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# Timing of Sexual Maturation and Women's Evaluation of Men

Stefan Belles<sup>1</sup>, Wilfried Kunde<sup>1</sup>, and Roland Neumann<sup>2</sup>

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## Abstract

Many antecedents and consequences of an accelerated sexual maturation are associated with negative experiences with the opposite sex. Here we show a connection between menarcheal age, a salient sign of female sexual maturation, and the implicit attitude toward men in later adulthood. In Study 1, earlier age at first menstruation was associated with automatic negative evaluations of male faces but not female ones. Study 2 revealed a relationship between early age of menarche and an implicit association between the concepts male and danger. In Study 3, the earlier the menarche, the larger was the estimated egocentric distance of virtual male voices and the shorter the estimated distance of female voices. These results, obtained about a decade after onset of menstruation, suggest that apparently subtle differences in the onset of sexual maturation may have long-lasting implications for intersexual relationships.

## Keywords

distance estimation, implicit evaluation, pubertal timing, menarche, gender attitudes

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Sexual maturation is an important life event for every human individual. It is accompanied by physical changes like an increased release of sexual hormones and a redistribution of body fat, which leads to sexual dimorphism and a typical adult body shape (e.g., Lassek & Gaulin, 2007; Sisk & Foster, 2004). These physical changes are obvious signals of the transition from childhood to adulthood at both the individual and the societal levels (e.g., Alsaker, 1995; Logan, 1980; Uskul, 2004). Although sexual maturation is a continuous process that normally extends over several years, there is a distinct event for women, the menarche, in which sexual maturation manifests itself in a salient manner. Although sexual maturation is an indispensable part of natural development, premature sexual development can have serious and sometimes negative consequences for physical and mental health. It is known, for example, that an early menarche increases the probability of breast cancer, affective disorders, and risk behavior (e.g., Golub et al., 2008; Stice, Presnell, & Bearman, 2001). In contrast, girls who mature later are less prone to depression and show a more positive body image (e.g., Compian, Gowen, & Hayward, 2004). We have seen a continuous decrease in pubertal timing in industrial countries and transition countries like China over the past decades (e.g., Euling et al., 2008; Graham, Larsen, & Xu, 1999). Therefore, we consider an understanding of the psychological consequences of this phenomenon an issue of broad interest to society (cf. Sprinkle, 2001).

## *Physical and Psychosocial Antecedents of Menarcheal Age*

Several physical factors have been identified so far that are considered to be responsible for an acceleration of sexual development, such as increasing environmental pollution (e.g., Blanck et al., 2000; Parent et al., 2003), improved nutrition (e.g., Adair, 2001; Davison, Susman, & Birch, 2003), improved health care (e.g., Kac, Velasquez-Melendez, & Coelho, 2000), and genetic heritability (e.g., Mustanski, Viken, Kaprio, Pulkkinen, & Rose, 2004).

Next to these primary physical antecedents there are also different psychosocial antecedents associated with girls' pubertal timing (e.g., Ellis & Garber, 2000; for a review, see Ellis, 2004). In particular, the family environment appears to have a substantial influence on the onset of the sexually reproductive phase of life (cf. Ellis, 2004). A low socioeconomic status of the family, for instance, is associated with a precocious menarche (e.g., Ellis & Essex, 2007). However, because socioeconomic status is correlated with numerous

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factors (e.g., caloric intake or access to health care), it is difficult to determine a specific relationship between socioeconomic status and age at menarche (cf. Ellis, 2004).

