived competences in children, multidimensional and sensitive instruments are needed (Mantzicopoulos, 2006; Marsh & Ayotte, 2003; Marsh et al., 2002), such as the pictorial scale of perceived competence and social acceptance for young children (Harter, 1982; Harter & Pike, 1984), the self-perception profile for children (Harter, 1985), the self-perception profile for learning disabled students (Renick & Harter, 1988), the self description questionnaire (Marsh, 1990), or the self description questionnaire for preschoolers (Marsh et al., 2002).

1.1.2. Self-perception in children and adolescents with ID

The postulates are either a delay or a difference of development of self-perception in children or adolescents with ID in comparison with TD children. As different methods have been applied in studies, the results have been heterogeneous. Studies have explored self-perception in children or adolescents with ID by comparing groups in different school contexts (specialised or ordinary) or receiving different types of support at school (Allodi, 2000; Jones, 2009, 2012; Maïano, Ninot, Bilard, & Albernhe, 2002; Maïano, Ninot, Bruant, & Benattar, 2003; Ninot, Bilard, Delignières, & Sokolowski, 2000; Pierrehumbert, Zanone, Kauer-Tchicaloff, & Plancherel, 1988); or by comparing them with TD children matched for chronological age (CA) (Lemétayer & Kraemer, 2005; Thomasset & Blanc, 2008), or mental age (MA) (Cadieux, 2003; Fiasse & Nader-Grosbois, 2011, 2013). In the case of CA matching, the length of life experience and the period of life are equivalent, but these studies neglect the impact of cognitive level on self-perception. In the case of MA matching, older children and adolescents with ID are compared with younger TD children who have less varied experience and have never faced similar personal challenges; however, such studies do make it possible to test whether there is a developmental delay or a difference in self-perception in children or adolescents with ID.

Some authors, by comparing with CA-matched TD pupils, have observed deficient self-perceived competences and an over-generalised feeling of incompetence in children and adolescents with ID (Jones, 2009, 2012) or with LD (Butler & Marinov-Glassman, 1994; Harter, 1986; Renick & Harter, 1989), because they do not regard complex situations as controllable and failures as limited to specific tasks and because they are confronted with the repeated experience of intellectual inadequacy and social stigmatisation (Cadieux, 2003; Evans, 1998; Zigler & Hodapp, 1986). Renick and Harter (1989) found that students with LD perceived themselves as less competent in intellectual ability, reading, spelling, writing, mathematic, social acceptance and behavioural conduct than TD students. Recently, Jones (2009, 2012) proposed a model of deficient self-perception in adolescents with ID: in interviews, 55% of them self-identify as having a deficiency, and they lack constructive and affirmative language to describe this. By contrast, other studies looking at children and adolescents with ID schooled in specialised classes or benefiting from specialised support have reported an over-evaluation or a more positive self-perception of academic or cognitive competences (Maïano et al., 2002, 2003; Ninot et al., 2000; Pierrehumbert et al., 1988), physical or athletic competences (Maïano et al., 2002, 2003; Ninot et al., 2000), appearance (Ninot et al., 2000) and social acceptance (Allodi, 2000), by contrast with those schooled in ordinary school. This overestimation in specific domains could be interpreted as a compensatory strategy to cope with the feeling of failure in order to maintain a positive self-perception (Allodi, 2000; Ninot et al., 2000; Pierrehumbert et al., 1988), and could also result from the fact that teaching in specialised classes is less demanding in terms of performance and more positively reinforcing and all pupils present difficulties in learning (Pierrehumbert et al., 1988; Prêteur & Vial, 1998). According to Diederich and Moyse (1995), this unrealistic overestimation in adolescents with ID in specialised environments could have associated risks when they are confronted with an ordinary environment, leading to humiliation, withdrawal, or violent reactions.

In the two studies comparing CA-matched TD children and children with ID obtain different results. [Lemétayer and Kraemer \(2005\)](#) reported better self-perception in general and in academic and physical domains in adolescents with ID in specialised classes than CA-matched TD adolescents. [Thomasset and Blanc \(2008\)](#) noticed that children with Williams-Beuren syndrome did not differ significantly in their overall self-perception from TD children, aged from 9 to 10 years. In two studies comparing MA-matched TD children and children with ID, their self-perceived competences and their teachers' other-perception were assessed. In a longitudinal study, [Cadieux \(2003\)](#) compared 152 TD children who were 8.5 years old and 31 children with ID who were 11.5 years old (10 in ordinary school, 21 in specialised class). Inter-group differences were found in self-perception and realism for cognitive, social and physical domains: children with ID in specialised class perceived themselves more positively in cognitive and social domains, but less realistically in cognitive, social and physical domains (whatever their schooling) than TD children. According to this author, limitations in cognitive functioning could explain these results, partly because self-evaluation of competences requires cognitive processing. [Fiasse and Nader-Grosbois \(2011, 2013\)](#) compared self-perception of 45 children with ID and in 45 TD preschoolers and their teachers' perception. The children with ID perceived themselves as more socially accepted than the TD children, but their self-perception of cognitive, physical and emotional domains did not differ. The teachers perceived children with ID more negatively in general and especially in the cognitive domain than the teachers of TD children. In addition, there was less realism in self-perception in children with ID than in TD children.

Some studies have emphasised individual, familial, environmental and activity factors in self-perception in children or adolescents with ID. [Weiss, Diamond, Demark and Lovald \(2003\)](#) noticed that the lower the IQ is, the better the self-perception is, especially with regard to social acceptance (in contrast with the non-significant link reported by [Pierrehumbert et al., 1988](#)); their positive athletic self-perception was linked to their wider experience of the physical activity programme. [Jones \(2009, 2012\)](#) identified two favourable factors of self-perception in adolescents with ID: family income and parental support; and positive links between their self-perception and their psychological empowerment, their self-determination, their perception of parental support, peers' support in class and parental perception of a positive impact on the part of their child.

