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Advanced theory of mind in adolescence: Do age, gender and friendship style play a role?

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ABSTRACT

The ability to recursively infer the mental states of others to explain their complex behavior in ambiguous social situation may be called Advanced Theory of Mind (aToM). The relations between two components of aToM, cognitive and affective, measured on a behavioral level in 151 Polish 13-year-olds and 174 16-year-olds was examined. The role of age, gender and friendship style and its relations to the cognitive and affective aToM was explored. Cognitive aToM was only weakly to moderately related to affective aToM. Across both age groups females scored higher than males. Males' aToM abilities did not differ according to age, but they scored higher in the cognitive aToM than affective ToM. Also, different aspects of friendship style were significant predictors of both aToM abilities. The implications for two aToM components within a gendered social context were discussed.
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Crone and Dahl's (2012) review article on adolescence referred to adolescence as a period of social—affective engagement and goal flexibility. The authors, who are neuroscientists, compellingly argue that there is growing evidence that important changes take place in adolescence, not only in cognitive control but also in social and affective processing during the onset of puberty. Given that these changes are crucial to the understanding of adolescent vulnerabilities, we decided to both broaden and narrow this topic. We narrow this topic by focusing on the developmental perspective incorporating theory of mind approach (Apperly, 2010; Astington & Baird, 2005; Wellman, 2014) and broadened it by taking the decision to study social-cognitive and social-affective processing in both early and middle adolescence. There is a paucity of research on theory of mind (ToM) in adolescence (for exceptions see: Blakemore, 2008; Brizio, Gabbatore, Tirassa, & Bosco, 2015; Dumontheil, Apperly, & Blakemore, 2010; Vetter, Altgassen, Phillips, Mahy, & Kliegel, 2013), so we decided to address this research gap. Moreover, rather than taking a neurocognitive approach, we studied the adolescents' ToM on a behavioral level. We aimed to provide new ToM assessment tools but also to verify if the neurodevelopmental model of ToM development in adolescence (Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010) is adequate when behavioral data are provided. Models that corroborate each other at the behavioral and neuropsychological levels are better suited to explaining any psychological phenomenon (Morton, 2008), in this case advanced theory of mind (aToM).

We begin by shortly reviewing what ToM is and providing justification for our decision to refer to the adolescent's ToM as advanced ToM (aToM). We then go on to explain why we chose to study age and gender differences in aToM development.

Moreover, inspired by the recent trend favoring a more social contextual approach to the development of ToM (Hughes & Devine, 2015a, 2015b), we also decided to explore not only the role played by age and gender, but also the role of social factors such as friendship style in the development of aToM.

1. Advanced theory of mind

ToM is the ability to infer others' mental states in order to explain and predict their behaviors within the context of social interactions (Premack & Woodruff, 1978; for review: Astington & Hughes, 2013). Despite over three decades of research on ToM from a developmental perspective, there is still very little research on the social roots of ToM abilities in older children and adolescents (Hughes & Devine, 2015a; Lagattuta et al., 2015). Most researchers focusing on children's ToM distinguish between two different kinds of competencies, such as early, automatic, spontaneous recognition, as opposed to the later onset of flexible and reflective understanding of mind (for a review see: Astington & Hughes, 2013; Schneider, Slaughter, & Dux, 2015). Moreover, some researchers (Wellman, 2014) have recognized that, in childhood, the emotions and desires of others are understood earlier than their beliefs and knowledge, and a two-system model of development has been proposed (Tager-Flusberg & Sullivan, 2000). On the one hand, neurocognitive studies on ToM in adolescence also emphasize the need to differentiate between the affective as opposed to the cognitive aspects of ToM (Shamay-Tsoory et al., 2010), but on the other, contrary to much childhood research, the affective aspects of ToM are viewed as being more challenging to master as well as developing later than the cognitive aspects.

Advanced or more mature ToM (aToM) is defined on the basis of the tested participants being older in age and also by an emphasis being placed on the increased role played by recursion and interpretation in the process of social understanding, in particular the understanding of complex social situations. As Brizio et al. (2015) emphasized, false belief tests and even tasks prepared for older but atypical populations, like the Strange Stories Task (Happé, 1994) are not valid tools for measuring advanced ToM due to the ceiling effect. Dumontheil et al. (2010) proposed using a "Director Task", previously used as a measure of referential communicative abilities, and Bosacki and Astington (1999) utilized Ambiguous Social Stories as tasks in which complex social situations and non-direct, recursive communicative cues are required to analyze and interpret the stories. Advanced ToM is therefore based on recursion conceived as the ability to reason about second and higher-order beliefs (Miller, 2009, 2012) and on the ability to interpret social actions conceived as the ability to understand multiple perspectives within a communicative situation. Carpendale and Chandler (1996) who tested for understanding of ambiguity were among the first to use the term interpretative ToM, describing it as a more mature or advanced ToM ability that differs from simple false belief understanding (*e.g.* when someone receives a present yet starts to cry; such an unexpected emotion requires a more complex interpretation).

Advanced ToM abilities are needed in adolescence in complex and ambiguous social situations, especially when they require differentiation between cognitive and affective mental states. As opposed to the recognition and comprehension of simple emotions by young children, in adolescence there is a need to infer complex, belief-based social emotions that are always embedded in social contexts and in other people's life histories (Hoffman, 2001). This idea corroborates Shamay-Tsoory et al.'s (2010) suggestion that in affective ToM, empathy and cognitive ToM are integrated, and also that affective ToM, when complex reasoning about social emotions is needed, develops later than cognitive ToM. Moreover, Sebastian et al.'s (2012) study showed that adults outperformed adolescents in understanding emotions in social situations. Furthermore, Vetter et al. (2013) and Bosco, Gabbatore, and Tirassa (2014) provided evidence that developmental changes in affective advanced ToM abilities take place in adolescence. To our knowledge, current, neurodevelopmental research with adults (Corradi-Dell'Acqua, Hofstetter, & Vuilleumier, 2014) also supports the idea that the affective and cognitive aspects of ToM should be differentiated. Moreover, studies on the "social brain hypothesis" (Blakemore, 2008; Moor et al., 2012) also showed that different regions of the brain were active during some theory of mind tasks (i.e. Reading the Mind in the Eyes) when adolescents and adults were tested. However, there is still a lack of research attempting to differentiate between the affective and cognitive components of ToM presented in adolescence, and so, by implication, those presented in advanced ToM abilities, especially on a behavioral level, when complex inferences about these two kinds of mental state are needed.