There is, however, substantial empirical evidence that within the family environment fathers play a unique role for the pubertal timing of their daughters. In particular, the quality of paternal investment seems to have an impact on women's reproductive strategies (e.g., Draper & Harpending, 1982; Ellis, 2004; Tither & Ellis, 2008; Trivers, 1972). Accordingly, several studies report that women with absent fathers tend to have an accelerated sexual development. In a study by Quinlan (2003) with more than 10,000 U.S. participants, women whose parents separated during the first 6 years of their lives experienced twice the probability of an early menarche compared to women whose fathers were present during this period. Similarly, Ellis, McFadyen-Ketchum, Dodge, Pettit, and Bates (1999) reported that the more time fathers spend with their daughters and the more positive their dyadic interaction was during the very early years of life, the more delayed sexual maturation was several years later. Additionally, Saxbe and Repetti (2009) recently reported that mothers' ratings of less emotional support of their husbands were correlated with an accelerated maturation of their daughters. According to paternal investment theory (cf. Draper & Harpending, 1982; Trivers, 1972), the correlation between a low early father-daughter relationship quality and a precocious pubertal development is based on an evolved psychological mechanism and reflects the phenotypic plasticity of the reproductive system. That is, girls who early in life detect and encode certain cues in their environment that indicate low quality of paternal investment develop a low expectation regarding male contribution to their own sexual reproduction in the future. Within the scope of such a life history perspective (see Charnov, 1993; Kaplan & Gangestad, 2005), several proximate factors are suggested that are indicative of paternal investment quality and determine inter-individual differences in female reproductive strategies, such as the aforementioned quantity and quality of father-daughter interaction, the absence of the biological father, the presence of a stepfather, and the quality of the father-mother interaction (for a review, see Ellis, 2004). It is assumed that women early in life adapt their reproduction strategy to this low expectation regarding paternal investment. Accordingly, father absence is, for instance, not only associated with an early menarche but also a relatively unreliable pair-bonding orientation later in life (e.g., Belsky, Steinberg, & Draper, 1991) and a greater attraction to infants (e.g., Maestripieri, Roney, DeBias, Durante, & Spaepen, 2004). Besides this unique impact of paternal investment quality on pubertal timing, also other direct and indirect negative experiences with men, like childhood abuse or the mother's negative attitudes toward men, are assumed to be precursors of a precocious sexual development (e.g., Ellis, 2004; Romans, Martin, Gendall, & Herbison, 2003; Trickett & Putnam, 1993; Turner, Runtz, &

Galambos, 1999; Vigil, Geary, & Byrd-Craven, 2005; Zabin, Emerson, & Rowland, 2005). The link between such aversive childhood experiences and an acceleration of sexual development can be explained by the close connection of the two distinct endocrine systems responsible for the regulation of stress responses and sexuality (cf. Del Giudice, Angeleri, & Manera, 2009; Gunnar, 1998).

### *Discrepancies Between Physical and Social Development*

The onset of the sexually reproductive phase of life not only implies radical physiological changes but has many consequences for the individual as a social being. In other words, the individual is not solely confronted with bodily changes, like the development of visible secondary sexual characteristics, but with reactions of the social environment to these changes. On the basis of such pubertal changes others might, for instance, misjudge the social and cognitive maturity of an adolescent (Eichorn, 1975). This is reflected by the finding that more physically mature girls are less controlled by their parents (Hill, Holmbeck, Marlow, Green, & Lynch, 1985). In general early maturers are already engaged in adult-like behaviors at an age when late maturers still show a more child-like behavior (e.g., Magnusson, Stattin, & Allen, 1985; cf. Brooks-Gunn, 1988). Among the most important social consequences of sexual maturation is the increased likelihood to be involved in romantic and sexual interactions. Accordingly, a precocious sexual maturation is associated with an earlier dating of boys (e.g., Kim & Smith, 1998), earlier sexual behavior (Bingham, Miller, & Adams, 1990; Flannery, Rowe, & Gulley, 1993; Lam, Shi, Ho, Stewart, & Fan, 2002; Phinney, Jensen, Olsen, & Cundick, 1990), and a younger age at first pregnancy (Manlove, 1997; Udry, 1979). This may be partly due to endocrine and neural changes that affect the salience of sexual stimuli, sexual motivation, and sexual behavior (for an overview see Sisk & Foster, 2004). These changes, however, might easily exceed the coping abilities of an early maturing girl because sexual and romantic relationships are not infrequently accompanied by negative events like romantic rejection, relationship break-ups, or verbal and physical interpersonal aggression (cf. Monroe, Rohde, Seeley, & Lewinsohn, 1999; Zimmer-Gembeck, 2002).