1.2. Self-regulation

1.2.1. Conceptions of self-regulation

Conceptions of self-regulation are based on different frameworks. Founded on [Bandura's \(1986\)](#) social-cognitive perspective, the models of [Zimmerman \(2000\)](#) and [Pintrich \(2000\)](#) propose that a learner may activate "behavioural self-regulation", "motivational self-regulation" and "environmental self-regulation" (exploitation of material, seeking help from adults and peers). In this perspective, self-regulation includes abilities of planning, identifying and using adequate resources, evaluating effects of actions, controlling actions, mobilising attention and motivation to attain a goal ([Boekaerts, 1996](#); [Schunk & Zimmerman, 1994](#)). Founded on the theoretical framework for metacognition ([Brown, 1978](#); [Flavell, 1976, 1987](#); [Sternberg, 1986a,b](#)), the model of [Borkowski, Chan and Muthukrishna \(2000\)](#) represents the information-processing perspective. In developmental models, self-regulation has been conceived of in its cognitive, affective and social aspects ([Bronson, 2000](#), [Vygotsky, 1978](#)). Inspired by socio-constructivist and developmental models, [Nader-Grosbois \(2007\)](#) have devised an integrated heuristic model of self-regulation and other-regulation to study typical and atypical people. People who self-regulate, identify an objective, plan their actions by exploring the means at their disposal, control their attention and motivation during the task, evaluate the effects of actions and adjust them accordingly; moreover, they solicit those around them by means of joint attention, and by behaviour regulation or requests if necessary. During development, self-regulation evolves depending on cognitive resources and the adjustment of scaffolding or other-regulation from adults or peers; consciousness and self-control increase. Self-regulatory strategies may vary depending on individual factors (such as MA, language, period of life, deficiency), tasks or situational contexts and environmental factors. On the basis of this model, a grid has been created for coding and scoring seven self-regulatory strategies that may be mobilised by the child or a learner in problem solving and of seven other-regulatory strategies that may be used by an adult or a peer ([Nader-Grosbois, Normandeau, Ricard, & Quintal, 2008](#); [Nader-Grosbois, 2007](#)).

1.2.2. Self-regulation in children and adolescents with ID

In theoretical descriptions of people with ID, self-regulation is conceived of as a process contributing to self-determination in learning and in daily life ([Mithaug, Mithaug, Agran, Martin, & Wehmeyer, 2003](#)). In order to self-regulate and self-determine, people with ID have to learn to mobilise strategies of goal determination, self-monitoring, self-reinforcement, problem solving, self-management, self-evaluation and adaptability ([Agran, 1997](#)). In his model, [Whitman \(1990a,b\)](#) postulates a generalised deficit of self-regulation in such people. Studies have identified people with ID at different ages and developmental levels as presenting either developmental delay in self-regulation or deficits in self-regulatory strategies in problem solving or in daily life management (see review by [Nader-Grosbois, 2007](#)). Founded on the integrated model of self-regulation and other-regulation ([Nader-Grosbois, 2007](#)), some studies have supported the existence of a developmental delay of self-regulation in children with ID through observation in play situations with their parents ([Nader-Grosbois & Lefèvre, 2011](#)) or in pretend play dyadic situations with peers ([Nader-Grosbois & Vieillevoys, 2012](#); [Vieillevoys & Nader-Grosbois, 2008](#)). However, the same studies have also reported a weakness in specific self-regulatory strategies in less structured contexts and inter- and intra-individual variability; moreover, as their mental or developmental age increases, so

their self-regulation improves. Better self-regulation in terms of identifying the objective, self-motivating and self-evaluating was also observed in the context of interactions between teachers and pupils with ID than in contexts in which the pupil with ID was alone (Haelewyck & Palmadessa, 2007). The weaknesses in self-regulatory strategies in people with ID could be explained by a low level of expectations, by deficient intrinsic motivation, given their habit of dependence on those around them (Mithaug, 1996), and by deficient language development affecting their self-instruction (Whitman, 1990a,b). In brief, a developmental delay of self-regulation has been confirmed in studies for sensory-motor and symbolic periods of development, whereas the existence of a difference or deficit in self-regulation is supported by studies for later periods.

1.3. Metacognition

1.3.1. Conceptions of metacognition

Metacognition refers to “one’s knowledge concerning one’s own cognitive processes and products or anything related to them” (Flavell, 1976, p. 232). This concept was developed to explain how people improve their control of thinking and learning, especially where there are difficulties in problem solving. Metacognition includes metacognitive knowledge, metacognitive experiences and metacognitive regulation (Brown, 1978; Desoete & Ozsoy, 2009; Efklides, 2008; Flavell, 1976, 1987). Metacognitive knowledge concerns personal variables (strengths and weaknesses), task variables and strategy variables. There is declarative, conditional and procedural knowledge. Metacognitive experiences relate to how one feels during tasks, one’s assessment of how well one has learned and of how much effort one has made, the time taken or needed to solve the task, the correctness of the solution and online task-specific knowledge. Metacognitive regulation is composed of planning, monitoring and evaluating processes mobilised in goal-oriented cognitive tasks. Noël (1997) distinguished three steps in metacognition mobilised by a person: the explicitation of one’s mental processes, metacognitive judgement about one’s activity and the metacognitive decision whether or not to modify one’s cognitive activities. In the developmental framework, starting from a very young age, metacognition gradually develops through experience, becomes more conscious, explicit and efficient, and helps the child or adolescent to control and regulate behaviour in problem solving, learning and activities (Kuhn, 1999; Lafortune & Deaudelin, 2001). Adolescents, who are more introspective and more self-conscious, improve their abilities to control their thinking and their behaviour (Wiens, 1983). According to Desoete and Ozsoy (2009), it is important in studies to calibrate the conception and assessment of metacognition, particularly in relation to self-regulation. To assess metacognition, there are self and other-reported questionnaires, structured interviews and observation designs; however, they are not all applicable to young children and to children and adolescents with ID. For example, in a study of preschoolers, Robson (2010) focused on their understanding of their activities and their conceptions of themselves as learners, taking their self-regulatory strategies into account. Two methods were used to analyse information about self-regulation and metacognition: the observation of videos of a play activity initiated by the child and the analysis of recorded metacognitive discussions between the child and an adult about the activity. The results showed the role of communication, of negotiation about goals and direction of play during the activity in the development of procedural knowledge about planning, monitoring and control in self-regulation processes. The metacognitive child-adult dialogue about the activity was also favourable to the development of self-regulation and metacognition. According to Shin et al. (2007), performance post-dictions as a measure of metacognitive monitoring throughout the individual’s judgments of learning, of knowing and of confidence, reflect the individual’s self-perception in specific situations. This observational design and metacognitive interview following an activity inspired the method applied in the present study.

