What stands and develops between creative and critical thinking?

Argumentation?

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Abstract

Creative and critical thinking have been traditionally considered as involving independent skills and dispositions. However, the definition of critical thinking has been gradually reconsidered to include skills and dispositions through which one opens new links instead of scrutinizing existing links in a closed analysis. Experimental studies have rarely focused on bonds between creative and critical thinking. The present study concerns the antilogos ability, the ability to critically evaluate whether specific information may support different claims. This ability pertains to critical thinking. One hundred and eight male adolescents from Grades 8, 10 and 12 participated in antilogos evaluation and answered tests measuring creative thinking and dispositions to critical reasoning. The study shows rich bonds between creative thinking and antilogos evaluation and between their developments. Analytical skills involved in antilogos evaluation were shown to develop, so that older adolescents could uncover unexpected aspects for interpreting given information, or could challenge the credibility of the given information. In contrast, heuristic biases may hamper older adolescents to free themselves from holding one meaning to given information, the meaning to which their heuristics is directed. We found that in order to free themselves from holding one meaning, adolescents need a high level of a particular aspect of creative thinking which does not develop during adolescence. The study shows then that effective antilogos evaluation involves both critical and creative thinking. We conclude that antilogos evaluation is archetypical in the sense that tasks involving both critical and creative thinking must be of argumentative nature.

Keywords: Critical reasoning; Creative thinking; Argumentation

1. Introduction

Critical thinking has a long history. Although since Antiquity it underpins many philosophical investigations, an articulated conceptualization of critical thinking emerges only at the end of the nineteenth century when Charles Saunders Pierce developed his early theory of ‘pragmatism’ and late theory of ‘pragmaticism’: in his efforts to describe the scientific method he identified Logic as the central component of critical thinking. By doing so, Pierce stressed the bonds between theory and practice through reflection and action upon the world to change it, and by such stressed clear frontiers between his view of critical thinking and other forms of thinking. Since then, many thinkers have reflected on the nature of critical thinking but the ‘logical’ residues proposed by Pierce are still object to fierce deliberation.
A typical prism through which the nature of critical thinking has been clarified concerns relations between critical and creative thinking. Two lines of thought have been developed with this respect. The first one stresses a gap. For example, Harris (1998) contrasted between critical thinking which is (for him) analytic, convergent, vertical, focused, objective, verbal, linear, etc., and creative thinking which is generative, divergent, lateral, diffuse, subjective, visual, associative, etc. respectively. At the other end of the spectrum, thinkers such as Paul (1987) claimed that creativity is essential to all rational dialogical thinking and that it is impossible to separate between critical and creative thinking. Paul has described any dialectical process as an involvement to imagine how one could provide reasons and how another one could give answers. The title of his most appraised book, “Critical thinking: what every person needs to survive in a rapidly changing world” (Paul, 1990) conveys flexibility and particular stress on adaptability to various contexts. Ennis (1991, 1996) stands in the middle of the spectrum. His definition of critical reasoning—reasonable and reflective thinking focused on deciding what to believe or do, although softer than a Peircian one, still remains traditional. However, the abilities and dispositions that he lists to define it uncover an activity in which the subject is for instance sensible to other and to others’ perspectives, and is even committed to figure out others’ view and reasons.

Considerations on the nature of critical thinking have been by definition theoretical. However, a clear and operational definition of critical thinking and of other forms of thinking enables empirical studies. This is what happened with the relations between creative thinking and critical reasoning. The empirical studies on this issue relied on a traditional definition of critical thinking; they have suggested that the two forms of thinking demand independent skills (e.g. Belenky, 1986; Walters, 1990). However one can question whether the tasks involved in this comparison did indeed provide an opportunity for a deep analysis of relations between critical and creative thinking. We argue in this paper that the skill we focus on in the present study should provide a propitious ground for this comparison.