In addition, the appearance of secondary sexual characteristics can lead to an increase of unwanted sexual attention from the opposite sex (e.g., Flannery et al., 1993; Liao, Missenden, Hallam, & Conway, 2005). Accordingly, McMaster, Connolly, Pepler, and Craig (2002) reported an increased frequency of cross-gender sexual harassment, but not same-gender sexual harassment, from Grade 6 to Grade 8. Notably, this relationship was directly linked to sexual maturation. Similarly, another longitudinal study by Goldstein, Malanchuk, Davis-Kean, and Eccles (2007) shows that especially females who perceived themselves as early maturers reported increased

sexual victimization. Moreover, there is evidence that an early age at menarche is systematically correlated with unwanted sexual activity by dates and/or boyfriends (Rickert & Wiemann, 1998; Vicary, Klingaman, & Harkness, 1995). Such early adverse confrontations with sexuality are connected to long-lasting negative psychological consequences, like doubts about future romantic relationships and depressive symptoms (Duffy, Wareham, & Walsh, 2004; Goldstein et al., 2007).

Thus, the earlier her menarche, the more likely a girl is to encounter a confrontation with sexuality with which she is ill prepared to cope (e.g., Dahl, 2004). According to stage termination hypothesis, a premature physical development shortens the time to accomplish the cognitive skills necessary to handle the next developmental stage (cf. Graber, Petersen, & Brooks-Gunn, 1996; Petersen & Taylor, 1980). Among the cognitive functions necessary to deal with the novel and affect-laden aspects of social life connected to sexual development, there are executive functions and other control operations for goal-oriented behavior and regulatory competence. These cognitive functions are known to develop slowly over the lifetime long beyond the pubertal phase (e.g., Choudhury, Blakemore, & Charman, 2006; Keating, 2004; Luna, Garver, Urban, Lazar, & Sweeney, 2004; Steinberg, 2005).

Thus, although pubertal status is correlated with subjective age (e.g., Stattin & Magnusson, 1990; Galambos, Kolaric, Sears, & Maggs, 1999), there seems to be no direct relationship between pubertal processes and cognitive development (cf. Dahl, 2004). Accordingly, an older age and the feeling of being prepared are associated with a more positive menarche experience (e.g., Koff, Rierdan, & Sheingold, 1982; Ruble & Brooks-Gunn, 1982). Hence, the situation of early maturing persons can be portrayed as one that gives rise to a discrepancy between physical and social maturity (e.g., Alsaker, 1995; Dahl, 2004; Ge, Conger, & Elder, 2001; Sisk, 2006; Steinberg, 2005).

### *Antecedents and Consequences of Menarcheal Age and the Implicit Evaluation of Men*

Negative evaluative tendencies typically reflect a direct or indirect negative prior experience with an attitude object. These evaluative tendencies have the function to adaptively prepare the organism for potentially adverse and threatening situations (e.g., Bechara, Damasio, Tranel, & Damasio, 1997; De Houwer, Thomas, & Baeyens, 2001). Moreover, such an acquired attitude toward a certain attitude object can be generalized to a whole class of objects (e.g., Shook, Fazio, & Eiser, 2007). These basic evaluative learning mechanisms also seem to play a crucial role for the formation of intergroup attitudes (e.g., Olson & Fazio, 2006; Olsson, Ebert, Banaji, & Phelps, 2005). Dunham, Baron, and Banaji (2008) have recently suggested that such implicit intergroup attitudes

might develop early in life and remain stable across development. Accordingly, several studies showed that the familial environment and experiences with the primary caregiver could predict implicit intergroup attitudes in adults (Rudman & Goodwin, 2004; Rudman, Phelan, & Heppen, 2007; Towles-Schwen & Fazio, 2006).

The aforementioned premenarcheal experiences are assumed to cause an early menarche and likely postmenarcheal experiences that are associated with negative intersexual experiences. Hence, low paternal investment and other premenarcheal negative experiences with men as well as the excessive demands regarding intersexual contact that can arise from a gap between cognitive and physical development might lead to a tendency to avoid and negatively evaluate persons of the opposite sex. Such an early experience might leave a trace even in later adulthood, when tested with sufficient sensitivity (cf. Rudman et al., 2007; Dunham et al., 2008).

To our knowledge, the relationship between the age at menarche and the implicit evaluation of men has not been investigated before. Therefore, we tested this relationship by means of different implicit cognitive measures. We believe this is a novel methodological approach in this field of research. Specifically, we measured females' evaluation of men with two established unobtrusive measures and a novel measure of perceptual bias. These measures were recorded from adult women about 10 years after their menarche. We predicted that, in each study, an early age of menarche would be associated with implicit negative evaluations of men.