Given the implications of Shamay-Tsoory et al.'s theory (2010), we assumed, for the purposes of the present paper, that cognitive aToM processes should be distinguished from affective processes, and also that cognitive aToM is a developmental prerequisite for affective aToM in adolescence. We also assumed that affective aToM requires intact processing of empathy or the ability to share and understand the emotional states of others (Singer, Critchley, & Preuschoff, 2009). These premises are important, as they enabled us to propose two different tasks, one to measure each aspect of aToM, and also to hypothesize that affective aToM is conceptually distinct and more complex than cognitive aToM.

2. Factors influencing aToM development

As previously noted, Hughes and Devine (2015a, 2015b) emphasized that contemporary research on ToM should be directed more towards finding the social factors responsible for the individual differences we see in ToM and aToM, in particular, differences related to gender. Furthermore, more biological approaches to ToM development, like, for example, Baron-Cohen's (2002) "extremely male brain" theory, stress that boys and girls may differ in their ability to infer mental states. The gender aspect is important because some studies show that girls possess higher levels of ToM, in particular, ToM emotional understanding (Białecka-Pikul, Rynda, & Syrecka, 2010; Bosacki & Astington, 1999; Cutting & Dunn, 1999; Devine &

Hughes, 2013), while others show that boys possess higher levels of emotional understanding (Laible & Thompson, 1998; Russell, Tchanturia, Rahman, & Schmidt, 2007), or there are no gender differences at all (Astington & Jenkins, 1995; O'Hare, Bremner, Nash, Happé, & Pettigrew, 2009). In addition, research shows that puberty starts 2 years earlier in girls than boys, and thus, gender differences should not be analyzed in a vacuum, but always in relation to age differences (see: Bosacki, 2016).

Moreover, given the specificity of adolescents' social relations and their need to learn to navigate more complex social situations (Blakemore, 2008; Crone & Dahl, 2012), peer relations and friendship, may have a particularly crucial influence on young people's aToM (Hughes, 2011). Peers become increasingly important in all aspects of young people's lives during adolescence, mainly replacing or supplementing the emotional support that was previously provided by their parents in younger childhood (Laursen & Mooney, 2008). As young people experience significant life changes, their friendships, as well as the way they perceive and experience these peer relations, i.e. their 'friendship style' (Baron-Cohen & Wheelwright, 2003), may be related to their ability to think about other people's minds. It can therefore be concluded that, as teens begin to think about their friends in new and unique ways, these divergent aspects of their friendship style may influence, and be influenced by, their level of aToM development. Studying the influence of friendship style on aToM is especially important in the case of adolescents as it may have valuable implications that promote social competencies.

We would also like to emphasize that friendship style is a very complex and multidimensional phenomenon, and may present differently in adolescent boys and girls. Brown and Klute (2004) claimed that friendship in adolescence differs according to gender, as girls' friendships have been found to be more intimate and emotionally expressive than boys. Research also shows that, in comparison to males, preadolescent females were more likely to report that they had emotionally close same-sex friendships or have 'best-friends' (Maccoby, 1998). In contrast, preadolescent males reported a higher number of same sex friends, many of whom were more emotionally distant and not necessarily 'close' or 'best' friends. To summarize, we would like to emphasize that, in addition to examining gender differences in friendship style, we asked a more precise question: Which aspects or dimensions of friendship style could be distinguished, and how would these aspects relate to aToM abilities?

3. Aims of the present study

Given that advanced ToM occurs during early to middle adolescence, we studied advanced ToM ability (cognitive and affective) in two groups of children — one group of 13 and one group of 16 year olds. Firstly, we predicted that the cognitive and affective aspects of aToM would represent distinct but partially overlapping abilities, and that the cognitive aToM task would be performed better than the affective one (Shamay-Tsoory et al., 2010). The measurement of cognitive and affective aToM on a behavioral level by using pen-and-pencil vignettes, necessitated the controlling of language skills (Hughes & Devine, 2015a). Secondly, we investigated gender and age differences in both aToM abilities, and hypothesized that the interactions between age and gender would play an important role in both cognitive and affective aToM. Thirdly, given that friendship is a complex and vital social factor during adolescence (Bagwell & Schmidt, 2011), our third research question was: How do social contextual factors, such as different aspects of friendship style, might be important for cognitive and affective aToM in adolescence?

4. Methods

4.1. Participants

The present study included 325 13-year-old ($M = 13.12$, $SD = 3.65$, 73 girls, $N = 151$) and 16-year-old Polish adolescents ($M = 16.23$, $SD = 4.44$ 132 girls, $N = 174$). The participants were mainly drawn from a middle socio-economic status (SES) urban area in South Poland, where they attended state schools at junior–high and secondary level.

