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Impact of induced joy on literacy in children: does the nature of the task make a difference?

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ABSTRACT

This research examined whether induced joy influences fifth graders' performance in literacy tasks. Children were asked to recall a joyful experience, used as a joy induction, before completing either a grammar (Study 1) or textual comprehension task (Study 2). The grammar task involved understanding at the surface level and retrieval of appropriate declarative and procedural knowledge, but limited elaboration unlike the textual comprehension task, which tackled inference generation. By differentiating tasks based on depth of processing required for completion we aimed at testing the validity of two concurrent hypotheses: that of a facilitating effect and that of a detrimental effect of induced joy. Compared to controls, joy induced children showed better performance on the grammar task – specifically children with lower language ability. No differences across groups emerged as a function of joy induction on the text comprehension task. Results are discussed with respect to emotion effects on cognition.

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To date, a large body of research has revealed complex influences of emotion on cognition (for a review Blanchette & Richards, 2010; Corson, 2002). The assumption of a differential effect of emotion as a function of the nature and complexity of cognitive tasks has been put forward by various researchers (e.g. Forgas, 1995; Isen, 2008; Martin, Ward, Achee, & Wyer, 1993). However, to the best of our knowledge, this assumption was never tested directly in the field of education nor with children. Research in educational settings, in addition to its ecological value and pragmatic implications, offers a great opportunity to test this assumption as learning tasks given to children vary a lot in their nature and complexity. The two studies presented in this article examined the influence of induced joy on children's performance in two literacy tasks namely, grammar (Study 1) and textual comprehension (Study 2) which allow interesting comparison with respect to the influence of emotion on cognition as they involve processes of varying depth and complexity. The grammar task consisted in processing of textual information at the surface level and in the retrieval of appropriate declarative (i.e. rules) and procedural (i.e. the application of rules) knowledge to identify the nature and function of words or groups of words in sentences. The textual comprehension task consisted in finding a title for a short narrative abstract, as well as explaining the meaning of words from the context and the causes of the protagonist's actions and thereby required both surface and deep processing of textual information (e.g. making inferences to fill in information not explicitly mentioned). Besides depth of processing, the processes at stake in these two tasks also vary in terms of finality: grammar tasks as that used in this study do not imply the construction of a coherent representation, as does textual comprehension.

Grammar learning and textual comprehension

Grammar learning according to Chartrand (2012) encompasses two purposes, namely to develop (1) children's linguistic skills, and (2) their knowledge and understanding of the system and functioning of a given language. Such a development relies on the explicit teaching of a set of

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rules and norms. By rules we mean a description of the regularities that form the system of a language; norms on another hand refer to the correct usage as defined by the social institution. Grammatical rules taught in French primary schools from first to fifth grade deal with the nature and function of words, the order of words or group of words within a sentence (i.e. syntax), and conjugation (e.g. subject–verb agreement) (French Ministry of National Education, 2008). As pointed out by Fayol (2010), learning grammatical rules may be best explained through Anderson's (1983) theory, which posits that explicit learning begins with the formulation of rules (e.g. regarding word order within a sentence: 'if it is a determinant then it should be placed before the noun'), which constitutes declarative knowledge. With practice, the application of rules becomes more and more rapid and automatic and requires less attentional resources (procedural knowledge).

Textual comprehension is an inherently complex activity in that it implies both the ability to decode textual information and to extract its meaning. Understanding text then results from the construction of an integrated and coherent representation in memory, often referred to as situation model (Kintsch, 1998). A significant amount of research has contributed to our understanding of the cognitive activities that underlie this construction and current models of textual comprehension (e.g. *Construction-Integration Model*, Kintsch, 1998; and *Landscape Model* Van den Broek, Young, Tzeng, & Linderholm, 1999) stress the role played by both mnemonic and strategic mechanisms and their dynamic interaction. In order to construct a coherent and integrated representation, readers need to make inferences to fill in information that is left implicit in the text (Graesser, Singer, & Trabasso, 1994). Some inferences (e.g. causal and referential) serve to link the main ideas together in order to maintain coherence; others serve to elaborate on information in the text but are not strictly necessary to understanding (Cain & Oakhill, 2003). Such processes serve to integrate textual information but may also involve reliance on prior knowledge (Kintsch, 1998). A lot of research has shown what cognitive processes underlie literacy activities, but few studies have integrated emotion in this endeavour.