## **Study I**

In Study 1, we measured the implicit evaluation of men and women with a task known as *affective priming* (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). Several studies have established the validity of this procedure as a measure of automatic behavioral tendencies. In a study by Towles-Schwen and Fazio (2006), affective priming measures predicted the success of interracial roommate relationships. In a study by Frings and Wentura (2003), the affective priming measure predicted television consumption over the course of 7 days. In the affective priming task, participants have to categorize target stimuli as being pleasant (e.g., beautiful) or unpleasant (e.g., disgusting). The target is preceded by a prime stimulus. Typically, responding is faster when prime and target share the same valence (e.g., prime and target both pleasant) than when they do not (e.g., prime pleasant and target unpleasant; cf. Fazio, 2001; Fazio et al., 1986). The automatic evaluation of a given prime can be inferred from the reaction time (RT) difference between subsequent pleasant and unpleasant targets. In one condition of Study 1, the prime stimuli consisted of male faces. We expected the evaluation of male faces to be more negative for those with an earlier onset of menstruation. To demonstrate that this evaluation bias is indeed sex

specific, we included a control group in which female instead of male faces were used as primes. Accordingly, we expected no influence of the age at menarche on the evaluation of female faces.

## Method

**Participants.** Fifty undergraduate adult females (mean age = 23 years) were recruited at Dortmund University of Technology and received course credits for their participation.

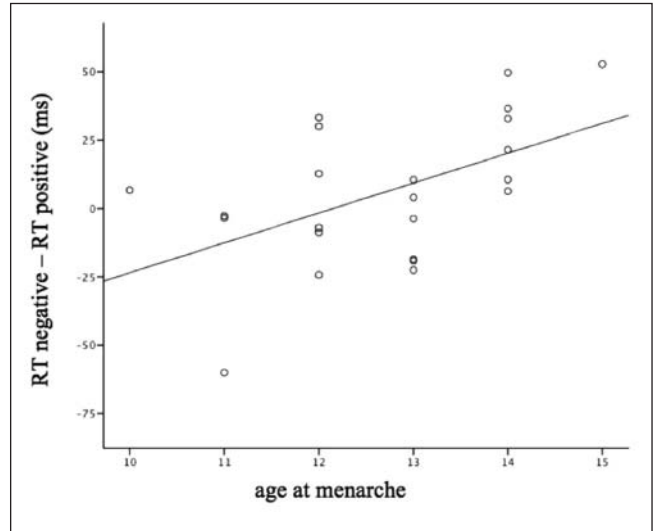
**Materials and procedure.** In the affective priming task, 14 different color images were used as primes obtained from the Aberdeen Face Database (available at <http://pics.psych.stir.ac.uk/>). Pictures of men were presented to one half of the participants; pictures of women were presented to the other half. Each trial started with a fixation cross for 500 ms. Then a face image was presented for 150 ms. After a blank screen of 100 ms a pleasant or unpleasant target word followed and was displayed on the screen until response. A wrong categorization of a target word as pleasant or unpleasant was indicated by a red X, which remained on the screen until participants responded with the appropriate key. Each prime face was presented three times with a randomly chosen pleasant German target word (i.e., *brave, open, beautiful, sagacious, smiling, honest, righteous*) and three times with a randomly chosen unpleasant German target word (i.e., *aggressive, avaricious, viperish, disgusting, bitchy, barbarous, cynical*). The affective priming task consisted of eight practice trials that used Chinese pictographs as primes and a different sample of pleasant and unpleasant target words as well as 84 test trials. The order of trials was random with the constraint that no prime was repeated more than twice. The intertribal interval was set to 2000 ms.

Subsequent to the affective priming task, participants were asked at which age they got their first menstrual bleeding (i.e., their menarche). It is known that self-reported age at menarche is a robust measure of actual age at menarche, which renders it unlikely that self-report is biased by the experimental manipulations we introduced (e.g., Damon & Bajema, 1974; Must et al., 2002).

## Results and Discussion

Two participants from the group with male stimuli and three participants from the group with female stimuli who reported that German was not their mother tongue were excluded from further analysis (cf. Bargh, Lombardi, & Higgins, 1988). The mean age at menarche, as measured by self-report, was 13 years, ranging from 10 to 17 years.