4.2. Procedure

This study is a part of a larger longitudinal project on *Psychological Self in Social World* which was accepted by the Ethics Board of the Institute of Psychology in Jagiellonian University, Kraków, Poland. The study took place from September 2014 to February 2015 in the participants' schools. It was preceded by 10 h of training for researchers and coders. Four researchers and four coders took part in this training, during which all tasks used in the study as well as possible answers were analyzed. The study took place in the city of Krakow, Poland (more than 800,000 inhabitants) and in one small city in Southern Poland (18,000 inhabitants). The directors of two junior high schools and three secondary schools accepted the researchers' invitation, which was extended by email or phone to 6 selected schools in these cities. The directors selected the classes that would participate in the study and, during the first parents' meeting of the academic year, the researchers presented the project to the parents of participants and asked them to sign a consent form. 325 out of 351 parents agreed to take part in the research and all their children also agreed. Having obtained written consent from the parents and children, questionnaires were presented to groups of 20–30 adolescent participants during school time. The female researchers always presented the questionnaires and their instructions during two 1 h sessions and these were always given out in a fixed order: the Friendship

Questionnaire and Modified Hinting Task (first session), followed one week later by a second session that involved the Modified Unexpected Outcome Test and the General Test of Word Comprehension.

4.3. Measures

Advanced ToM was measured using two different tasks: cognitive aToM with a modified version of the Hinting Task (Corcoran, Mercer, & Frith, 1995), and affective aToM with a modified version of the Unexpected Outcome Test (Dyck, Ferguson, & Shochet, 2001). Both of these instruments were designed as an individual interview and, for pragmatic purposes — to measure large numbers of participants in their classes — we decided to prepare a pencil and paper version of these tests. All the tasks were translated from English to Polish.

The Modified Hinting Task (MHT) measures the cognitive aspect of advanced ToM. The presented stories describe social situations. To answer the test question, the adolescent had to think about the content of the protagonist's mind, in particular what they believe to be the beliefs or desires of another character. The test consists of 10 short stories in which one of the two characters says something that is an indirect request for information (see Appendix A for an example of one story and the coding schema). Since each answer was scored on a scale ranging from 0 (no answer or an inappropriate answer) to 2 (complex), each participant was able to obtain from 0 to 20 points. All the answers were classified by one coder, and 20% of the whole sample was coded by a second coder. The inter-rater reliability was sufficient (mean correlation $r = 0.86$, range of correlations 0.68—0.99, Cohen's kappa 0.87, with 95% confidence intervals 0.84—0.90), proportion of conformity 0.91. The Modified Hinting Task showed high internal consistency, $\alpha = 0.77$.

The Modified Unexpected Outcomes Test (MUOT) is a 12-item measure of advanced ability to apply reasoning skills and knowledge of the causes of emotions to the explanation of apparent incongruities between emotion-eliciting contexts and the emotions elicited by the contexts. The MUOT examines the advanced affective aToM abilities needed to understand other people's strange motives and unexpected, atypical emotions. The MUOT presents short stories which describe a situation likely to cause an emotional response in a protagonist, but one that would be expected to occur in such a situation. The adolescent is asked to provide additional situational information to resolve the apparent incongruity (see Appendix B for an example of a story and coding schema). Since each answer was scored on a scale ranging from 0 to 2 points, the participant could obtain from 0 to 24 points. Responses were classified by one coder, and 20% of the complete sample was coded by an independent coder. The inter-rater reliability was sufficient (mean correlation $r = 0.80$, range of correlations 0.61—0.96, Cohen's kappa 0.75, with 95% confidence intervals 0.71- 0.80), proportion of conformity 0.84. The MUOT test demonstrated high internal consistency, $\alpha = 0.73$.

The Friendship Questionnaire (FQ). The FQ is a measure of individual differences in perceptions of relationship style. As Baron-Cohen and Wheelwright (2003) stated, a high FQ score is achieved by respondents who report enjoying close, empathic, supportive friendships, like and are interested in people, enjoy interaction with others for its own sake and highly value friendships. The FQ comprises 35 questions, 27 of which offer the possibility of a score being attained. The FQ has a forced choice format. The maximum score for each item on the FQ is 5 points, so the scores for the whole test could range from 0 to 135 points. Approximately half of the items are worded to produce a "disagree" response and half to produce an "agree" response, so as to avoid a response bias either way. All FQ items are randomized with respect to the expected response. The FQ test showed high internal consistency $\alpha = 0.72$ (favorably comparable to the original FQ $\alpha = 0.75$, Baron-Cohen & Wheelwright, 2003).

Adaptation of the FQ to Polish conditions was performed via a three-step procedure. First a translation of each item was prepared and then the language for each of the individual items was adjusted on the basis of a pilot study of 63 Polish-speaking adolescents ($M = 13$ years 9 months, range from 13 years 0 months—15 years 8 months). Thirdly, we investigated if the FQ provided data on some components or aspects of friendship. To uncover the underlying structure of a friendship's relational style as measured by the FQ, we conducted an Exploratory Factor Analysis (EFA). The EF analysis was performed on a larger group of adolescents ($N = 412$; $M = 14$ years 8 months; range from 11 years 11 months—17 years 9 months, girls: $n = 262$), because the Friendship Questionnaire was used during the first introductory meeting in classes. We used a principal components method in the EFA, and as a differentiation criterion, adopted eigenvalues larger than 1. This criterion allowed 5 factors to be identified, explaining a total of 42% of the variance in the relationship between the variables. Also an analysis of the scree plot (Cattell, 1966) demonstrated that it is legitimate to distinguish five factors, as to the right of the fifth factor, a gentle fall begins in the value of the factors' eigenvalues. The factor loadings as well as the items for each factor after an orthogonal Varimax rotation are presented in Appendix C.