Impact of emotion on cognition: models and empirical evidence in literacy

Several theoretical models have been developed to explain emotion effects on cognition. In a set of models, emotion is thought to influence performance through activation processes. Thus, *Semantic Networks Theories* (Bower, 1981; Isen, Daubman, & Nowicki, 1987) account for emotion effects in terms of spread of activation in the semantic network with positive mood, generally promoting a broader activation of concepts in memory (mood-congruency effect and mood-state dependent retrieval). Also, as pointed out by Isen (2008, p. 550), positive mood may promote 'such processes as elaboration, responsiveness to context, creative problem solving, and flexible focus of attention all of which result in changes in cognitive organisation and the ability to see things in new or multiple ways without losing sight of the usual ways' (i.e. positive mood facilitates a variety of cognitive processes and does not lead to mindlessness). Consistent with this view, in a study examining the effect of adult readers' emotional state on textual comprehension, Blanc and Tapiero (2002) found mood-congruency effect on the generation and judgment of inferences. Induced mood also seems to influence students' strategy use while reading expository texts; happy-induced readers are more likely to make causal inferences than sad-induced readers but both happy and sad mood induction seems to foster memory for the text (Bohn-Gettler & Rapp, 2011). Research findings also support this view in children. For example, induced positive mood has been found to enhance children's verbal fluency (Greene & Noice, 1988).

An extension of these theories was developed by Forgas (1995) in the *Affect Infusion Model* (AIM) to account for contextual effects (i.e. type of task and cognitive processes involved). The more processes required for successful completion of a task are deep and complex the more they are likely to be influenced by mood. Forgas (1995) suggests the infusion of affect predicted by his model may be explained in terms of affect-priming mechanisms. Mood effects on cognition have also been explained in terms of the information mood provides individuals on the situation, thus directing information processing (*Affect as Information Model*, Schwartz, 1990; *Mood as Input Model*, Martin & Stoner, 1996). These models stress the informative function of emotion: negative emotions by signalling a problematic situation promote effortful systematic processing, and positive emotion by signalling a secure environment can lead to increased reliance on heuristic processing and general knowledge structures (*Mood and General Knowledge Model*; Bless & Fiedler, 1995; Bless et al., 1996) and may

facilitate performance in task involving such processes. Beyond this valence approach of emotion, the *Appraisal Tendency Framework* (Lerner & Keltner, 2000) proposes that emotion effects on cognition are likely to vary as a function of the appraisal pattern associated with discrete emotions (Smith & Ellsworth, 1985). These models all propose that emotion (and especially positive emotion) can sometimes have a positive effect on cognitive functioning.

In contrast to these models, the *Resource Allocation Model* (Ellis & Ashbrook, 1988), based on the assumption that individuals cannot help focusing on emotional information, proposes that emotion place a burden on attentional and working memory resources by producing task-irrelevant thoughts thus creating interference and leading to performance decrements especially in complex problem-solving tasks such as textual comprehension (Ellis, Varner, Becker, & Ottoway, 1995). In other words, the cognitive resources allocated to emotion may no longer be available to successfully engage in problem solving. Moreover, it seems both positive and negative mood can reduce cognitive resources and produce irrelevant thinking leading to poorer performance in problem solving (Oaksford, Morris, Grainger, & Williams, 1996). In the last version of this model, Ellis and Moore (1999) consider the interfering influence of emotion as independent of valence.

The current studies

Although, most of the aforementioned accounts of the interaction between emotion and cognition are 'adult' models, a growing amount of research has contributed to our understanding of the influence of emotion on children's cognitive processes suggesting, as in adults, both an enhancing (e.g. Bryan & Bryan, 1991; Bryant & Zillmann, 1989; Greene & Noice, 1988; Rader & Hughes, 2005) and a detrimental influence of emotional content on performance (see references below). However, the question of the influence of children's emotional state on performance in literacy tasks has, to the best of our knowledge, not yet been addressed. Research on the interaction between emotion and cognition in literacy activities in children has examined the influence of the emotional content in textual comprehension (Clavel, 2007; Clavel & Cuisinier, 2008), dictation (Cuisinier, Sanguin-Bruckert, Bruckert, & Clavel, 2010), writing production (Fartoukh, Chanquoy, & Piolat, 2012) but not the direct influence of children's emotional state. In this research we specifically examined how induced joy affects children's performance in solving literacy problems that mobilise cognitive processes of varying depth. Our aim was to test two competing hypotheses: that of facilitating effect, and that of a detrimental effect of emotion on children's performance as a function of the depth of the processes involved.