We already recently studied a particular critical thinking ability, the antilogos ability—the ability to critically evaluate whether specific information may support different claims (Glassner & Schwarz, 2005). In the research procedure, subjects were presented a claim (e.g. “We should enforce Death Penalty for people who found guilty in first degree murder”) and a piece of information meant to support the claim (e.g. “There are countries in which, the number of homicides decreased after a decision was made to adopt DP”). Subjects were invited to figure out as many different ideas as possible to explain why the piece of information does not necessarily support the presented claim. We called these ideas flaws (in the alleged support of the given information to the claim). The results of the study among adolescents suggested several interesting consequences that go beyond the specific antilogos ability. First, we suggested that antilogos necessitates the application of principles of critical reasoning as well as dispositions for critical reasoning. Second, we suggested that antilogos relies on creative thinking since it affords the elaboration of many new ideas. We finally suggested that antilogos depends on the knowledge people have of the issue at stake. Such suggestions are reasonable interpretations of the results. Although antilogos has not been included in any list of critical reasoning skills, theorists of critical reasoning such as Paul, and Ennis have consistently extended the definition of critical reasoning skills in a direction that turns antilogos to a reasonable candidate in the growing list of skills that redefine critical reasoning. More, the suggestions that rose from the first study point at an interesting interplay between critical and creative thinking.

Our objective in this article is the empirical study of this interplay.

2. Theoretical background: antilogos, critical thinking skills and dispositions, and creative thinking

Whatever the definition of critical thinking/reasoning is, it is always presented in contrast to other forms that are not critical in a clear cut way. This distinction is for example present in Perkins’ (1990) considerations about informal reasoning. Perkins discerns between two kinds of epistemologies in informal reasoning, a ‘makes sense’ and a ‘critical’ epistemology that satisfy different needs. A critical epistemology is necessary when people need to analyze a situation before taking important decisions or while solving challenging problems. A ‘makes sense’ epistemology is enough to handle well-known situations. The term “reasoning” is used to describe the processes involved in both cases. For Perkins, the two epistemologies are exclusive. In the same vein, two different types of argumentation—the fueling/motivating aspect of informal reasoning, and of the subsequent arguments elaborated during argumentation, have also been identified: argumentation which is common in natural contexts such as dinners or disputes, and argumentation which is common in court or in scientific teams.

Another tradition linked to decision and judgment making in Cognitive Psychology, operates similar distinctions in reasoning strategies. When they adopt heuristic strategies, people tend to judge arguments or to solve problems by intuitive mechanisms such as anchoring and availability of evidence (e.g. Kahneman, Slovic, & Tversky, 1980; Nisbett
Typically when using heuristic strategies, arguers evaluate arguments simply by checking whether they are in accordance with their own initial opinions. In general, the use of heuristic strategies often leads to biases (e.g., Klaczynski, 1997; Kuhn, 1991; Lord, Ross, & Lepper, 1979). These biases are rooted in the self-motivation to be consistent with previous beliefs, whatever the evidence is. In contrast, analytical strategies require cognitive efforts and abilities for normative reasoning and decision making.

The antilogos ability skill seems to fall in the middle of these distinctions: it seems to rely on a ‘makes sense’ and a critical epistemology, or, if we prefer both on heuristic and analytical strategies: people often intervene in informal conversations by spontaneously reacting with interjections such as this [data/event] doesn’t show that you’re right! and intuitively expressing ideas that counter the whole argument brought forward by the interlocutor(s). Also people may go on scrutinizing and challenging the link between the opponent’s claim and evidence/explanation brought to support the claim by developing a relevant argument. Both moves are argumentative. In the first one, heuristic strategies seem involved; in the second, analytical ones. The findings from a study we undertook on antilogos evaluation (Glassner & Schwarz, 2005), seem to confirm this speculation: we found that providing a written worked-out example in which antilogos evaluation is enacted dramatically improves performance. We also found that inviting to express personal opinion on the issue at stake improves antilogos evaluation in young students but not in older students. Since research has shown that older adolescents are more sensitive to contextual variables and are able to identify situations in which to apply analytical skills and to ignore heuristic strategies (Berg, 1989), the results of the first study are perfectly in line with the hypothesis that antilogos involves both analytical and heuristic skills. Also, the study showed the development of antilogos with age. Since we know that analytical skills develop with age (Jacobs & Klaczynski, 2002), such a result strengthens our hypothesis that antilogos evaluation involves analytical skills. A detailed analysis of the flaws—the different ideas subjects elaborated in order to challenge the support of a given piece of information to a claim, suggests much more about the nature of antilogos evaluation. We list here the types of flaws we discerned in the first study.