On the basis on the content analysis of each factor, we created descriptive labels for each factor of friendship style. We labelled the first factor as Need for Affiliation given that the highest number of items are related to the need to be frequently in touch with friends over the course of a day or week, as well as a desire or preference to be close to friends or other people. The second factor, Emotional Closeness, mostly groups items which described friendship as a special kind of emotionally close or intimate relationship. The related items reflect a shared mental experience and described friendship as a supportive and unique relationship based on communication, empathy and similar viewpoints. The third factor, Self-Disclosure, relates to emotional exchange and disclosure during the course of conversation relating to human emotions, character weaknesses and personal failures. The fourth factor, General Social Interest, reflects related items denoting a general interest in everyday details about relatives and friends. The fifth and final factor, the Social Mirror, incorporates items that suggests one's friends

could serve as a social mirror that reflects important objective information about ourselves. These five factors of friendship style may be understood as different aspects of friendship style.

The last technique we used was the *The General Test of Word Comprehension — Standard Version* by Matczak, Jaworowska, and Martowska (2012). This technique is a standardized instrument that measures language skills requiring receptive vocabulary. The participant identifies synonyms of the word-stimuli from four listed examples. The language skills test consists of 32 tasks, so the score could range from 0 to 32 points. The test has high rates of internal consistency ($r = 0.88$) and stability ($r = 0.94$) as well as validity ($r = 0.71$).

4.4. Statistical analysis

In cross-sectional study, we explored advanced ToM ability (cognitive and affective) in (early and middle) adolescence. We answered the question about the relations between aToM abilities doing correlational analysis (the Pearson coefficient was used). We explored the role of age and gender differences in both aToM abilities by using analysis of variance (ANOVA). When exploring whether age, gender and friendship style predicted each aToM ability, a hierarchical regression was performed. All statistical analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS 24) software. Probability values of less than 0.05 were considered to indicate statistical significance.

5. Results

The goal of this study was to analyze cognitive and affective aToM performance in adolescence, as well as their individual and social correlates such as age, gender and friendship style. First, we present the descriptive statistics of all the tested variables. The next part of the Results section focuses on correlational analysis in order to answer how strong the relations between cognitive and affective aToM are. The third part of the analysis concentrates on age and gender differences in relation to both advanced ToM skills. Finally, in the fourth part, we analyzed if the friendship style, age and gender were important factors for cognitive and affective aToM. We expected to find different predictors for cognitive and affective aToM in the hope that this could also be an important argument for distinguishing these two abilities at the behavioral level.

5.1. Descriptive statistics

Descriptive statistics for all variables are presented in Table 1. Table 2 presents the percentage of each kind of answer in both aToM tasks across the whole tested group and also in the early and middle adolescents' groups. In both age groups, about 28% of responses to the affective aToM test were wrong, while only about 10% were wrong in the case of the cognitive aToM task. More wrong answers were observed in the affective aToM task (33% in the early adolescence group, 22% in the middle adolescence group) than the cognitive aToM task (12% for the early adolescence group and 7% for the middle adolescence group), indicating that a higher level of difficulty was presented by the affective than the cognitive aToM tasks.

5.2. Correlational analysis

To answer the first research question, i.e. whether affective and cognitive aToM are related, we calculated the Pearson correlation coefficients between performances on cognitive and affective aToM tasks. We found a medium correlation between abilities in affective aToM and cognitive aToM across the whole tested group ($r (325) = 0.28$, $p < 0.001$ bivariate correlation); this correlation decreased when we recalculated the partial correlation controlling for language skills ($r (297) = 0.22$, $p < 0.001$), or language skills and age ($r (296) = 0.19$, $p < 0.001$). Since we found that age differences had a significant relation to language skills ($t (298) = -9.76$, $p < 0.001$), we also controlled for that variable, analyzing results separately by age group. The correlation was small and not significant in early adolescents ($r (130) = 0.06$, $p = 0.508$ partial correlations) and significant or moderate in size in middle adolescents ($r (164) = 0.32$ $p < 0.001$ partial correlation). The difference between these correlations was significant, $z = -2.29$, $p < 0.022$.

Table 1
Descriptive statistics for advanced ToM, friendship style factors and language tasks.

Variable	N	M	SD	Range
Advanced Theory of Mind				
Cognitive aToM	325	11.83	3.19	1—20
Affective aToM	325	13.04	4.47	1—24
Friendship style				
Need of affiliation	324	3.61	0.87	0—5
Emotional Closeness	325	3.37	1.11	0—5
Self —disclosure	324	3.08	1.07	0—5
General social interest	324	2.08	0.72	0—3.75
Social Mirror	324	2.74	1.20	0—5
Language skills	320	10.75	4.41	2—25

Table 2
Percentage of Each Kind of Answers in Age Groups in both Cognitive and Affective aToM Tasks.

Adolescence	cognitive aToM Modified Hinting Task			affective aToM Modified Unexpected Outcomes Test		
	Wrong	Realistic	Complex	Wrong	Partially adequate	Fully adequate
Early	12.38	65.16	22.46	33.29	36.83	29.87
Middle	7.47	59.48	33.04	22.41	36.30	41.28
Whole group	9.75	62.12	28.12	27.47	36.55	35.98