We conducted two studies with children in fifth grade (aged 10–11 years). In the first study, we investigated the influence of induced joy on performance in a grammar task involving understanding at the surface level and retrieval of appropriate declarative (i.e. rules) and procedural (i.e. the application of rules) knowledge but requiring limited elaboration. The second study aimed at determining the influence of induced joy when the task involves deep processing and elaboration. For this purpose we examined the influence of induced joy in a textual comprehension task and more precisely its influence on inference generation, a process requiring deep processing of textual information. As performance in solving these types of tasks relies on skills still developing in children at that age and subject to individual differences, we considered the influence of induced emotion on performance in the light of children's language ability level.

To induce joy we asked children to vividly recall a joyful autobiographical experience in school. This method has indeed been shown to be one of the most efficient to induce an emotion (Westermann, Spies, Stahl, & Hesse, 1996) and, is not only ethically acceptable but also ecologically valid (i.e. such a method could easily be implemented in the classroom). Moreover, as pointed out by Bohn-Gettler and Rapp (2014) manipulation checks for mood induction often occur after the induction procedure but not after task completion which raises the question of the lasting effects of induction throughout the whole task. In the present research we measured emotion experience before and after task completion in order to gain insight into the temporal continuity of the joy induction.

Hypotheses

We tested two competing hypotheses: the first predicts a facilitating influence of induced joy (hypothesis 1a) likely to vary as a function of the type of processes involved (hypothesis 1b); in contrast, the second one predicts a detrimental influence of induced joy (hypothesis 2).

Hypothesis 1a

Based on *Semantic Network theories* (Bower, 1981; Isen et al., 1987) joy induced children might be expected to make more inferential connections between the main ideas in the text which should translate into better performance in answering inferential question (Study 2). Moreover, based on accounts from the *Mood and General Knowledge Model* (Bless et al., 1996), one might expect that joy induction by fostering access to knowledge regarding grammatical rules would facilitate children's performance in the grammar task (Study 1).

Hypothesis 1b

In addition, based on Forgas' AIM (1995), which provides the influence of emotion varies as a function of depth of processing, one might expect that induced joy would have a greater influence on children's performance in the textual comprehension task than in the grammar task (Study 2 vs. Study 1).

Hypothesis 2

Based on accounts from the Resource Allocation Model (Ellis & Moore, 1999), children's allocation of resources to process induced joy might be expected to create interferences with the cognitive processes involved in both textual comprehension and grammar tasks and to lead to performance decrements in both tasks. Also, as the model provides greater performance decrements in complex task, one might expect that induced joy would have a greater detrimental effect on performance in the textual comprehension task.

Study 1

Method

Participants

The sample consisted of 44 fifth grade pupils from two Parisian schools, none located in disadvantaged areas and comparable in terms of socio-economic background of the families (low-middle to middle class). All children were allowed to participate by their parents with informed consent and took part to the study on a voluntary basis. Based on teachers' report, none of the children had repeated school years nor identified linguistic problems. All children were deemed competent to decode a text by their teacher. Two children with poor general language ability scores (more than two standard deviations below the mean) were excluded from the sample in order to ensure the two groups (induction vs. control) were similar at baseline. The final sample comprised 42 fifth grade pupils (21 girls and 21 boys; M_{age} = 10 years 10 months; SD = 0.4 months).

Procedure

The study took place in children's schools in their habitual classrooms. Children were randomly assigned to a joy induction or control group. In the first session, children's general ability in French was measured by a test lasting 20 minutes. In the second session, children were told that they were going to complete a task similar to what they usually do in class, but the type of task was not specified. Then they filled in the emotion questionnaire for the first time (3 minutes). In the induction group, children were asked to close their eyes and vividly recall a joyful/happy experience in school for 2 minutes before answering the emotion questionnaire for the first time. In the control group, there was no intervention to modify children's emotion experience. Children were subsequently instructed to complete the grammar task at their own pace (approximately 15 minutes). Finally, they filled the emotion questionnaire for the second time right after completion of the task.