The first type, different aspects, included flaws elaborated through thinking of relevant aspects that challenge the support to the claim. For example, students were provided the text: “there are countries in which it was decided to give money to good drivers and in these countries the number of car accidents decreased”. This text was meant to support the claim “Careful drivers without driving violations need to be provided financial awards”. One student found the following flaw in this support: “There might be long-term educational implications: citizens will be used to demand awards for good and legal behaviors”. Such a flaw uncovers a new aspect that challenges the support of the text to the claim proposed.

A second type, different meanings, consists of flaws obtained by giving a different meaning to the given piece of information that challenges its support of the claim. For instance, for the text given above (on good drivers), one could argue that the fact that “there are countries in which . . .” is weak since it is possible that in most countries, this does not work. One also could argue about the term “decreased”. Was really the decrease significant?

The third type of flaw is relevance. It consists of challenging the relevance of the reasons invoked, whether the reason is evidential or conveys theoretical explanations (Kuhn, 2001). For example one might argue that we do not really know whether the decrease in the number of accidents was directly caused by the awards given to good drivers. Also, there may be countries in which culture does not fit this measure.

The fourth type found in the first study, credibility, consists of flaws that concern the credibility of the text presented in order to support the claim. People might ask who collected information about the number of accidents, how it has been analyzed, whether all the truth has been said, or where it was published/advertised.

So far, all types of flaws presented were productive in the sense that subjects played the rules of the game. A fifth type, external, expresses a misunderstanding of the antilogos task: the subject may attack the claim itself instead of challenging the support of the information to the claim. For example, one may argue that this is wrong to give such awards because it does not help.

The elaboration of the four first types of flaws seems to indicate not only the expression of critical (analytical) skills but also of heuristic skills interwoven with the analytical skills. From another perspective they seem to involve the combination of two distinct epistemologies, makes sense and critical. We claim here that this interweaving expresses creativity. Such a suggestion is reasonable from a theoretical point of view: Ennis (1996) includes in the list of critical thinking skills the credibility of sources as well as supposition, that is “considering and reasoning from premises, reasons, with which ideal critical thinkers disagree or about which they are in doubt—without letting the disagreement or doubt interfere with their thinking”. Such skills seem exactly the ones necessary for analyzing in antilogos evaluation. At the same time, in antilogos evaluation, one should imagine as many situations in which what was supposed to support
a given claim, does not necessarily support it. Such a task is supposed to free from an imposed meaning. Subjects probably feel they can listen to their intuitions and imagination, and that they can go astray from conformism. We suggest that they operate here heuristic skills. Ennis’ list of dispositions in critical thinking includes “consider seriously other points of view than own” or “be clear about the intended meaning of what is said . . . seeking as much precision as the situation requires”. But again, this consideration relies on previous experiences and personal knowledge. We claim that the integration of critical and heuristic skills is probably an expression of creativity: freedom from accepted frames accompanied with contingency to critical judgment. If our hypothesis is verified, it will constitute novel findings on the relations between critical and creative thinking.