Only correct responses were included for further analyses (94.42%). Moreover, RTs below 300 ms were regarded as premature. Conversely, response times above 1000 ms typically indicate temporary attention lapses and were excluded (for a similar approach see, e.g., Maddux, Barden, Brewer, &



**Figure 1.** The difference of mean reaction times to negative and positive targets preceded by a male portrait as a function of the age at menarche

Petty, 2005). Consequently, 5.94% of the responses were regarded as outliers. Furthermore, for each participant, mean RTs to pleasant target words were subtracted from mean RTs to unpleasant target words. Accordingly, the more positive this RT difference score, the more positive is the supposed implicit evaluation of the primes (e.g., Fazio et al., 1986). As hypothesized, the earlier the menarche the more negatively were male images evaluated ( $r = .520, p = .011$ ; cf. Figure 1). In contrast, there was no significant relationship between age at menarche and the implicit evaluation in the female prime condition ( $r = -.26, p = .244$ ). The correlations between age at menarche and RT measures of evaluation were significantly different regarding male and female prime pictures ( $z = -2.62, p < .01$ ). To summarize, male but not female photographs were implicitly evaluated as more negative, the earlier the age at first menstruation.

## Study 2

In Study 1, male photographs were more negatively evaluated, the earlier the age at menarche. Study 2 was conducted to test this evaluation bias in more detail, namely, that men are perceived as being more threatening the earlier the age at first menstruation. Therefore, we designed a bipolar Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) with the two target categories male/female and the two attribute categories danger/safety. The IAT is a response competition task, which is an established measure in social cognition research for the association strength between different target and attribute concepts. Several studies have demonstrated that the IAT is able to predict spontaneous and impulsive behavior. For example, IAT measures predicted



alcohol consumption over the course of a month (Wiers, van Woerden, Smulders, & De Jong, 2002), uncontrollable shy behavior during social interactions (Asendorpf, Banse, & Mücke, 2002), or avoidance behavior regarding AIDS victims (Neumann, Hülsenbeck, & Seibt, 2004). Moreover, in a meta-analysis by Hofmann, Gawronski, Gschwendner, Le, and Schmitt (2005), a high reliability of the IAT measures could be confirmed. During the task participants had to classify stimuli belonging to a certain target category, such as being male/female and a certain attribute category such as signaling danger/safety. The basic idea is that responding is faster when associated rather than unassociated targets and attribute categories are assigned to the same response. Consider that participants have to respond to male and danger-signaling stimuli with a left key press and to female and safety-signaling stimuli with a right key press. If responding with this mapping is faster than with the mapping male/safety  $\Rightarrow$  left, female/danger  $\Rightarrow$  right, this would indicate that the associations between male-danger and female-safety are stronger than the associations between male-safety and female-danger.

## Method

**Participants.** Thirty undergraduate adult females (mean age = 23 years) of Dortmund University of Technology were recruited; they received course credits for their participation or a small compensation.

**Materials and procedure.** The exemplars of the target categories (male/female) of the IAT consisted of five different color images depicting male faces and five different color images depicting female faces obtained from the Aberdeen Face Database. The attribute categories (danger/safety) consisted of five different German words for danger (i.e., *aggressive, dangerous, hostile, malicious, deceiving*) and five different words for safety (i.e., *tender, agreeable, peaceful, reliable, friendly*). The entire IAT consisted of seven blocks, each with 20 trials. In the first block, participants practiced the sorting of the male and female exemplars. In the second block participants had to practice the sorting of the exemplars of the concepts danger and safety. Blocks 3 and 4 were test blocks. In these test blocks the concepts male and safety and the concepts female and danger shared the same response key. In the following practice trials of the fifth block, the required response for the sorting of the male and female exemplars was reversed. The sixth and seventh block again consisted of mixed categories. In these last two blocks the concepts female and safety and the concepts male and danger required the same response. The exemplars stayed in the middle of the screen until participants responded with the appropriate key. In case participants gave a wrong response, a red cross appeared beneath the exemplar. Participants had been encouraged to respond rapidly while making as few mistakes as possible. The intertrial interval was set to 500 ms.