Tasks and measures

Grammar task. The task consisted of three grammar tasks selected from the French primary school learning assessment (French Ministry of National Education, 2010). These tasks were chosen for their ecological value (i.e. they are tasks usually given to fifth graders). The first exercise dealt with identification (i.e. recognition as opposed to selection from multiple choices) of the subject and verb in two sentences; the second problem with the identification of two nouns, two articles (i.e. determinants), two adjectives, one personal and one relative pronouns in four sentences; the third problem with the identification of two adverbial phrases of space and time in four sentences. Each correct response on the 16 items was granted half a point; the maximum possible score was 8. It took children approximately 15 minutes to complete the task.

Emotion questionnaire. Children (in both the induction and control groups) filled in a questionnaire, measuring on a 5 point Likert-scale going from 1 *not at all* to 5 *a lot*, the intensity of their experience of 11 emotions labelled as adjectives, namely surprised,

angry, ashamed, bored, proud, afraid, relieved, sad, hopeful, worried and joyful. Our focus was directed on joy, a pleasant and activating emotion (Russell, 1980). The instruction of the questionnaire before the task (first time) was as follows: 'How do you feel right now?' and, after the task (second time): 'Now that you have finished doing the exercises, how do you feel?'.

General language ability. We tested children's general language ability with textual comprehension tasks as well as grammar and conjugation problems using a standardised school test designed from the French primary school learning assessment (French Ministry of National Education, 2004).[1] The measure comprised 32 items measuring (1) children's textual comprehension through multiple choice questions or questions requiring a short answer tapping both inferential and surface textual comprehension and (2) grammar and conjugation ability; transposition of singular forms to plural forms in four sentences and in finding appropriate determinants left blank within a short text (the maximum score on each item was 4; total score could range from 0 to 128). The reliability of the measure assessed by Cuisinier (2010) on a sample of 218 children yielded a Cronbach alpha of .89. In our sample (Study 1 and Study 2) Cronbach alpha was .69. The general language ability variable was split at the 50th percentile, thus creating two groups (low and high ability). The number of children with low and high ability was about equal in both the induction ($n_{low} = 11$; $n_{high} = 10$) and control groups ($n_{low} = 10$; $n_{high} = 11$).

Results

Firstly, we conducted preliminary analysis to verify (1) equivalence of general language ability as a function of group and gender with a 2 group (induction vs control) × 2 gender ANOVA, and (2) to check the efficiency of the joy-induction procedure with a 2 group ANOVA on pre-task joy, and the stability of joy-induction with a 2 time (pre-task vs. post-task) × 2 group repeated measure ANOVA. We also examined pre- and post-task joy experience separately for (1) gender differences with 2 group × 2 gender ANOVAs and for (2) ability differences with 2 group × 2 ability level (low vs. high) ANOVAs. Secondly, we tested the impact of induced joy and general language ability level on performance in the grammar task using a 2 group × 2 ability level ANOVA. We performed pairwise comparisons (*t*-tests) to follow up on significant interactions, controlling for Type I error with Bonferroni correction (acceptable alpha level .01).

Preliminary analysis

Equivalence of general language ability in the two groups

General language ability scores were similar in the two groups $F(1,41) = 0.7$, $p = .40$, *ns* ($M_{Induction} = 93.61$, SD = 12.87; $M_{Control} = 90.29$, SD = 15.48). There were no gender differences $F(1,41) = 0.61$, $p = .44$ *ns*, or any interaction between gender and group $F(1,41) = 0.64$, $p = .43$ *ns*.

Effectiveness and stability of induction

Effectiveness of induction

Children in the induction group experienced joy with significant more intensity than controls $F(1,41) = 6.77$, $p = .01$, $\eta_p^2 = .15$ before the task ($M_{Induction} = 4.29$, SD = 1.01; $M_{Control} = 3.24$, SD = 1.55).

Stability of induction

The effect of time on joy was moderated by group $F(1,40) = 12.64$, $p = .001$, $\eta_p^2 = .24$. Children in the induction group experienced significantly less joy after the task; there was no significant change in controls' post-task joy (pre-task joy: $M_{Induction} = 4.29$, SD = 1.01; post-task joy: $M_{Control} = 3.24$, SD = 1.55; $M_{Induction} = 2.43$, SD = 1.25; $M_{Control} = 3.24$, SD = 1.73).