1.3.2. Metacognition in adolescents with ID

Metacognition and self-regulation have been linked to effective learning and intelligence (Borkowski, Carr, & Pressley, 1987; Brown, 1987; Sternberg, 1986a,b). Studies of metacognition have focused on children and adolescents with LD more than on those specifically with ID. Pupils with LD present difficulties in thinking about their thoughts (Wiens, 1983) and a deficit in self-knowledge which leads to difficulties of learning (Vaidya, 1999), and they apply metacognitive strategies ineffectively by comparison with TD peers at similar age (Butler, 1998; Desoete & Roeyers, 2002). Moreno and Saldana (2005) explain that metacognition and self-regulation play a central role in specific limitations in people with ID, such as outer-directedness and lack of strategy transfer. They show that computer-assisted training in specific cognitive abilities can improve metacognition in adolescents and adults with ID.

1.4. Links between self-perception, self-regulation and metacognition

Several authors have emphasised that a good level of self-perceived competences plays an important role in self-regulated learning and metacognition: evaluating what we know, what we understand well or less well and who we are, is a critical aptitude in learning and in problem solving, helping us to mobilise resources adequately and to make the required effort; it differentiates good pupils from pupils with LD (Bandura, 1986; Borkowski et al., 2000; Bouffard & Vezeau, 2010; Bouffard, Boisvert, & Vezeau, 2003; Bouffard, Marcoux, Vezeau, & Bordeleau, 2003; Efklides, 2011). These authors have suggested that when pupils perceive themselves as incompetent or have a bias in self-perceived competences, they perform with less success in learning. The individual’s self-concept as an “agent” in achievement generates self-regulated behaviours in learning (Hacker, Dunlosky, & Graesser, 2009) and is related to the activation of metacognitive monitoring (Cornoldi, 2010; Efklides, 2011). The ability to introspect or activate mental representations about oneself from past and ongoing experiences helps the individual to

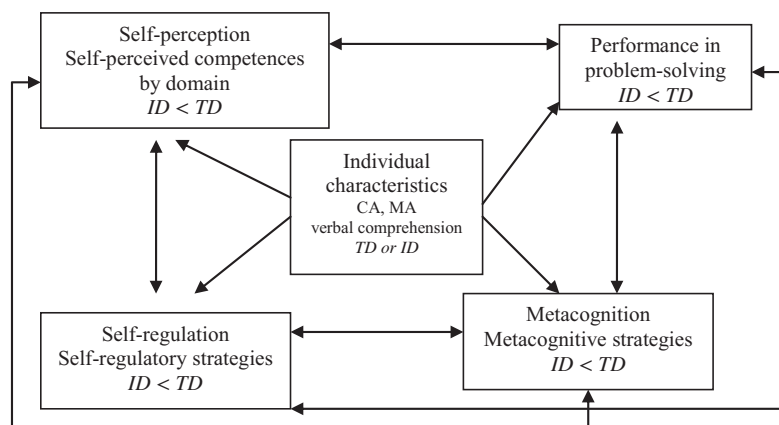


Fig. 1. Postulated inter-group difference and postulated positive links.

evaluate his or her competences and self-regulation and metacognitive monitoring in activities (Lyons & Ghetti, 2011). The links between these processes needs to be further investigated in studies in children with ID.

2. Objectives of the study

The study tests developmental delay *versus* difference in overall self-perception and self-perceived competences in distinct domains, and their importance in children or adolescents with ID, in comparison with MA-matched TD children. The study also tests developmental delay *versus* difference in self-regulatory strategies in problem solving and in metacognition. Variability of self-perception, self-regulation and metacognition according to CA, MA and language quotient is examined. We investigate whether self-perceived competences in diverse domains are linked to self-regulatory strategies in problem solving and to metacognition, and *vice versa*. We assess whether the interrelations between these processes differ in both groups and whether sub-groups can be distinguished. Fig. 1 summarises the postulates.

3. Method

3.1. Participants

The participants were 28 TD children aged from 7 to 9 years and 32 children or adolescents with mild to moderate ID, aged 11 to 16 years, schooled in special education schools in Belgium. For the group with ID, the aetiologies of ID were Down syndrome ($n = 15$) and pre-, peri- and post-natal complaints ($n = 17$).

3.2. Instruments

3.2.1. WISC-IV (Wechsler, 2005)

The WISC-IV assessing verbal and non verbal intelligence was used to match the two groups for MA and to assess whether MA and level of verbal comprehension caused any variation in the studied processes.