However, our hypotheses do not rely on data. In the present study, we attempted to measure critical reasoning and creative thinking with standard tests for students who engaged in an antilogos evaluation. In the first study, antilogos scores had been significantly higher for students who were shown one worked-out example and/or who were asked to express first their personal opinion about the issue at stake. Such variability according to contextual variables suggests that antilogos evaluation involves a mix of competence variables as well as dispositional cognitive variables (Stanovich, 1999). Since measuring critical thinking skills, dispositions to critical thinking skills and creative thinking puts too a heavy burden on subjects, we decided to focus on disposition skills for critical reasoning, and not to focus on critical thinking skills.1 As for creative thinking we decided to use tests that measure different aspects that pertain to the elaboration of new meaning since the antilogos task invites subjects figuring out unexpected meanings.

3. Research design

3.1. Objective

The present study is intended to study the development antilogos ability, namely the ability needed to elaborate a critical evaluation of how a claim is supported by a given piece of information, in relation with the development of critical reasoning and of creative thinking. The study of antilogos provides then lenses to study relations between critical and creative thinking. The factors studied the present study are grade age, creative thinking and dispositions for critical thinking. Accordingly, we aimed at answering two questions:

1. Does each of the flaw types of the antilogos evaluation develop in the course of adolescence?
2. To what extent, each of the flaw types of antilogos evaluation, creative ability and dispositional skills to critical reasoning are correlated?

3.2. Population

One hundred and eight male adolescents of Grades 8, 10 and 12 in an educational institution of the Jewish orthodox stream (Yeshiva) participated in the study. Previous research justifies such a specific choice without weakening the external validity of the present study for several reasons. First, concerning gender, Glassner and Schwarz (2005) showed that no difference could be detected between males and females in antilogos evaluation. Secondly, in the institution we chose, achievements were comparable to those of most public schools as witnessed by the principal and the teachers in the school. Thirdly and most importantly, the present study checks correlations between creative and critical thinking. Even in the case the levels of the particular population we chose are different from those in the general population, it is not reasonable for this correlation to be different in the population we chose. Each grade age group was divided into two different task groups. Although the task groups were provided the same two claims, each task group was provided a different piece of information to support each claim. Half of the task groups (in each grade age) were provided two claims ($G_1; N = 53$). The first claim was: “Careful drivers without driving violations need to be provided financial awards”. We provided the following ‘evidence’ to support this claim: “There are countries in which it was

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1 Such a preference of disposition over skills is also rooted in theory. For example, in Educating Reason, Siegel (1988) argued that the two dimensions of critical thinking are the ‘reason assessment’ and the ‘critical spirit’ components. More than knowing how to assess reasons, a person must be disposed to do so; and more than having critical thinking skills, a person must use them. Like Ennis and Paul, Siegel is then more concerned with dispositions than with skills.
decided to give awards to good drivers, and the number of car accidents decreased”. The second claim was: “Sunday needs to be a holiday” (as Sunday in Israel is a working day). For this claim we provided what is called a theoretical explanation (Kuhn, 2001): “The decision for Sunday to be a resting day should avoid struggles between religious and secular groups concerning the opening of stores on Saturdays because Sundays will turn to shopping days and there will be no need for opening working places in Saturdays. The other task groups (G2; N = 55) were provided the same claims, but the first one was provided a theoretical explanation for support, “Financial awards encourage drivers to keep on driving according to the law”, and the second was provided evidence, “Studies have shown that shortened working weeks contribute to more effective work”. In order to control the influence of order on antilogos evaluation, half of each task group evaluated the two arguments in a different order. Since the issues involved in both tasks are largely discussed in Israeli society, we could reasonably consider that no lack of knowledge would avoid students from engaging in the tasks. It may be argued that the issues chosen were too specific. However, previous research has shown that argumentative skills are comparable for different social issues on which subjects are knowledgeable (Kuhn, 1991) and that are relevant to their life (Schwarz & Glassner, 2003). One could also argue that the issues we chose risked involving students too much emotionally, then hindering thinking: for them the issues at stake are ‘hot’. However, in our first study on antilogos (on the death penalty issue) we showed that no correlation could be found between personal opinion and antilogos ability. In other words, the ‘thinking game’ character of antilogos tasks moderates emotional involvement. We believed that the relevance of the issues at stake would motivate participants to take an active part in the task.