## Results and Discussion

Four participants who reported that German was not their mother tongue were excluded from further analysis. The mean age at menarche for the remaining participants was 13 years, ranging from 10 to 17 years. Only correct responses were included for further analyses (93.9%). Moreover, response latencies below 300 ms and above 1000 ms were regarded as outliers and excluded from further analysis (10.2%) as was done in Study 1. An IAT effect was calculated as a measure of the association strengths between target and attribute categories. With mapping male/safety and female/danger the mean RT was 680 ms ( $SD = 82$  ms) and with mapping male/danger and female/safety the mean RT was 582 ms ( $SD = 72$  ms),  $t(25) = -10.93$ ,  $p < .001$ . Thus, overall the concept male was more closely associated to the concept danger and the concept female was more closely related to the concept safety. For each participant the mean RTs with the grouping male/danger and female/safety were subtracted from the mean RTs with the opposite grouping. The more positive this difference score is, the closer the association between male/danger and female/security compared to the other concept combinations. The earlier the age at menarche, the faster participants responded to the combination of the concepts male/danger and female/safety compared to the opposite combination. This resulted in a significant negative correlation of the subjects' age at menarche and the IAT score ( $r = -.423$ ,  $p = .032$ ). These results suggest that part of the negative evaluation of men may be mediated by the perception of men as being threatening.

## Study 3

The third study should investigate the relationship between the age at menarche and an auditory spatial bias regarding male stimuli. According to a New Look perspective, perception is largely influenced by emotional and motivational factors, like current need states, expectations, goals, affective states, or attitudes. These factors can influence the way incoming sensory information is selected and integrated (e.g., Bruner & Postman, 1949; Dunning, 1999). A study by Balcetis and Dunning (2006) demonstrates by means of different unobtrusive measures (i.e., eye tracking and a lexical decision task) that participants preconsciously interpreted ambiguous figures in a way that was most favorable to them. Thus, what people perceive and how they perceive it can be understood as the result of an interplay of low-level bottom-up processes and high-level top-down processes alike (e.g., Balcetis & Dunning, 2006). In a study by Carbon and Leder (2005), for example, participants from Eastern Germany and Western Germany had to estimate the distance between different cities within one part of Germany and between cities of different parts of Germany. They found that the distances between German cities across the former Iron Curtain had been

systematically overestimated compared to distances between cities within one part of Germany. This spatial distance estimation effect was clearly pronounced for people with a negative attitude toward the reunification of Germany. Hence, a more negative attitude was accompanied by more psychological distance (cf. Carbon & Leder, 2005). According to Williams and Bargh (2008), the concept of psychological distance is primarily based on spatial concepts like near-far that develop during early childhood. They showed that priming people with spatial distance compared to spatial closeness, for instance, lessened the emotional distress from violent media. Williams and Bargh argued that the spatial distance primes muted the phenomenal experience of emotional events without people's awareness because of a hardwired association between distance and safety (cf. Mobbs et al., 2007).

Whether people face the processing of aversive information or tend to distance themselves from it seems to depend on the temporal proximity to a threatening event. Thus, for instance, people appear to pay more attention to health-threatening information they expect to be relevant in the near future than to information they expect to be relevant in the more distant future (e.g., Ouweland, de Ridder, & Bensing, 2008). Hence, it might be adaptive for an organism to underestimate the egocentric distances toward aversive stimuli in urgent situations to increase its arousal level and action readiness toward a certain threat (cf. Haselton & Nettle, 2006; Mühlberger, Neumann, Wieser, & Pauli, 2008). In nonurgent situations, however, it appears to be more emotionally adaptive to distance oneself from an aversive stimulus to protect the system from the stress responses that would be accompanied by more closeness (e.g., Erdelyi, 1974).

In line with the two previous studies, therefore, we predicted that an early menarche would be accompanied by an increased estimated egocentric distance of virtual male voices. As in Study 1 we used a control condition with virtual female voices as stimulus material. Here, no influence of the age at menarche on distance estimations was predicted.

## Method

**Participants.** Seventy-two undergraduate adult females (mean age = 23 years) of Dortmund University of Technology were recruited and received course credits for their participation. Thirty-four participants were presented with male voices and 38 were presented with female voices. One participant from the group with female voices had to be excluded because she did not report her age at menarche.

**Materials and procedure.** In the egocentric distance estimation task, participants were instructed to imagine they would walk toward a person whose voice they heard via headphones and subsequently to estimate the egocentric distance of the virtual speaker. At the beginning of the study, participants once heard a neutral sound (i.e., a bell) and were informed that this sound was located 10 meters away from

them. This was done to create a frame of reference for the subsequent distance estimations. The voice stimuli were presented in randomized order and consisted of 3 different male or female voices that spoke the 5 different vowels (*a, e, i, o, u*) in German. Before each trial the participants saw a blinking dot in the middle of the screen for 3000 ms immediately after a vowel was presented for 1000 ms.