5.3. Comparisons between age and gender in advanced ToM tasks

Additionally, in order to analyze the differences between cognitive and affective aToM and to explore if cognitive aToM is "more developed" than affective aToM, we needed to compare the results obtained with tasks used to measure both these abilities. We are aware that our cross-sectional design is not suited to providing a truly developmental analysis, but we expect to attain preliminary support for the idea that the cognitive aToM task is easier for both tested age groups than affective the aToM task. However, we also expected that gender might be important for age differences, so we tested here our second hypothesis that there is an interaction between age and gender for advanced ToM. Moreover, because both the cognitive and affective aToM tasks had a different possible range of results (0–20 and 0–24), we re-calculated the results of these tasks on a new scale that showed the percentage of maximum results obtained for the task for individual participants. We performed an analysis of variance with repeated measures for advanced ToM (×2 cognitive and affective aToM) as within-subject factors and Age (×2 early and middle adolescents) and Gender (×2, female, male) as between-subject factors. Descriptive statistics for all the variables are presented in Table 3. Our analysis showed the significant main effect of aToM (F $(1, 321) = 28.49$, $p < 0.001$, $\eta_p^2 = 0.08$, Age $F(1, 321) = 15.92$, $p = 0.001$, $\eta_p^2 = 0.05$), and Gender ($F(1, 321) = 43.60$, $p < 0.001$, $\eta_p^2 = 0.12$), and a significant Age and Gender interaction ($F(1, 321) = 4.41$, $p = 0.037$, $\eta_p^2 = 0.01$). The analysis showed a significant interaction between aToM and Gender ($F(1,321) = 18.27$, $p < 0.001$, $\eta_p^2 = 0.05$), but no significant interaction between aToM and Age ($F(1,321) = 0.01$, $p = 0.916$, $\eta_p^2 < 0.01$), or aToM × Gender × Age interaction ($F(1,321) = 0.89$, $p = 0.347$, $\eta_p^2 < 0.01$) was found. An analysis of significant simple effects using pairwise comparison showed that adolescents performed better on the cognitive aToM task ($M = 59.18$, $SD = 15.97$) than the affective aToM task ($M = 54.35$, $SD = 18.64$). Analysis of Age and Gender interaction by pairwise comparison showed that middle adolescent females ($M = 64.21$, $SE = 1.07$) performed aToM tests better than early adolescent females ($M = 55.21$, $SE = 1.43$, $F(1,321) = 25.24$, $p < 0.001$, $\eta_p^2 = 0.07$), while the performance of male age groups did not differ significantly between age groups ($F(1,321) = 1.41$, $p = 0.235$, $\eta_p^2 < 0.01$). Although females received higher aToM scores than males in both early ($F(1,321) = 11.07$, $p < 0.001$, $\eta_p^2 = 0.03$) and middle adolescent groups ($F(1,321) = 34.93$, $p < 0.001$, $\eta_p^2 = 0.10$), the gender effect in the middle adolescent group was stronger.

Subsequent analysis of the significant interaction effect for aToM and gender by pairwise comparison showed that males received higher scores in cognitive aToM tasks ($M = 55.82$, $SE = 1.47$) than in affective aToM tasks ($M = 44.08$, $SE = 1.54$), while female performance on both aToM tasks did not differ significantly. Comparison of aToM task performance by gender showed that females scored higher that males in cognitive aToM tasks ($F(1,321) = 6.00$, $p = 0.015$, $\eta_p^2 = 0.02$) and in affective aToM tasks ($F(1,321) = 57.33$, $p < 0.001$, $\eta_p^2 = 0.02$). However, the effect was stronger for affective aToM.

5.4. Regression analysis

Finally, to answer the third research question – How do social contextual factors such as different aspects of friendship style might be important for cognitive and affective aToM in adolescence? – we first calculated correlations between five

Table 3
Descriptive Statistics for Re-calculated Results of Cognitive and Affective aToM by Age and Gender.

Variables Age	Gender	n	Cognitive ToM			Affective ToM		
			M	SD	Range	M	SD	Range
Early-adolescence	Female	73	56.36	13.62	30–100	54.05	19.93	8.33–100
	Male	78	53.78	16.77	5–100	43.32	16.31	4.17–79.17
	Total	151	55.03	15.33	5–100	48.50	18.87	4.17–100
Middle–adolescence	Female	132	64.35	14.12	30–100	64.07	13.85	37.5–100
	Male	42	57.85	19.19	10–100	44.84	17.50	4.17–83.33
	Total	174	62.78	15.68	10–100	59.43	16.91	4.17–100
Total-adolescence	Female	205	61.51	14.43	30–100	60.50	16.93	8.33–100
	Male	120	55.20	17.68	5–100	43.85	16.68	4.17–83.33
	Total	325	59.18	15.97	5–100	54.35	18.64	4.17–100

Notes: Re-calculated results of the aToM tasks are in the scale which shows the percentage of maximum results obtained for the task for individual participant.

Table 4

Bivariate and partial correlations (controlling for language skills and age) between friendship style and advanced ToM.

Friendship style	Cognitive aToM		Affective aToM	
	bivariate correlations	partial correlations	bivariate correlations	partial correlations
Need of Affiliation	−0.08	−0.08	−0.17**	−0.10
Emotional Closeness	0.20***	0.14*	0.30***	0.25***
Self − disclosure	0.01	0.00	−0.03	−0.09
General Social Interest	0.07	−0.03	0.10	0.06
Social Mirror	−0.01	−0.06	0.12*	0.12*

Notes: *p < 0.05. **p < 0.01. ***p <0.001.

friendship style factors and the aToM results. We controlled for language skills and age in these analyses (see Table 4). The results showed significant and small or moderate correlations between advanced ToM and different aspects of friendship. The pattern of results was different for affective and cognitive aToM. Cognitive aToM was only positively and moderately related to Emotional Closeness, but the effect size decreases when language skills are controlled for. Affective aToM was related to 3 aspects of friendship style. There was a small negative correlation with Need for Affiliation and moderate positive correlation with Emotional Closeness. Moreover, the correlation between affective aToM and Social Mirror was positive but the effect size was small.

In order to directly answer the third research question about the role of age, gender and chosen aspects of friendship styles in aToM, we computed hierarchical multiple regressions. We performed the analysis separately for cognitive aToM and affective aToM as outcome variables. Age, gender and language skills were used as control factors, and three factors of friendship style that turned out to be significant in the earlier correlation analysis (Need for Affiliation, Emotional Closeness and Social Mirror) were used as main predictors. Detailed results are presented in Table 5.