3.2.2. Self-perception profile for learning disabled students (Renick & Harter, 1988)

The SPPLD is a questionnaire used for the self-reported measurement of overall self-perception and self-perceived competences in nine domains: intellectual or cognitive ability, reading, spelling, writing, mathematics, social acceptance, athletic competence, behavioural conduct and physical appearance. For 46 items presenting two opposed self-perceptions, the child chooses the proposal which corresponds to his or her own self-perception more closely and specifies whether he or she is a lot like the chosen proposal or a little bit. Depending on the response, each item is scored from 1 to 4. The questionnaire also measures the importance attributed to domains by the child. For 18 items, the child indicates whether the domain is important or not and he or she specifies whether the chosen proposal is completely exact or a little bit exact, for him or her. Depending on the response, each item is scored from 1 to 4. Average scores are calculated for self-perception and the perceived importance of domains (max = 4).

3.2.3. Spatial and temporal problem solving (Nader-Grosbois & Dautrebande, 2007a)

The researcher presents the plan of “Loupliboulou Park”, divided into five coloured zones (Plouf-land, Chair de poule-land, Sensation-land, Zen-land, Pic-Nic zones), on which attractions are illustrated and pathways are drawn. The bottom of the plan is marked out in squares to enable distances to be estimated. Next to each attraction, a length of time in minutes is indicated. Reading from the instruction manual, the researcher asks the child to draw four routes in order to solve four spatial problems (Appendix A). The child has markers in different colours with which to draw the routes. He or she is then asked to

choose certain attractions in order to solve two temporal problems (Appendix A). The child has coloured sticky labels to stick next to the chosen attractions, a pocket calculator, and a cardboard clock, to help add up the time taken by the attractions. These tasks are used to assess the children's performance in spatial and temporal problem solving. Depending on whether they succeed in each task, succeed with occasional help or fail, we calculate an average score out of a maximum of 10.

3.2.4. Coding and scoring grid for self-regulation (Nader-Grosbois, 2007)

This validated grid (Nader-Grosbois et al., 2008; Nader-Grosbois, 2007) was applied in order to measure and analyse self-regulatory strategies used in problem-solving tasks. Seven self-regulatory strategies are measured: identification of objective, exploration of means and planning, joint attention, behaviour regulation, attention, motivation and evaluation (Appendix B). This tool was used to perform a macroscopic analysis of the level at which the child displayed the self-regulated strategies. For each task, the prevailing behaviour displayed by the child guided the coding. The score given graded the level of the child's self-regulation for each strategy: none scored 0; (–) low scored 1; (/) moderate scored 2; (+) high scored 3. For each problem-solving task, we calculated scores for each self-regulatory strategy (from 0 to 3) and total scores for overall self-regulation (from 0 to 21); for all problem-solving tasks, we calculated mean scores for each self-regulatory strategy (from 0 to 3) and mean scores for overall self-regulation (from 0 to 3).

3.2.5. Interview and coding and scoring grid for metacognition (Nader-Grosbois & Dautrebande, 2007b)

These authors designed a manual including a questionnaire for guiding a structured interview with the child after each type of problem-solving task, and a grid for coding and of scoring seven metacognitive strategies (as a corollary to the seven self-regulatory strategies) applicable to the child's responses (Appendix C). This assessment of metacognition is based on the child's judgement about the strategies he or she used in problem-solving tasks. It is applied twice: after the set of spatial problems and after the set of temporal problems. The coding and scoring of items is done according to gradated scale of meta-perception of use of each of seven self-regulatory strategies (metacognition about self-identification of objective, self-planning, joint attention, behaviour regulation, attention, motivation and evaluation): "completely correct perception" (= 3), "moderately correct perception" (= 2), "slightly incorrect perception" (= 1), "completely incorrect perception or no perception" (= 0). For each type of problem-solving task, we calculated scores for each metacognitive strategy (from 0 to 3) and total scores for overall metacognition (from 0 to 21); for all problem-solving tasks, we calculated mean scores for each metacognitive strategy (from 0 to 3) and mean scores for overall metacognition (from 0 to 3).

3.3. Procedure

The participants were recruited in French-speaking Belgian schools. In each school, a meeting was organised in order to inform the director and the teachers about the research project and the conditions of participation. The teachers identified children who met the inclusion criterion of comprehension and production of spoken French, and of a level of schooling equivalent to the second half of the second year and the third year of primary school. The teachers gave the parents information letters about the project, the nature of their child's participation and ethical aspects (confidential information, anonymity), as well as a consent form for the child's participation and for video recording. The parents completed and signed the consent form and sent it to the researchers' lab. The individual sessions took place on two consecutive days in a quiet room at school. At the first session, the WISC-IV was administered and some prerequisites were verified, notably abilities in calculation, spatial orientation and temporal sequences and the comprehension of some key-verbal expressions that would be used in the problem-solving tasks. At the second filmed session, the researcher set up the spatial and temporal problem-solving tasks with the material of "Loupliboulou Parc" and recorded the children's performances; he then asked the questions in the metacognitive interview. In a third session, he read the items of the SPPLD and recorded the children's responses. This procedure ensured that items were understood, minimised random answers and enabled spontaneous comments to be recorded. On the basis of videos of the second session, the researcher completed the self-regulation coding grid for each problem-solving task, and the metacognition coding grid for each type of problem-solving task. A second independent judge coded and scored these grids. A summary report on the participants' abilities was sent to their parents and teachers.

4. Results

4.1. Participants' characteristics

For each group, Table 1 presents the means and standard deviations of chronological age (CA), mental age (MA), intellectual quotient (IQ) and verbal comprehension index (VCI). As the mean MA in ID and TD children did not differ significantly, the two groups were well matched. However, the mean VCI was significantly lower in the group with ID than in the TD group.

4.2. Self-perception and importance of domains

As indicated in Table 2, self-perception and self-perceived competence in all domains did not differ significantly between both groups, except for reading competences. The only significant inter-group difference that was found was in the

Table 1

Chronological ages, mental ages, intellectual quotients and verbal comprehension index in both groups.