Gender differences on pre- and post-task joy

Girls experienced more pre-task joy than boys $F(1,41) = 5.57$, $p = .02$, $\eta_p^2 = .13$ ($M_{Girls} = 4.29$, SD = 1.23; $M_{Boys} = 3.24$, SD = 1.37). However, there was no interaction between gender and group $F(1,41) = 0.33$, $p = .57$ *ns* on pre-task joy. There were no significant effect of gender $F(1,41) = 2.59$, $p = .12$ *ns*, or any interaction between group and gender $F(1,41) = 0.17$, $p = .68$ *ns* on post-task joy.

Ability differences on pre- and post-task joy

Efficiency of induction was moderated by ability level $F(1,41) = 6.16$, $p = .02$, $\eta_p^2 = .13$: joy-induced children with low ability experienced significantly more joy before the task than controls ($M_{Induction} = 4.5$, SD = 0.97 ; $M_{Control} = 2.54$, SD = 1.57). However, high ability children in both the induction and control groups were equivalent in their pre-task joy scores ($M_{Induction} = 4.09$, SD = 1.04; $M_{Control} = 4.00$, SD = 1.15).

Table 1. Descriptive statistics for performance in the grammar and textual comprehension tasks as a function of induction and general language ability level.

	Grammar (Study 1)		Textual comprehension (Study 2)	
	Control *M* (SD)	Induction *M* (SD)	Control *M* (SD)	Induction *M* (SD)
Low ability	3.66 (1.96)	5.65 (0.94)	2 (0.76)	1.65 (0.75)
High ability	5.80 (1.34)	5.86 (0.86)	2.72 (1.06)	2.65 (1.67)
Total	4.68 (1.98)	5.76 (0.89)	2.38 (0.98)	2.15 (1.36)

Note: Maximum possible score was 8 in the grammar task and 5 in the textual comprehension task.

There was no significant effect of ability level $F(1,41) = 0.03$, $p = .85$ *ns*, nor any significant interaction between group and ability level $F(1,41) = 1,67$, $p = .20$ *ns* on post-task joy.

Effects of induction and general language ability on performance

Joy-induced children performed better than controls $F(1,41) = 5.98$, $p = .02$, $\eta_p^2 = .14$, and children with high ability performed better than children with low ability $F(1,41) = 7.86$, $p = .01$, $\eta_p^2 = .17$. Moreover, results revealed the effect of induction was moderated by ability level $F(1,41) = 5.27$, $p = .03$, $\eta_p^2 = .12$. Only the performance of children with lower ability was enhanced by induction. Joy-induced children with low ability performed as well as children with high ability (see table 1 for descriptive statistics).

Discussion

The aim of this study was to examine the influence of induced joy on fifth graders performance in a grammar task. According to the first hypothesis one might have expected induced joy would facilitate children's performance in solving grammar problems by increasing reliance on general knowledge structures (Bless et al., 1996). Our results confirmed this hypothesis. When the task involves the retrieval of appropriate stored declarative and procedural knowledge but limited elaboration, induced joy seems to enhance performance. Yet, only the performance of joy-induced children with lower language ability was facilitated, suggesting a differential effect of induced joy as a function of ability level. Preliminary analysis revealed that children with high ability experienced joy with the same intensity in the induction and control groups maybe because the intensity of children's experience of joy in the induction group was already high at baseline. This could explain in part why no effect of emotion could be detected for these children. However, in line with predictions from Forgas' AIM (1995) we may hypothesise that the processes involved in such tasks are automatised in children with higher language ability and therefore, may not be permeable to an influence of emotion. Conversely, the fact that these processes may not be automatised in children with lower general language ability may have allowed for an infusion of induced joy in these children, maybe through an impact on children's motivation. Indeed, based on the Mood as Information (Schwartz, 1990) and Mood as Input models (Martin & Stoner, 1996), we may hypothesise the joy induction, through activation of joyful memories related to children's academic self, altered their representation of the situation. For children with lower language ability, this could increase their experienced level of control, and improve performance.

A complementary explanation of this facilitating effect of joy on children with lower ability's performance stems from the Appraisal Tendency Framework (Lerner & Keltner, 2000). We may indeed hypothesise based on this model, that the underlying appraisal pattern of joy (Smith & Ellsworth, 1985), such as intrinsic pleasantness, certainty and individual control determined the effect of joy on children's performance by shaping their perception and evaluation of the situation along this specific appraisal pattern. Indeed, Efklides and Petkaki (2005) showed that mood induction impacts children's metacognitive experiences and learning-related emotions. Testing a mediating influence of metacognitive experiences defined along emotion appraisal criteria (such as novelty, pleasantness, goal significance, coping potential, and normative significance) on the effect of emotion on performance or cognitive processes appears as a stimulating track for future research.