In the first regression analysis, we entered cognitive aToM as the outcome variable. When age and gender were entered as a control variable at Step 1, the regression was significant ($R = 0.28$, $R^2 = 0.08$, adjusted $R^2 = 0.07$, $F(2, 296) = 13.42$, $p < 0.001$). The addition of language performance as a predictor in Step 2 did not improve the prediction ($R\ change = 0.01$, $F(1, 295) = 3.35$, $p = 0.06$). The addition of friendship factors resulted in a statistically significant increment in the prediction ($R\ change = 0.03$, $F(3, 292) = 3,51$, $p = 0.01$). For the final model, multiple regression was significant ($R = 0.35$, $R^2 = 0.12$, adjusted $R^2 = 0.10$, $F(6, 292) = 6.95$, $p < 0.001$). Inspection of the final model indicated that only age and Emotional Closeness positively predict cognitive aToM, but the effect size was small. Also Social Mirror was a small, negative but significant predictor of cognitive aToM.

In the second regression analysis, we entered affective aToM as the outcome variable. When age and gender were entered as control variables at Step 1, the regression was significant ($R = 0.48$, $R^2 = 0.23$, adjusted $R^2 = 0.22$, $F(2, 296) = 44.97$, $p < 0.001$). The addition of language skills as a predictor in Step 2 improved the prediction ($R\ change = 0.06$, $F(1, 295) = 29.28$, $p < 0.001$). The addition of friendship factors resulted in a further statistically significant increment in the prediction ($R\ change = 0.02$, $F(3, 292) = 3.38$, $p = 0.01$). For the final model, multiple regression was significant ($R = 0.57$, $R^2 = 0.32$, adjusted $R^2 = 0.31$, $F(6, 292) = 23.51$, $p < 0.001$). Analysis of the final model coefficients indicated that there were only three predictors of affective aToM. Among them, Need for Affiliation and gender (being male) negatively predicted affective aToM but the effect size was small. Moreover, language skills positively and moderately predicted affective aToM.

Table 5

Hierarchic Regression Analysis Results for Cognitive and Affective aToM. In Step 1 Age and Gender as Predictors were Added. In Step 2 Language Skills were Added and in Step 3 All Five Aspects of Friendship Style were Added.

Variables	Cognitive aToM			Affective aToM		
	B	SE B	β	B	SE B	β
Step 1						
Age	0.04	0.01	0.24***	0.04	0.01	0.19***
Gender	−0.68	0.37	-0.10	−3.51	0.47	−0.39***
Step 2						
Age	0.03	0.01	0.18**	0.01	0.01	0.05
Gender	−0.74	0.37	−0.11*	−3.72	0.45	-0.41***
Language Skills	0.08	0.04	0.11	0.29	0.05	0.29***
Step 3						
Age	0.02	0.01	0.16*	0.00	0.01	0.03
Gender	−0.63	0.42	−0.09	−3.48	0.51	−0.38***
Language Skills	0.07	0.04	0.10	0.27	0.05	0.27***
Need of Affiliation	−0.03	0.02	−0.07	−0.08	0.03	−0.14**
Emotional Closeness	0.05	0.02	0.15*	0.04	0.02	0.09
Social Mirror	−0.10	0.05.	−0.12*	-0.00	0.06	<-0.01

Notes: *p < 0.05. **p < 0.01. ***p < 0.001.

6. Discussion

Based on Shamay-Tsoory et al.'s (2010) neurobehavioral model of aToM in adolescence we studied the relations between cognitive and affective aToM on a behavioral level. We also explored the role age and gender play in cognitive and affective components of aToM, and the relevance of friendship style to these two components of aToM was proved.

Regarding the first finding, the aToM scores of participants suggested that two kinds of aToM systems could be distinguished during adolescence, and not only, as has previously been shown, at a neurobiological level (Corradi-Dell'Acqua et al., 2014; Sebastian et al., 2012; Shamay-Tsoory et al., 2010), but also in our research on the behavioral level. The two techniques we used to measure aToM took the form of short stories but conceptually they tap different abilities. In the Hinting Task, the social scripts presented are easily understood by using the epistemic mental states of the protagonist. On the other hand, in the Unexpected Outcome Test, a reference to the emotional state is needed to explain the strange behavior of the lead protagonist. By using these tasks with adolescents while always controlling for their language skills, we managed to test cognitive and affective advanced ToM. As the correlations between the results were small we can state that in adolescence the ability to understand and explain behavior by reference to cognitive and affective mental states probably seems to create two separate systems that only partially overlap. Moreover, the significant difference between correlations of cognitive and affective aToM in early and middle adolescence supported for this conclusion.

The study results also showed that adolescents performed better on the cognitive aToM task than in the affective aToM task. This result can be interpreted within the framework of the Shamay-Tsoory et al. (2010) model of ToM. In this model, affective ToM incorporates cognitive aspects of empathy and interacts with emotional empathy, while cognitive ToM can be treated as a prerequisite for affective ToM. In our study, we have shown that in accordance with the model, the cognitive aToM task was easier in relative terms than the affective aToM task. Although this is an especially interesting result, we should be very careful interpreting it in terms of developmental change, because we based all our findings on a cross-sectional design. During childhood, as Tager-Flusberg and Sullivan (2000) pointed out, the emotional component of ToM based on perceptual cues and automatic reactions is more fundamental, but in adolescence, affective aToM turned out to be more complex and probably developed for a longer period of time. Here, we can only speculate that inferences based on unexpected emotions are needed in affective aToM stories, which may explain why they were more difficult for adolescents.

Moreover, when we calculated the results independently for early and middle adolescence, low but significant correlation was only observed in the older group. So relations between affective and cognitive aToM only occurred in 16 year olds. This finding supports past research that suggests ToM is, in a sense, a multidimensional construct and these abilities continue to develop along the lifespan (Hughes, 2011; Wellman, 2014).