3.3. Dependent variable

The dependent variable was CECSI, the critical evaluation of how a claim is supported by a piece of information. A reasoning game was constructed in order to test CECSI (Glassner & Schwarz, 2005). The explicit goal in this game was to find as many flaws as possible in the support of a given piece of information to a specific claim. The number of different flaws generated in the task measured the CECSI score. Since we suggested that some types may be linked to critical reasoning and to creative thinking we also counted separately the number of flaws from different types, different aspect, different meaning, relevance, credibility and external.

3.4. Independent variables

The independent variables were grade age (Grade 8, N = 48; Grade 10, N = 27; Grade 12, N = 33), the level of visual creative thinking, the level of verbal creative thinking and the level of disposition in critical thinking. The level of visual creative thinking was established through the Circle test, a test developed by Torrance (1966). In this test, subjects are presented a plate with circles arranged in columns and rows. The subjects are invited to add signs and lines inside/outside circles and between them in order to create as many pictures as possible. The number of meaningful pictures measured the level of visual creative thinking. This test measures the ability to synthesize in creative thinking: one needs to consider each circle as a part of as many as possible retrieved familiar figures. As such, it seems related to antilogos for which one needs to consider a given piece of information as part of as many as possible arguments. Another test, a Rorschach test inspired by Torrance was used to measure another aspect of creative thinking. This test was verbal as subjects were asked to write as many different meanings as possible to one Rorschach inkblot. This inkblot does not represent a part but a whole. As such, the test and measures imagination as a process which is not reducible. We hypothesized that subjects successful in this test would imagine and generate new meanings in antilogos tasks directly without considering the support of the given claim separately and completing it with another claim. Since the modality of the two tests (visual and verbal) was not relevant to our working hypotheses, we called the two tests synthesis and imagination creativity tests. The level of disposition in critical thinking was tested by the CCTDI—California Critical Thinking Disposition Inventory (Facione & Facione, 1992). The participants had to rate their degree of agreement with some assertions which had been used as indications to their level of critical level dispositions.

3.5. Procedure

The experiment took place in 50 min long session organized in five stages. At the first stage, subjects read a written example of dialectical evaluation of an argument (Glassner & Schwarz, 2005). At a second stage, subjects played the
reasoning game for 15 min. They then answered the CCTDI questionnaire for 15 min. Subjects undertook then the synthesis creative test (Circle test) for 10 min. Finally, subjects undertook the imagination creative test (Inkblot test) for 5 min.

4. Results

4.1. Effect of grade age on dependent variables

A MANOVA program was run to compute the effect of age on dependent variables. A multivariate Wilks’ Lambda effect of Grade was found ($F = 2.95, p = .002, \eta^2 = .128$). An effect was found between subjects concerning the different aspect type ($F(2, 108) = 3.42, p = .036, \eta^2 = .061$). Grade 12 students found more different aspects ($M = 2.58; S.D. = 1.98$) than Grade 10 students ($M = 1.85; S.D. = 1.56$) and Grade 8 students ($M = 1.58; S.D. = 1.54$). A similar effect, more graduated though, was found concerning the credibility type ($F(2, 108) = 7.19, p = .001, \eta^2 = .12$) (Grade 12, $M = .90; S.D. = .88$; Grade 10, $M = .40; S.D. = .74$; Grade 8, $M = .29; S.D. = .61$). The same direction, although not significant was found concerning the relevance type. An opposite effect was found concerning the external type ($F(2, 108) = 4.86, p = .01, \eta^2 = .085$). Grade 8 students found more external flaws ($M = 1.08; S.D. = 1.48$) than Grade 10 ($M = .67; S.D. = 1.04$) and Grade 10 students found more external flaws than Grade 12 students ($M = .27; S.D. = .52$). No effect was found concerning the different meaning type.