	TD children (<i>n</i> = 28)	Adolescents with ID (<i>n</i> = 32)	Student <i>t</i> test (df)
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>t</i> (58)
Chronological age	8.16(1.30)	12.76(2.04)	−9.45*
Mental age	8.49(1.31)	7.89(1.19)	1.72
Intellectual quotient	105.67(11.64)	61.51(14.10)	−12.04*
Verbal comprehension index	102.30(16.75)	67.26(20.24)	−6.56*

* $p < .001$.**Table 2**

Comparison of self-perceived competences and importance of domains in the two groups by the Mann–Whitney test.

	TD children			Mann Whitney's <i>U</i>	Adolescents with ID		
	<i>M</i>	Mdn	<i>SD</i>		<i>M</i>	Mdn	<i>SD</i>
Self-perception							
Cognition	2.86	2.80	.56	375	2.80	2.79	.52
Reading	3.02	3.00	.67	267 ⁺	2.52	2.50	.87
Writing	2.52	2.50	.66	356	2.37	2.23	.72
Spelling	2.75	2.86	.65	329	2.57	2.49	.67
Mathematic	2.78	2.87	.81	373	2.67	2.75	.85
Social acceptance	3.09	3.10	.76	393	3.01	2.99	.64
Athletic competences	2.75	3.00	.78	379	2.79	3.00	.83
Appearance	3.22	3.00	.73	371	3.15	3.00	.74
Conduct	3.08	3.00	.65	327	2.81	2.99	.79
Overall self-perception	2.89	2.90	.69	323	2.74	2.75	.73
Importance of domains							
Cognition	3.43	4.00	.88	340	3.18	4.00	.91
Reading	3.38	4.00	.96	358	3.24	4.00	.93
Writing	2.80	3.00	1.09	348	3.02	3.00	1.04
Spelling	2.96	3.00	.95	384	3.00	3.00	1.05
Mathematic	3.12	3.50	.94	388	3.07	4.00	1.08
Social acceptance	2.54	2.00	1.06	256 ⁺	3.23	4.00	.97
Athletic competence	2.95	3.00	1.03	375	3.05	3.00	.99
Appearance	3.17	4.00	.96	380	3.24	4.00	.94
Conduct	3.70	4.00	.62	353	3.53	4.00	.79

* $p < .05$.

importance attributed to social acceptance: the adolescents with ID attributed more importance to social acceptance than TD children did.

The comparison of self-perceived competences in different domains by Manova showed that they differed significantly between the TD group ($F(9, 27) = 79.96, p < .001$) and the group with ID ($F(9, 31) = 169.73, p < .001$). The analysis of multiple comparisons (Student Newman Keuls) emphasised the following significant differences ($p < .05$ to $p < .001$) in each group. In TD children, appearance was more positively perceived than competences in cognition, writing, spelling and athletics; writing competence was less positively perceived than competences in cognition, social acceptance, reading, mathematics, athletic competence, appearance and conduct. Cognitive competence was less positively perceived than conduct. Athletic competence was less positively perceived than social acceptance and appearance. In adolescents with ID, appearance was more positively perceived than cognition, reading, writing, spelling and athletics. Social acceptance was more positively perceived than competences in reading, writing and spelling. Writing competence was less positively perceived than competences in cognition, social acceptance, athletics, appearance and conduct.

When Manova was applied to compare the importance attributed to different domains, significant differences were found in the TD group ($F(9, 27) = 124.69, p < .001$) and the group with ID ($F(9, 31) = 100.32, p < .001$). The analysis of multiple comparisons of importance of different domains emphasised significant differences in each group ($p < .05$ – $p < .001$). In TD children, the importance of conduct was seen as greater than that of social acceptance, writing, spelling and appearance. The cognitive domain was seen as more important than those of writing, spelling and social acceptance. The importance attributed to social acceptance was inferior to that of cognition, reading, appearance and conduct. In adolescents with ID, the importance attributed to conduct was greater than that attributed to writing, spelling, mathematics and appearance.

In the TD group, positive correlations were obtained between self-perception and the importance of cognition ($r_s = .659, p < .001$), reading ($r_s = .391, p < .05$), mathematics ($r_s = .666, p < .001$) and athletics ($r_s = .392, p < .05$). In the group with ID, positive correlations were obtained between self-perception and the importance of reading ($r_s = .393, p < .05$), mathematics ($r_s = .469, p < .01$), athletics ($r_s = .545, p < .001$), appearance ($r_s = .354, p < .05$) and conduct ($r_s = .358, p < .05$).

Table 3

Comparison of performance, self-regulation and metacognition between the two groups by the Mann–Whitney test.

	TD children			Mann Whitney's U	Adolescents with ID		
	M	Mdn.	SD		M	Mdn	SD
Performance in problem solving	6.96	8.75	4.04	237.5**	3.86	3.13	3.76
Self-regulation							
Overall self-regulation	18.19	19.89	3.48	144****	13.57	14.23	3.49
Identification of objectives	2.59	3.00	.84	151****	1.56	1.51	.75
Planning	2.47	2.50	.59	162****	1.62	1.50	.74
Attention	2.80	3.00	.39	286*	2.38	2.74	.70
Self-motivation	2.72	3.00	.70	174****	1.84	1.74	.79
Self-evaluation	2.41	3.00	.98	199****	1.54	1.49	.75
Joint attention	2.56	3.00	.79	287*	2.17	1.99	.78
Behaviour regulation	2.68	3.00	.71	297*	2.37	2.83	.73
Metacognition							
Overall metacognition	17.84	19.00	3.62	145****	13.37	13.99	4.00
Identification of objectives	2.43	3.00	.74	247**	1.72	1.51	1.08
Planning	2.66	3.00	.69	154****	1.42	1.05	1.12
Attention	2.64	3.00	.69	302.5*	2.35	2.00	.67
Motivation	2.83	3.00	.48	254****	2.32	2.50	.76
Evaluation	2.38	3.00	.88	285*	1.78	2.00	1.09
Joint attention	2.48	3.00	.66	255**	1.90	2.00	.87
Behaviour regulation	2.42	3.00	.81	268*	1.84	2.00	.91

* $p < .05$.** $p < .01$.*** $p < .005$.**** $p < .001$.