The second main finding from our study demonstrated that age and gender were found to be important factors for cognitive and affective aToM. In general, females performed better in both the cognitive and the affective aToM tasks. If we take into account age when comparing effect size, we can see that gender difference is more pronounced in middle than early adolescence. It is possible that this is a result of growing gender differentiation. Generally, this supports past research pointing to a higher level of ToM in females (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Baron-Cohen, Tager-Flusberg, & Cohen, 2000). However, given the differences in the male and female group size as well as the cross-sectional design of the study, this result should be interpreted with caution. Moreover, an interaction analysis of both advanced ToM tasks and gender showed that females outperformed males in both affective and cognitive ToM, but this effect was stronger, in particular, for affective aToM. Moreover, female aToM abilities do not differ with regard to affective and cognitive tasks, while male abilities were higher for the cognitive than the affective task. Our results support past results, indicating that emotional understanding, in particular, is more developed in girls than in boys (Bosacki & Astington, 1999; Cutting & Dunn, 1999).

Most importantly, given the current lack of research, our results provide a novel insight into gender differences in affective and cognitive aToM abilities. Interpreted from a developmental and social-cognitive perspective (Bandura, 2001), it is possible that during adolescence, females are encouraged by their peers, families, and teachers to express and reflect upon their emotions at a deeper level than is the case with males. Popular media such as film, TV, social media and so on (ter Bogt, Engels, Bogers, & Kloosterman, 2010) may also support gender-role stereotypes in females that could influence them to discuss their emotions more than is the case with males. As a result, females are expected to show greater ability to understand the emotions of others by displaying empathy and compassion.

On the other hand, adolescent males may be socialised by images presented in the media to focus on immediate action rather than time-consuming contemplation and reflection on their own and other people's feelings (ter Bogt et al., 2010). Young boys may also be more prone to adopt the norms of masculinity, i.e., emotional stoicism, physical toughness, and autonomy (Lobel, Nov-Krispin, Schiller, Lobel, & Feldman, 2004). Moreover, adolescent males more often form friendship relations based on joint action than the sharing of feelings (Bagwell & Schmidt, 2011; Way, 2011). Therefore, adolescent males may not have as many opportunities to practice emotional skills, especially within the contexts of interpersonal conflict or personal adversity.

Our final aim was to investigate if different aspects of friendship style were predictors of cognitive and affective aToM (while controlling for age, language skills and gender). The results of regression analyses suggest that being older and perceiving friendship as a supportive relationship based on emotional closeness help to develop cognitive aToM. On the other hand, adolescents who were less likely to view friendship as a social mirror, or as a source of objective information about themselves, were able to understand others' cognitive mental states. As cognitive aToM is less difficult to develop than affective aToM (Shamay-Tsoory et al., 2010), maybe social processing based on the cognitive states of others calls for more

intimate, frequent contact with friends who, rather than criticizing the adolescent, should allow them to exercise their abilities for a longer time. This insight should be regarded as a potential basis for further research.

Moreover, the pattern of results for affective aToM, as opposed to cognitive aToM, was completely different. In fact, age, Emotional Closeness, and Social Mirror factors were no longer important predictors, but three other factors turned out to be significant. Being a female with more developed language skills aided the development of mature affective aToM. Moreover, a lower Need for Affiliation assisted the development of affective aToM. This shows that the less the participants need instant close contact with friends, the better they understand others' emotions. Maybe in girls with better language abilities, no direct, physical contact is important to imagine the inner worlds of others. It is worth emphasizing that gender again turned out to be an important factor for emotional processing abilities and, although this may appear to be speculation, these results are in line with the idea that alexithymia, i.e. difficulty in identifying and describing feelings, is more frequent in males (Levant, Hall, Williams, & Hasan, 2009).

Moreover, it is worth adding two more general points. First, the finding that cognitive and affective aToM are related to different aspects of friendship style supported our result that these two abilities are partially distinct on a behavioral level. Second, we want to emphasize that in the correlational analysis, Emotional Closeness was positively related to cognitive and affective ToM, but in the regression analysis, when gender was also added as a predictor, Emotional Closeness was only a significant predictor for cognitive aToM. It would appear that in the case of gender, the need for intimate relationships is either already present or is something more specific to females.

In summary, the present results support the idea that friendship style, conceived as a social contextual factor, could provide an important context for the development of advanced ToM abilities in adolescence. This study makes a novel and unique contribution to the current discourse on advanced ToM, since it has provided empirical evidence that age, gender and the way young people experience and perceive their friendship relations partially contribute to their aToM abilities. Future research needs to explore the complexity of intimate, emotionally intense friendships in adolescence including the harms and benefits of such closeness (Bosacki, 2016; Schneider, 2016).

The patterns of results as they stand should be treated with caution for many reasons. Firstly, the predictors explained only 10% of the variance in cognitive aToM and 31% of the variance in affective aToM. Therefore, in further research, other important – in particular, social contextual – predictors should be added. Secondly, we assumed that friendship style would influence aToM development either positively or negatively, but of course the reverse relationship could be true, i.e. aToM development may affect friendship style. Thirdly, the main strength of our study – the measurement of aToM on a behavioral level – could also be considered a limitation. Our results might have been more reliable if we could have referred to Shamay-Tsoory et al.'s (2010) model at a neurobiological and behavioral level at the same time. Such an approach would be useful for future research.

In addition, our cross-sectional design did not allow us to assume the existence of causal effects. Further longitudinal studies are needed, specifically to explore if adolescent females develop affective advanced ToM earlier and faster than males. Future studies should also explore why, and how, other social contextual factors at the schools where the study took place, such as emotional climate, teacher-learning relationships, ethnicity and family income level or the level of education attained by parents, peer popularity, digital media habits, and so on, may influence advanced ToM development.