4.2. Effect of grade age on independent variables

The only between subjects effect was found concerning the Circle test ($F(2, 108) = 11.61, p = .000, \eta^2 = .181$). The score of the Circle test among Grade 12 students ($M = 23.55; S.D. = 9.58$) and among Grade 10 students ($M = 24.89; S.D. = 11.41$) were found significantly higher than among Grade 8 students ($M = 16.19; S.D. = 5.53$).

4.3. Correlations among independent variables

Correlations among independent variables (Grade, Circle test, Inkblot test and CCTDI) were tested by Pearson correlation two-tailed tests in both task groups (G1 and G2). The only significant correlation was found between Grade and Circle test in the two task groups (for G1, $r = .396, p < .001$; for G2, $r = .318, p = .018$).

4.4. Correlations among independent and dependent variables

Correlations among independent and dependent variables were tested by correlation Pearson two-tailed test followed by regression tests. Statistically significant correlation was found between creative tests (Inkblot and Circle), and the adolescents’ ability to find flaws by conferring a different meaning to given information among G2 students (see Table 2). No correlation was found between grade age and the ability to find flaws of the different meaning type (see Tables 1 and 2). In an ANOVA test, we found that information evaluated by the second group afforded a higher number of flaws of the different meanings type ($M = 4.02; S.D. = 3.17$) than by the first group ($M = 1.87; S.D. = 2.45$) ($F(1, 108) = 15.47, p = .000, \eta^2 = .13$). Therefore, in the second group, both measures of creative thinking and number of flaws of the type different meanings were correlated. No correlation was found between these variables and age.

Table 1
Correlations (Pearson) for G1 ($N = 53$)

<table>
<thead>
<tr>
<th>Independent variables/type of flaw</th>
<th>Grade age (three degrees)</th>
<th>Circle test</th>
<th>Inkblot test</th>
<th>CCTDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different aspect</td>
<td>0.12</td>
<td>0.03</td>
<td>0.31*</td>
<td>−0.06</td>
</tr>
<tr>
<td>Different meaning</td>
<td>0.01</td>
<td>0.04</td>
<td>0.07</td>
<td>−0.11</td>
</tr>
<tr>
<td>Relevance</td>
<td>−0.06</td>
<td>0.02</td>
<td>0.13</td>
<td>−0.31</td>
</tr>
<tr>
<td>Credibility</td>
<td>0.48**</td>
<td>0.38**</td>
<td>−0.05</td>
<td>−0.02</td>
</tr>
<tr>
<td>External</td>
<td>−0.30*</td>
<td>−0.24</td>
<td>0.18</td>
<td>−0.21</td>
</tr>
</tbody>
</table>

*p < .05; **p < .001 (two-tailed).
Table 2
Correlations (Pearson) for G2 (N = 55)

<table>
<thead>
<tr>
<th>Independent variables/type of flaw</th>
<th>Grade age (three degrees)</th>
<th>Circle test</th>
<th>Inkblot test</th>
<th>CCTDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different aspect</td>
<td>0.36**</td>
<td>0.22</td>
<td>0.09</td>
<td>0.16</td>
</tr>
<tr>
<td>Different meaning</td>
<td>0.00</td>
<td>0.44**</td>
<td>0.39**</td>
<td>0.18</td>
</tr>
<tr>
<td>Relevance</td>
<td>0.34*</td>
<td>0.28*</td>
<td>0.22</td>
<td>0.18</td>
</tr>
<tr>
<td>Credibility</td>
<td>0.23</td>
<td>0.11</td>
<td>0.16</td>
<td>0.29*</td>
</tr>
<tr>
<td>External</td>
<td>−0.28*</td>
<td>−0.31*</td>
<td>−0.00</td>
<td>−0.12</td>
</tr>
</tbody>
</table>

*p < .05; **p < .001 (two-tailed).