4.3. Self regulation, metacognition and performance

The inter-judge agreement for all children is good for the self-regulation grid ($r_s = .91, p < .001$) and metacognition grid ($r_s = .83, p < .001$). As shown in Table 3, performances in all problem-solving tasks, overall self-regulation, the seven self-regulatory strategies in problem-solving and also overall metacognition and the seven metacognitive strategies, are significantly weaker in adolescents with ID than in TD children.

4.4. Links between individual characteristics and self-perception, performance, self-regulation and metacognition

In the case of TD children, the older they are, the more they perceive themselves as being socially accepted ($r_s = .376, p < .05$). The higher their MA is, the more positive their perception of their competences in cognition ($r_s = .380, p < .05$) and in reading ($r_s = .377, p < .05$). The higher their VCI is, the more positive their perception of their cognitive competences ($r_s = .379, p < .05$). In the TD group, there is no significant correlation between CA, MA, VCI and the importance attributed to domains.

In the case of adolescents with ID, the older they are, is the less positive their perception of their appearance is ($r_s = -.372, p < .05$). The higher their MA is, the more positive their perception of their competence in mathematics ($r_s = .398, p < .05$). The higher their VCI is, the more positive their perception of their appearance ($r_s = .481, p < .01$). In the group with ID, no significant correlation was obtained between CA and the importance attributed to domains. The higher their MA is, the greater the importance they attribute to mathematics ($r_s = .360, p < .05$). The higher their VCI is, the greater the importance they attribute to spelling ($r_s = .442, p < .01$).

Performance is positively and significantly linked with MA ($r_s = .428, p < .05$) and VCI ($r_s = .542, p < .005$) in TD children, but only with MA in adolescents with ID ($r_s = .344, p < .05$).

In TD children, overall self-regulation is positively and significantly linked with CA ($r_s = .465, p < .01$), MA ($r_s = .434, p < .01$) and VCI ($r_s = .492, p < .01$); overall metacognition is positively and significantly linked with MA ($r_s = .425, p < .02$) and VCI ($r_s = .444, p < .01$). In adolescents with ID, overall self-regulation is positively and significantly linked with MA ($r_s = .592, p < .005$), and VCI ($r_s = .360, p < .05$); overall metacognition is positively and significantly correlated to MA ($r_s = .597, p < .001$) and VCI ($r_s = .433, p < .01$).

4.5. Links between self-perception and performance, self-regulation and metacognition

In the two groups, no significant correlation is obtained between performance and self-perceived competences in all domains.

In TD children, positive and significant correlations are obtained between self-perceived competence in cognition and overall self-regulation ($r_s = .431, p < .05$), self-motivation ($r_s = .508, p < .01$) and joint attention ($r_s = .540, p < .01$). In the TD group, positive and significant correlations are obtained between self-perceived competence in cognition and overall metacognition ($r_s = .378, p < .05$), and metacognitive strategy related to evaluation ($r_s = .452, p < .01$); between self-perceived

solving, self-regulation and metacognition, but not for self-perception. *Post hoc* multiple comparison by the Bonferroni test emphasised significant inter-cluster differences ($p < .001$ and $.002$): cluster 1 presents lower MA, performance, self-regulation and metacognition than cluster 2, and higher MA, self-regulation and metacognition than cluster 3; cluster 3 presents lower MA, self-regulation, metacognition and self-perception than clusters 1 and 2, and also lower performance than cluster 2.

Fig. 2 summarises the main results about our postulates.

5. Discussion

Overall self-perception and self-perceived competences by domain do not differ in adolescents with ID (except for a more negative perception of competence in reading) and in TD children presenting similar MA. These results confirm the postulate of delayed development of self-perception and of self-perceived competences in most domains (as was reported by Fiasse and Nader-Grosbois (2011, 2013) for children situated in the symbolic period of development) rather than a difference of development. These results contrast with those of other studies, notably because of different matching criteria (including CA), or even the absence of comparison with TD children. We did not observe any over generalisation of negative self-perception of competences; this could be explained by the fact that these adolescents with ID are schooled in specialised classes in which teaching is based on success, functional learning, positive reinforcement, absence of competitive pressure and of expectations of efficiency and adaptation to the rhythm of pupils facilitated by small class sizes (as was suggested by Pierrehumbert et al. (1988) and Prêteur and Vial (1998)). Appearance in the case of both groups and social acceptance in the case of the adolescents with ID are more positively perceived than a number of other domains. A positive perception of appearance in adolescents in specialised classes was also observed by Ninot et al. (2000). A more positive perception of social acceptance was also reported in adolescents with ID in specialised classes by Cadieux (2003), in comparison with TD children presenting similar MA, by Allodi (2000), in comparison with ID without specialised support, and by Lemétayer and Kraemer (2005), in comparison with TD adolescents with similar CA. We did not find any positive overestimation of competences in cognitive and academic domains, unlike some other studies. Moreover, in both groups, competences in writing are less well perceived in comparison with those in several other domains. The adolescents with ID attribute more importance to their social acceptance than TD children. In TD children, competences in cognition, notably in reading, are seen as more important than those in other domains, including social acceptance. In both groups, conduct is more important than several other domains. In adolescents with ID, the greater the importance they attribute to specific domains, such as reading, mathematics, athletics, appearance and conduct, the more positively they perceive their competences in these domains. In adolescents with ID, the older they are, the less positively they perceive their appearance and the less importance they attribute to the domains of reading and spelling. The higher their MA is, the more positively they perceive their competence in mathematics and the more importance they attribute to this domain. The better their verbal comprehension is, the more positively they perceive their appearance and the greater the importance they attribute to the domain of spelling. From an individual perspective, given the heterogeneity of children and adolescents with ID in terms of cognitive and verbal abilities, experience, schooling and the importance attributed to different domains, some individual profiles in terms of self-perceived competences could reflect a developmental delay of self-perception while others could reflect deficits.