Acknowledgments

Appendix A

The Modified Hinting Task (MHT). An example of a story and coding schema

"Gordon goes to the supermarket with his mum. They arrive at the sweetie aisle. Gordon says: 'Cor! Those treacle toffees look delicious.' Question: What does Gordon really mean when he says this?"

The answers were classified as: (0) inappropriate answer or lack of an answer. (1) Egocentric/realistic – perspective of only one person is included (*e.g.* he wants sweets) or they say what one character wants from the other person (*e.g.* he wants his mum to buy him sweets). (2) Complex/interpersonal –focused on relations between two characters and their communicative intentions (*e.g.* he suggests to his mum that he wants sweets and this is why he tries to persuade her to buy him sweets) or there is clear explanation of the implicit request included in the indirect speech (*e.g.* this way he tries to ask for sweets).

Appendix B

The Modified Unexpected Outcome Test(MUOT). An example of a story and coding schema
In one of the stories. A boy called Johnny gets a new bicycle for Christmas. The test question was: *What do you think Johnny would feel? Happy? Well. Johnny didn't feel happy. He started to cry. Why would Johnny cry?* The participant in the study has to write an answer to this last question. The answers were then classified as: (0) inappropriate. for no response. irrelevant responses and answers giving inappropriate emotions; (1) partially adequate. for general relevant explanations without reference to how it applies to the specific situation or for an answer that is relevant to the context. but implausible. not

explaining all the variables or the intensity of the protagonist's emotions; (2) fully adequate. for an explicit explanation that demonstrates an understanding of what conditions give rise to the emotions and which is directly relevant to the context of the item. An adequate answer must also imply an understanding of human motivation as well as being of appropriate intensity.

Appendix C

Results of Exploratory Factor Analysis of Friendship Questionnaire

Friendship style factor	Item/maximum scored alternative	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1 Need of Affiliation	What would be the minimum social contact you would need to get through a day?	**0.74**	<0.01	0.03	0.07	0.39
	What would be the minimum social contact you would need to get through a week?	**0.72**	0.02	0.05	0.10	0.30
	How often do you make plans to meet with friends?	**0.52**	0.03	0.07	0.09	-0.07
	My ideal working space would be … in an open plan office.	**0.46**	0.11	0.10	-0.04	-0.08
	How easy to do you find it to make new friends?	**0.37**	-0.02	0.33	0.03	-0.16
	I like to be close to people.	**0.36**	0.06	0.29	0.07	0.12
	Do you work harder at your career than at maintaining your relationships with friends?	**0.29**	0.01	0.04	0.09	-0.00
	If I fell out with a good friend and I thought that I hadn't done anything wrong. I would: do whatever it takes to repair the relationship.	**0.12**	0.05	0.09	-0.03	0.00
Factor 2 Emotional Closeness	The most important thing about a friendship is having somebody to confide in.	0.01	**0.63**	-0.11	0.00	0.08
	My friends value me more as someone who is a support to them than as someone to have fun with.	-0.00	**0.50**	0.07	-0.04	0.00
	When I talk with friends on the phone. it is usually to chat rather than to make arrangements.	0.13	**0.40**	0.10	0.11	0.09
	I prefer meeting a friend for a chat. e.g. at a pub. at a café.	0.06	**0.35**	0.03	0.08	0.00
	If a friend had a problem. I would be better at discussing their feelings about the problem than coming up with practical solutions.	-0.03	**0.33**	0.03	0.09	0.09
	If I had to pick. I would rather have a friend who feels the same way about life as I do. than a friend who enjoys doing the same things as me.	0.06	**0.27**	0.04	-0.00	-0.05
	I have one or two particular best friends.	-0.18	**0.24**	0.00	0.02	0.07
	I tend to arrange to meet somebody and then think of something to do.	0.09	**0.20**	0.11	0.09	0.06
Factor 3 Self -disclosure	How easy to do you find it to tell a friend about your weaknesses and failures?	0.06	0.09	**0.72**	-0.02	0.00
	How easy do you find discussing your feelings with your friends?	0.09	0.15	**0.66**	0.13	0.23
	How easy do you find it to admit to your friends when you're wrong?	0.08	0.00	**0.32**	-0.11	-0.30
	If I have to say something critical to a friend. I think it's best to broach the subject gently.	0.07	0.00	**0.12**	0.01	-0.02
Factor 4 General Social Interest	How interested are you in the everyday details (e.g. their relationships. family. what's currently going on in their lives) of your close friends' lives?	0.08	0.38	0.06	**0.71**	0.13
	How interested are you in the everyday details (e.g. their relationships. family. what's currently going on in their lives) of your casual friends' lives?	0.14	0.24	0.05	**0.55**	0.13
	When you are in a group. e.g. at work. school. church. parent group etc. how important is it for you to know the "gossip" e.g. who dislikes who. who's had a relationship with who secrets.	0.07	-0.22	-0.06	**0.33**	0.23
Factor 5 Social Mirror	How important is it to you what your friends think of you?	0.06	0.33	-0.04	0.23	**0.42**
	When I have a personal problem. I feel that it is better to share it with a friend.	0.11	0.31	0.29	0.08	**0.40**
	In terms of personality. how similar to your friends do you tend to be?	0.01	0.03	0.01	0.06	**0.39**
Descriptive statistics	M	28.87	27.03	12.34	8.33	8.23
	SD	6.97	8.94	4.31	2.88	3.62
	Range	3–40	2–40	1–20	0–15	0–15
Percentage of explained variance		14.99	8.94	7.15	5.45	4.79

Notes: The method of extracting factors – maximum likehood. Method rotation - Varimax with Kaiser normalization. The rotation of convergence reached in 6 iterations. Lodings for items used to create each factor are bolded.

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