However, significant correlation was found between grade age and the ability to find other types of flaws (credibility among G1, and different aspect among G2—see Tables 1 and 2).

In the regression tests, among G1 students, a significant positive connection was found between Inkblot test scores and the ability to find different aspect type of flaws (t(53) = 2.68, p = .01, β = .381). Students who found more meanings for the Inkblot also found more different aspect flaws. A significant negative connection was found between CCTDI score and the ability to find relevance type of flaws (t(53) = −2.35, p = .023, β = −.324). A significant positive connection was found between Grade and the ability to find flaws whose type is credibility (t(53) = 2.74, p = .009, β = .389).

In the regression test, significant positive correlations were found among G2 students between each of the two creative tests score (Circle and Inkblot) and the ability to find different meanings type of flaws (respectively, t(55) = 2.77, p = .008, β = .37; t(55) = 2.1, p = .04, β = .271). A significant positive connection was found between Grade and the ability to find different aspects type of flaws (t(55) = 2.47, p = .017, β = .353).

5. Discussion

This experiment has replicated a previous finding, the fact that beyond the type of flaw, the ability to find flaws develops with age. However, the findings of this study have shown that this development is not monolithic. For the different aspect type, and the credibility type, the number of flaws increased with age. Also for the external type, the number of flaws decreased, indicating that older students understood the antilogos task. For the relevance and the different meaning types, no significant effect was found. It also appears that different text presented for antilogos evaluation yield different tendencies: for example, the number of different aspect flaws increased with age in the second group but not the first one.

A quite important and interesting finding concerns correlations between the level of disposition to critical thinking and antilogos ability. We did not find that the two were correlated, and this seems to suggest that antilogos ability is more a skill than a disposition, although a type-2 error is of course possible.

In order to study relations between the development of creative thinking and antilogos ability, we first observed that the synthetic part of creative thinking (measured by the Circle test) develops with age. Our suggestion is that in the Circle test, subject must undertake syntheses within and between circles in order to create meaningful pictures. This result is then understandable since the ability to undertake syntheses (an analytic skill) develops (Klaczynski, 2000). As for the imaginative part of creative thinking (measured by the inkblot) we found that it does not develop with age.

We have shown that information evaluated by the second group afforded a higher number of flaws of the different meanings type than by the first group. Therefore, in the second group, both measures of creative thinking and number of flaws of the type different meanings were correlated. No correlation was found between these variables and age. Although the kinds of objects are different in the two tests (a picture versus a text) it is conceivable that analogous abilities are needed to find different meanings for an inkblot and for ideas to find flaws in pieces of information. However, the correlation between the number of flaws and the number of pictures (in the Circle test) and the absence of correlation with age are quite surprising.

A possible explanation is that in the Circle test, subjects not only enact their ability to elaborate syntheses, but also use an additional ability that consists of imagining different meanings for images. The same ability seems needed for the inkblot too, and is also needed for finding different meanings in information. It helps people freeing themselves from initial interpretation of information when undertaking antilogos evaluation. The findings suggest that this specific ability for imagining different meanings of the same object (in different modalities) does not develop with age. On the
other hand, the ability to synthesize—an ability that helps people in their initial judgments and interpretations, develops with age, but at the same time gradually hampers the finding of alternative interpretations because they become more decisive and more entire in their opinions.

Such an explanation fits the dual process theory (Jacobs & Klaczynski, 2002): analytical skills (including the ability to undertake syntheses) increase in the course of childhood and adolescence (Kokis, Macpherson, Toplak, West & Stanovich, 2002). On the other hand, development leads adolescents to rely on heuristic skills and may lead to biases (e.g., evaluating arguments simply by checking whether they are in accordance with their own initial opinions) when they process information and elaborate schemes (Toplak & Stanovich, 2002). This kind of fixation is a reasonable theoretical explanation for the correlation between creative thinking and flaws of the kind different meanings, and for the absence of correlation between age and this kind of flaw.