Overall self-regulation and self-regulatory strategies in problem-solving tasks are less highly developed in adolescents with ID than in TD children; this supports the notion that there is a difference of development in this developmental period (as suggested by Whitman (1990a,b)). The higher the MA and the level of verbal comprehension are, the more these adolescents with ID self-regulate, as has also been noticed in other studies (Nader-Grosbois & Lefèvre, 2011; Nader-Grosbois & Vieillevoys, 2012; Vieillevoys & Nader-Grosbois, 2008; Whitman, 1990a,b). Some specific positive links were identified between certain self-regulatory strategies and self-perceived competences in particular domains, but these links differ in the two groups. A structural difference of interrelations between these processes is emphasised in adolescents with ID, by comparison with TD children. In adolescents with ID, metacognition and metacognitive strategies following problem-solving are also weaker than in TD children, supporting the postulate of a difference of development (as observed by other authors in adolescents with ID, Moreno and Saldana (2005); and also in adolescents with LD, Butler, 1998; Desoete & Roeyers, 2002; Vaidya, 1999; Wiens, 1983). Metacognition improves with verbal comprehension and self-regulation in adolescents with ID, as in TD children. Some specific positive links were obtained between certain metacognitive strategies and self-perceived competences, but these differ in the two groups. In adolescents with ID, the more positively they perceive their competence in mathematics, the better their metacognitive strategies related to the identification of objectives, planning and evaluation. The more positive their perception of their social acceptance, the better their metacognitive strategy related to joint attention. The more positively they perceive their conduct, the better their metacognitive strategy of behaviour regulation. It is surprising that performance in problem-solving is not significantly linked with self-perception and self-perceived competences, although it is positively and significantly linked with overall self-regulation and metacognition, and particularly with specific self-regulatory and metacognitive strategies, to a variable degree. In other words, the adolescents with ID whose performance was poorer did not present a significantly less positive perception of their competences. This could be interpreted as an adaptive or protective strategy used to maintain their motivation (Bjorklund & Bering, 2002; Shin et al., 2007). However, better self-regulation and metacognition seem to be assets for developing a positive self-perception (in particular concerning competence in mathematics). These results partly agree with those of Jones (2009, 2012) about the predictive role of self-determination in self-perception in adolescents with ID. However, the

identification of three subgroups (one including TD children and adolescents with ID together, and two subgroups consisting of either TD children or adolescents with ID, separately) yielded more nuanced results. It emphasised that the relational and structural links, between the three studied processes and performance in problem-solving, are similar in some individual profiles of TD children and of adolescents with ID, while they are different in other individual profiles of adolescents with ID and of TD children.

This study presents some limitations: performance, self-regulation and metacognition were measured in a specific context of complex problem-solving, requiring several prerequisites (notably in calculation and spatial orientation), which could induce methodological biases; there was no analysis of academic performance and its links with self-regulation and metacognition; and the other-perceptions of teachers and parents were not taken into account. In future research, it seems relevant to study the extent to which the perception of competences by teachers and parents with regard to adolescents with ID influences their self-perception and their self-perceived competences (as occurs in TD children) (Fiasse & Nader-Grosbois, 2011, 2013; Spinath & Spinath, 2005). Such research could go beyond comparing self-perception in children and other-perceptions by adults in order to assess how realistic children's views of themselves are. Further investigation of the impact of self-regulation and metacognition in children and adolescents with ID on the perception they have of themselves, and on the other-perception of teachers and parents, seems essential to us in order to identify more clearly educational approaches which will be conducive to the development of these processes in a combined way. This study suggests that in psycho-educative intervention, it is essential to outline the importance of competences in several domains, and to train self-regulatory strategies in various problem-solving tasks and metacognition (as suggested by Butler, 1998; Moreno & Saldana, 2005) in order to support the construction of positive self-perceived competences. Assessing profiles of multidimensional self-perception, of self-regulation and of metacognition could be useful for identifying intervention objectives and choosing methods of tutoring adolescents with ID in different schooling contexts.

Appendix A. Problem-solving tasks

First, the researcher introduces the overall objective of the problem-solving tasks. *“Have you ever gone to an amusement park? It is not always easy to find the attractions you want to try out when you don't already know the park. We need a plan. Here is the plan of an amusement park, Loupliboulou Parc, so that we can pretend that you are visiting the park and choosing the attractions according to my instructions”.*

Second, the researcher briefly presents and describes the material at the child's disposal. *“On the bottom there are squares. You can measure the length of routes by the number of these squares. Loupliboulou Park has five zones in different colours. Here is Sensationland, where the attractions are all very exciting. This is Chair de poule-land, where the attractions will all give you goose-bumps and frighten you. This is Ploufland, where all the attractions are in the water. This is Zenland, where the attractions are quiet and allow you to have a rest. There are attractions in each zone. Each attraction has an entrance in one square. Each attraction has its own name and number which are also shown in the legend of the plan. Next to each attraction, the length of time that it takes in minutes is indicated. And the white zone in the middle allows you to go from one zone to another. It is also a Pic-Nic zone where there are benches and tables so that you can eat”.*

Third, the researcher asks the following questions for each problem-solving task and specifies the material the child can use (markers in different colours to draw the routes, a lath, a thread, coloured sticky labels to stick next to the chosen attractions, a pocket calculator and a cardboard clock).