The second (competing) hypothesis presented above predicted a detrimental effect of induced joy on performance. Our results did not confirm this hypothesis. However, it may be that induced joy left enough cognitive resources available for children to

solve this grammar task. This interpretation raises the question of the validity of this hypothesis when the task is more cognitively demanding and involves deep processing and elaboration, as is the case of textual comprehension.

Study 2

Our aim in this second study was to clarify whether the influence of induced joy depends on the nature of the task and the level of complexity of the processes it requires by testing further the hypotheses of a facilitating or detrimental effect of induced joy on performance. The first study revealed, in line with our first hypothesis, a facilitating effect of induced joy on children's performance in a grammar task. Textual comprehension, as opposed to the grammar task we used, requires reliance on elaborated and constructive processes (e.g. inference generation) in order to integrate textual information into a coherent representation; in that respect textual comprehension offers an interesting track to further test the validity of our contrasted hypotheses.

Method

Participants and procedure

The sample consisted of 37 fifth grade pupils (19 girls and 18 boys; $M_{age} = 10$ years 10 months; SD = 0.4 months) from two Parisian schools, none located in disadvantaged areas and comparable in terms of socio-economic background of the families (low-middle and middle class). All children were allowed to participate by their parents through informed consent and took part to the study on a voluntary basis. According to teachers' report, none of the children had repeated school years, nor identified linguistic problems. All children were deemed competent to decode a text by their teacher. The procedure of this second study was the same as that of Study 1.

Tasks and measures

The emotion and general language ability measures were the same as those used in Study 1. As in Study 1, the general language ability variable was split at the 50th percentile. The number of children with low and high ability was about equal in both the induction ($n_{low} = 10$; $n_{high} = 10$) and control groups ($n_{low} = 8$; $n_{high} = 9$).

Textual comprehension task. Children were asked to read carefully a 250 words abstract of *Lullaby* (p. 6), a novel by Le Clézio (1980), telling the story of a girl who explores a sea side environment, before responding to the questions. This book was selected from the Ministry of Education's suggested readings for children in grade 5. The abstract was descriptive and the five questions measured inferential comprehension of the text (e.g. select among five titles the most appropriate one; explain the meaning of a word from the textual context; explain the causes of the protagonist's experiences). Scores could range from 0 to 5. Children could reread the text to respond to the questions. None of the children were familiar with the book or abstracts from the book.

Results

The procedure for statistical analysis was the same as in Study 1.

Preliminary analysis

Equivalence of general language ability in the two groups

General language ability scores were similar in the two groups $F(1,41) = 0.10$, $p = .75$, *ns* ($M_{Induction} = 96.4$, SD = 14.74; $M_{Control} = 94.94$, SD = 16.80). There were no gender differences $F(1,36) = 0.10$, $p = .75$ *ns*, or any interaction between gender and group $F(1,36) = 1$, $p = .32$ *ns*.

Effectiveness and stability of induction

Effectiveness of induction

Children in the induction group experienced joy with significant more intensity than controls $F(1,36) = 10.31$, $p = .003$, $\eta_p^2 = .23$ before the task ($M_{Induction} = 4.75$, SD = 1.80; $M_{Control} = 3.41$, SD = 0.44).

Stability of induction

Results revealed an interaction between time and group $F(1,35) = 9.37$, $p = .004$, $\eta_p^2 = .21$. Children in the induction group experienced significantly less joy after the task; there was no significant change in controls' experience of joy after the task ($M_{Induction} = 3.05$, SD = 1.76; $M_{Control} = 3.29$, SD = 1.45).

Gender differences on pre- and post-task joy

There were no significant gender differences on pre-task joy $F(1,36) = 0.76$, $p = .39$ *ns*, and post-task-joy $F(1,36) = 0.08$, $p = .77$ *ns*. There also were no significant interaction effects between gender and group on

pre-task joy $F(1,36) = 0.40$, $p = .53$ *ns,* and post-task-joy $F(1,36) = 1$, $p = .32$ *ns*.