In conclusion, the findings suggest that the development of critical reasoning is not monolithic. Since analytical skills develop, older adolescents can analyze information in order to find some types of flaws such as uncovering another (unexpected) aspect for interpreting the information, or challenging the credibility level of the given information. In contrast, it seems that heuristic biases may hamper older adolescents to free themselves from holding one meaning to given information, the meaning to which their heuristics is directed. Our findings suggest that in order to free themselves from holding one meaning, adolescents need a high level of the imagination aspect of creative thinking which does not develop during adolescence. Antilogos evaluation is then a prototypical example that shows the intertwining of critical reasoning and creative thinking when it is effective.

At the beginning of the article we showed that creative thinking and critical reasoning have been often considered as totally different kinds of abilities. We also showed that thinkers such as Ennis or Paul reconsidered the definition of critical reasoning to include skills and dispositions through which one opens new links instead of scrutinizing existing links in a closed analysis. We have shown that the antilogos ability should be considered as pertaining to critical thinking. We have shown rich links between this ability and creative thinking. We have also shown that the CCTDI test does not reflect this change. The absence of observed correlations with the CCTDI test may originate from a type-2 (beta) error. It may also originate from the fact that the antilogos ability is more a skill than a disposition. Using other tests that measure critical skills might have yielded interesting correlations. There is more to say, though, about the tools generally used to measure creative thinking as well as critical thinking. The Torrance Test of Creative Thinking that has been developed in 1966 and has not been used very often since then in education, but has not been replaced by other tests of creative thinking. Our study challenges then not only the lack of intersection between critical reasoning and creative thinking but the nature of tests used to measure creative thinking. Thinkers have already questioned the accepted nature of critical reasoning to propose a new list of skills and dispositions that are reflected in new tests. We suggest that these welcome developments should be followed by similar efforts to reconsider the nature of creative thinking. It seems to us that Perkins (1990) has expressed the relation between creative thinking and critical reasoning in the most convincing way: he claimed that the opposition between these two activities is in the goals that people want to attain. Perkins expressed that critical reasoning is targeted at evaluation whereas creative thinking is targeted at generation of creative products. According to Perkins, the two activities can be integrated: good creative thinking depends on multiple evaluative actions; good critical reasoning relies on imagination since a good evaluator should consider new perspectives that others miss or can imagine. Antilogos evaluation is an example that leads many adolescents to enact good critical reasoning integrated with creative thinking.

The integration of critical and creative thinking or from another perspective, heuristic and analytical skills, characterized antilogos evaluation. This evaluation was argumentative in nature, and we suggest that this is not accidental. Reasoning which is both critical and creative is open to unexpected/new meanings or perspectives but must be tamed in order to be acceptable. We suggest that this back and forth movement is argumentative. In other words, argumentative processes stand at the intersection of critical and creative thinking. Such a suggestion can explain the developmental incompatibility between Stein and Miller’s findings that showed the remarkable propensity of young children to apply argumentative skills (Stein & Miller, 1993), and Kuhn’s findings (Kuhn, 1991) according to which argumentative skills develop with age. Scrutiny over specific skills shows that in Stein and Miller’s study, children know to rebut argument, while in Kuhn’s study even adults have difficulties in rebutting arguments. Voss and Van Dyke (2001) have already addressed this contradiction to claim that Stein and Miller have observed children in natural conversations while Kuhn questioned subjects in structured interviews. Schwarz and Glassner (2003) pointed at the extreme sensibility of subjects to contexts in argumentation. The present study gives a clearer picture of this phenomenon. While analytic processes develop with age, heuristic processes develop too and may gradually hamper adolescents to free themselves from
holding one meaning to given information. Only students with high level creative thinking can do so when the context does not indicate how heuristics should be directed.

References