A.1. Spatial problem-solving tasks

Task A. *“Loupliboulou Park has just opened. You are at the entrance of the park, just here. You want to go on a really scary attraction! You want to go on the Train of Death! What route will you take in order to get there as quickly as possible? When you are sure you have found the right way, draw it with the blue marker.”*

Task B. *“What is the shortest route to get from the Train of Death to the Hot-Air Balloon of Clouds? When you are sure you have found the right way, draw it with the red marker.”*

Task C. *“What is the shortest route to get from the Hot-Air Balloon of Clouds to Loupliboulou's Table, via the Splash Train? When you are sure you have found the right way, draw it with the green marker.”*

Task D. *“What is the quickest possible way to visit all five zones of the park without retracing your steps? Draw the route you will take with the brown marker.”*

A.2. Temporal problem-solving tasks

Task E. *“What attractions can you go on in Ploufland in 30 minutes? When you are sure of your choice, stick an orange coloured sticky label on the attractions you have chosen.”*

Task F. *“You are at the entrance of the park. You want to go on three attractions in three different zones of the park. You have 1 hour or 60 minutes. Which attractions are you going to choose? When you are sure of your choice, stick a white coloured sticky label on the attractions you have chosen.”*

Appendix B. Coding and scoring grid for child's self-regulation

Self-regulation	Child's self-regulatory strategies	Tasks					
		Spatial				Temporal	
		A	B	C	D	E	F
<i>Identification of objective</i>	+ Identifies the objective (begins the activity, refers verbally or gesturally to the objective) /Listens to or asks for explanation or approval of the objective – Does not identify or forgets the objective						
<i>Exploration of means and planning</i>	+ Planning, anticipation of means displayed /Trial-and-error exploration – Child performs actions when instructed by the adult, no spontaneous activity						
<i>Socio-communicative self-regulatory strategies of joint attention (looking, gestural or verbal pointing, questioning, commenting)</i>	+ Initiates and responds regularly to joint attention /Initiates and responds sometimes to joint attention (2–3 times) – Loses interest in initiating or responding to joint attention						
<i>Socio-communicative behaviour regulation, self-regulated request (request for help, approval, or explanation)</i>	+ Makes rare and absolutely necessary requests (<2 times) /Makes some requests which are necessary (2–3 times) – Makes very regular, or even excessive, unnecessary requests (>3 times)						
<i>Self-regulated attention</i>	+ Manages his/her attention (no lapse of concentration) /Manages his/her attention moderately (<2 lapses of concentration) – Does not manage his/her attention (>2 lapses of concentration)						
<i>Self-motivation</i>	+ Regularly expresses his/her pleasure or self-reinforces or maintains his/her motivation /Expresses his/her pleasure or self-reinforces or maintains his/her motivation moderately or sometimes – Does not express his/her pleasure or does not self-reinforce or does not maintain his/her motivation						
<i>Self-evaluation</i>	+ Identifies his/her errors and adjusts or corrects them /Asks for help or approval to correct self-identified errors – No personal self-evaluation						
<i>Overall</i>							

Appendix C. Metacognitive questions and grid for coding and scoring metacognitive strategies

C.1. Questions per strategy after each type of problem-solving task

Metacognition of identification of objective: “Can you explain to me what I asked you to do? Did you understand easily what I asked you to do? Did you need to ask me to explain what you had to do again?”

Metacognition of planning and exploration of means: “Explain to me how you did what I asked you to do?”

Metacognition of joint attention: “Did you want to show me and explain to me what you were doing while you were doing it?”

Metacognition of behaviour regulation: “Did you ask for help or explanations from me? Often or only sometimes?”

Metacognition of attention: “Did you find it difficult to pay attention or concentrate, or not?”

Metacognition of motivation: “Did you enjoy this exercise? Did you need me to encourage you?”

Metacognition of evaluation: “Did you notice when you made mistakes and when you did well? Did you correct yourself? Did you need me to tell you whether what you were doing was right or whether you had made a mistake?”

Coding and scoring grid for child’s metacognition

Metacognition	Child’s metacognitive strategies	Problem-solving		
		Spatial	Temporal	All
<i>Identification of objective</i>	3 Perceives correctly his/her own identification and understanding of the objective 2 Perceives partially correctly his/her own identification and understanding of the objective 1 Perceives somewhat incorrectly his/her own identification and understanding of the objective 0 Perceives incorrectly or does not perceive his/her own identification and understanding of the objective			
<i>Exploration of means and planning</i>	3 Perceives correctly his/her own planning of actions and exploration of means 2 Perceives partially correctly his/her own planning of actions and exploration of means 1 Perceives somewhat incorrectly his/her own planning of actions and exploration of means 0 Perceives incorrectly or does not perceive his/her own planning of actions and exploration of means			
<i>Joint attention</i>	3 Perceives correctly his/her own joint attention 2 Perceives partially correctly his/her own joint attention 1 Perceives somewhat incorrectly his/her own joint attention 0 Perceives incorrectly or does not perceive his/her own joint attention			
<i>Behaviour regulation</i>	3 Perceives correctly behaviour regulation or requests of help 2 Perceives partially correctly his/her own behaviour regulation or requests of help 1 Perceives somewhat incorrectly his/her own behaviour regulation or requests of help 0 Perceives incorrectly or does not perceive his/her own behaviour regulation or requests of help			
<i>Attention</i>	3 Perceives correctly his/her own attention (or distraction) 2 perceives partially correctly his/her own attention (or distraction) 1 Perceives somewhat incorrectly his/her own attention (or distraction) 0 Perceives incorrectly or does not perceive his/her own attention (or distraction)			
<i>Motivation</i>	3 Perceives correctly his/her own motivation 2 Perceives partially correctly his/her own motivation 1 Perceives somewhat incorrectly his/her own motivation 0 perceives incorrectly or does not perceive his/her own motivation			
<i>Evaluation</i>	3 Perceives correctly his/her own evaluation 2 Perceives partially correctly his/her own evaluation 1 Perceives somewhat incorrectly his/her own evaluation 0 Perceives incorrectly or does not perceive his/her own evaluation			
Overall				

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