Ability differences on pre-and post-task joy

Results indicated no significant ability differences on pre-task joy $F(1,36) = 0.26$, $p = .62$ *ns*, and post-task joy $F(1,36) = 2.55$; $p = .12$ *ns;* as well as no significant interaction between ability level and group on pre-task joy $F(1,36) = 0.45$, $p = .51$ *ns,* and post-task joy $F(1,36) = 1.69$, $p = .20$ *ns*).

Effects of induction and general language ability on textual comprehension

Children's performance in the textual comprehension task was not influenced by induction $F(1,36) = 0.31$, $p = .58$ *ns*. Children with high ability performed better than children with low ability $F(1,36) = 5.21$, $p = .03$, $\eta_p^2 = .14$. There was no interaction between ability level and group $F(1,36) = 0.14$, $p = .72$ *ns*. Descriptive statistics are shown in Table 1.

Discussion

This second study was conducted in order to examine the influence of induced joy on fifth graders' performance in a textual comprehension task involving deep and substantive processes. Our results indicated no significant effect of induced joy on textual comprehension providing support for neither of the competing hypotheses proposed. One possible explanation of this lack of effect of induced joy on textual comprehension may be that the instruction given to children set a specific goal: 'read to answer questions on the text' in spite of the fact it was formulated as follows: 'read the text and then answer the questions'. Indeed, previous studies have shown that reading goals influence the way a text is processed (Linderhom & van den Broek, 2002) and may even cancel the effect of the emotional content of a text on comprehension (Tornare, 2014). In accordance with the AIM (Forgas, 1995), this specific goal by directing and motivating information processing may have prevented an infusion of induced joy on inference making. Similarly, Hertel and Rude (1991) observed effects of goal setting on cognitive processing in depressive patient. The 'cognitive initiative hypothesis' they developed holds that processing decrements linked to depressive states may be overridden by asking participants to direct their attention on meaningful aspects of the task. Echoing this assumption, the findings of this study are consistent with the hypothesis that the reading instruction may have fostered specific strategy use that may not have been spontaneously used by the children and cancelled the effect of joy on text processing and inferential comprehension. Future research is needed to address the question of the interplay between goal and emotion in textual comprehension.

Although the reading instruction given to children may have motivated processing and cancelled effects of induced joy on inference generation, it is interesting to note that a study by Bohn-Gettler and Rapp (2011) showed that happy-induced adult readers did not engage in more text- and/or knowledge-based inference of expository texts than readers in a neutral mood even though they were not given a reading goal. Similarly, in Efklides and Petkaki's (2005) mood-induction did not influence fifth graders' performance in a complex math word problem-solving task. In Study 1 of the present research, processing may also have been motivated by specific questions, yet induced joy facilitated performance. This evidence suggests that complex processes may not be permeable to emotion in all types of tasks. In other words, the nature of the task itself seems important to consider in delineating the effects of emotion on deep, substantive processing. In cognitively demanding tasks such as textual comprehension and math word problem solving, experienced joy may not be a relevant (or protective, enhancing) factor to guide children's processing and consequently its contribution to performance may be limited. Nonetheless, this evidence does not allow us to conclude on a lack of influence of induced joy on textual comprehension processes.

We need to acknowledge that this study did not measure the use of different kinds of processes but success in answering textual inferential questions. Although the questions used in our study were selected for their ecological validity (i.e. they are similar to questions usually asked to children in textual comprehension learning activities) they do not enable an investigation of spontaneous inferences. Following Bohn-Gettler and Rapp (2011), an examination of the influence of induced joy on the use of textual comprehension processes (e.g. inference generation; paraphrase) in children, a non-expert population still developing its reading-comprehension skills appears as an interesting track for future research. As highlighted by research on the development of textual comprehension, many factors at the student-

and task-level play a role in textual comprehension. For example, at the student-level, the ability to use knowledge relative to hierarchical and logical structure of the text, to generate inference and to monitor comprehension is of critical importance for understanding a text (Cain, Oakhill, & Bryant, 2004). At the task-level, narrative and expository texts have been shown to be processed differently (Eason, Goldberg, Young, Geist, & Cutting, 2012), also with regards to their emotional content (Clavel, 2007; Davidson, Luo, & Burden, 2001). These accounts warrant the need to examine potential interaction effects of these factors with experienced emotion on textual comprehension processes. Moreover, we cannot exclude the possibility that the text used in this study was not engaging. Future studies should indeed investigate if pleasant emotions elicited by reading of a text and related to motivation and engagement in the task influence comprehension in different ways than pleasant emotions induced through other means, such as remembering some past happy experience.

Another possible interpretation of the absence of carry-over effects of induced joy on performance may be, as underlined by Brenner (2000), that emotion induction efficiency is of short duration (between 5 and 10 minutes). It took the children 15 minutes to complete the task and involvement in this cognitively demanding activity modified their emotion experience as evidenced by the decrease in the intensity of their experienced joy. However, in Study 1, joy-induced children performed better on the grammar task in spite of the fact it took them the same amount of time to complete the task (15 minutes) and of a decrease in the intensity of their experienced joy. This suggests that induced-joy is more likely to exert an influence on children's performance in tasks that require the activation and use of rules but limited elaboration. This point will be further developed in the general discussion.

General discussion

The main goal of this research was to examine the influence of induced joy on children's performance in two types of school tasks, namely grammar production and textual comprehension. Although various researchers have put forward the assumption of a differential effect of mood on tasks of different nature and complexity, it was never tested directly in the field of education nor with children. In this research, we tested two competing hypotheses of the effects of induced joy on performance: that of a facilitating effect, that one might expect to be greater on textual comprehension and that of a detrimental effect in both tasks and on textual comprehension in particular.

Results indicated that joy-induced children and controls performed equally well on the textual comprehension task (Study 2) and that performance was best predicted by general language ability. Conversely, joy-induced children with lower language ability performed better than controls on the grammar task (Study 1). These findings are inconsistent with resource allocation accounts but partially support the hypothesis of a facilitating effect of joy on performance. Furthermore, they point towards a differential effect of induced joy on children's performance as a function of the nature of tasks and processes underlying their completion. This differential effect, however did not translate into an enhancement of performance in textual comprehension, which raises the question of the relevance and contribution of joy to children's solving of some complex tasks. Results also suggest ability is an aspect of task difficulty that should be distinguished from complexity. In Study 1, the grammar task was probably more difficult for children with lower ability and yet induced joy fostered their performance. In contrast when the task is inherently complex, induction does not seem to influence performance, regardless of ability. Results from Study 1 (grammar task) and previous findings in children (Bryan & Bryan, 1991; Greene & Noice, 1988; Rader & Hughes, 2005) suggest joy or positive mood facilitates children's performance in closed tasks, that is tasks calling for a univocal solution; however, it seems that when the task is open, or in other words requires elaboration and construction such as textual comprehension, the complexity of the processes at stake may cancel the effect of joy on children's performance. This interpretation warrants the need to analyse the nature of the task and of the processes involved when investigating the effect of emotion on cognition and also to further explore the influence of emotion on children's performance in complex academic task. In order to determine under which conditions specific emotion experience may affect performance as well as the processes involved in problem-solving tasks future research may for example compare the influence of joy, as well as other emotions varying in terms of activation and valence, on children's performance in different complex literacy task such as dictation, writing production (e.g. essay and summary), textual

comprehension as well as the interaction between children's emotional state and the content of the material to be processes whether it be emotional or reflecting social dimensions. It also appears essential to investigate the influence of emotion induced by the task itself on the processes at stake and performance in textual comprehension, as well as in other types of tasks. Such investigations along with a direct focus on development is necessary to adapt current 'adult' models of the influence of emotion on cognition in children and to gain insight into its underlying mechanisms throughout development.

Investigation of the stability of the joy induction – emotion was measured before and after the task – indicated a decrease in the intensity of joy-induced children's experience of joy after the task, in both studies. These findings echo results from previous research in children (Cuisinier et al., 2010; Efklides & Petkaki, 2005; Tornare, Czajkowski, & Pons, 2015) and suggest that our attempts to alter children's emotion experience with induction possibly interferes with emotion regulation linked to the dynamic nature of emotion.

In conclusion, from a theoretical perspective, the present work highlights the importance of taking affective factors into account in the study of cognitive processes underlying school problem solving and of characterising the nature of the task and of the processes involved when examining the effect of emotion on cognition. From an applied perspective it supports the view that efforts to foster children's experiences of joy in the classroom may be beneficial to learning, especially for children with lower ability level.

Note

1. No longer available on the French Ministry of National Education website.

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No potential conflict of interest was reported by the authors.

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