Previous studies could show that perceived masculinity in male voices (i.e., a lower vocal pitch) and femininity in female voices (i.e., higher vocal pitch) can affect attractiveness ratings (e.g., Apicella, Feinberg, & Marlowe, 2007; Feinberg, DeBruine, Jones, & Perrett, 2008). Therefore, to control whether distance estimations would be affected by the pitch of voices as a sexually dimorphic characteristic, their pitch was manipulated without changing the speech tempo so that each voice was altered to a relatively low (i.e., 10% lowering of vocal pitch) or high voice (i.e., 10% heightening of vocal pitch) or presented unaltered. Each voice was presented once in three different pitches forming one of five vowel sounds. In addition, the frequency range of the voice signal, which is an important cue for auditory distance estimation (cf. Little, Mereshon, & Cox, 1992), was either left unaltered or confined to frequencies above 2000 Hz or above 8000 Hz. This manipulation strongly prompts the impression of varying distances of the virtual speaker (i.e., voices appear as being farther away the higher the cut-off frequency) and should hence increase the plausibility of the distance estimation task. The combination of 3 Voices  $\times$  3 Pitches  $\times$  5 Vowels  $\times$  3 Cut-Off Frequencies resulted in 135 experimental trials. After each vowel sound, participants responded by typing the estimated egocentric distance of the virtual speaker. After the distance estimation task participants were asked to judge the gender expression of the voices on a 7-point scale ranging from (1) *very masculine* to (7) *very feminine*.

## Results and Discussion

As a manipulation check, we first compared the masculinity judgments of male and female stimulus voices. The males' voices were judged as being more masculine on the 7-point rating scale ( $M = 2.93$ ,  $SD = 0.73$ ) than the female voices ( $M = 4.97$ ,  $SD = 0.64$ ),  $t(69) = 12.619$ ,  $p < .001$ . The participants' mean age at menarche was 13 years, ranging from 11 to 17 years.

In the group with male voices the frequency spectrum of the voice signal affected the judged distance of the speaker as expected. With a high cut-off frequency (8000 Hz), the estimated distance of the virtual speaker was larger (11.28 m) than with a low (2000 Hz) cut-off frequency (6.03 m) or no cut off at all (2.38 m),  $F(2, 33) = 40.95$ ,  $p < .001$ . This shows that participants actually complied with the task instructions and based their responses on the perceived distance of the voices. By contrast, the pitch of the voices did not affect the distance estimations,  $F(2, 33) = 1.22$ ,  $p = ns$ . Of greatest

interest to us was whether the distance estimation was correlated with the age at menarche. This was the case. The earlier the age at menarche, the higher was the judged distance of male voices, producing a negative correlation of age at menarche and estimated distance,  $r = -.39, p = .024$ .

As in the group with male stimulus voices, the estimated distance of female speakers was larger (15.16 m) with a high cut-off frequency (8000 Hz) than with a low (2000 Hz) cut-off frequency (7.09 m) or no cut off (2.53 m),  $F(2, 36) = 57.98, p < .001$ . The pitch of the voices did not affect distance estimations,  $F(2, 36) = 1.96, p = ns$ . Interestingly, there was a correlation between distance estimations of female voices and age at menarche ( $r = .368, p = .025$ ). Notably, this correlation went into the opposite direction compared to the judgment of male stimuli. This means that the earlier the age at menarche, the closer the distance of female voices was estimated. Although the reasons for this positive correlation are to be identified, these results show clearly that the age at menarche is differently associated with the perception of male and female voices. This is also suggested by the significantly different correlations between age of menarche and mean estimated distance between male and female stimulus voices ( $z = -3.21, p < .001$ ).

## General Discussion

This study shows, for the first time, a relationship between the age at menarche, as a simple marker of female sexual maturation, and the implicit evaluation of men. Remarkably, this finding was obtained with two different established measures of implicit attitudes. In Study 1, an earlier age of menarche was associated with negative implicit evaluations of men in an affective priming task (Fazio et al., 1986). In Study 2, an earlier age of menarche was linked with a strong association between the concepts men and threat, as measured with an IAT (Greenwald et al., 1998). In addition, in Study 3 we observed a relationship between the age at menarche and the estimated egocentric distance toward virtual male voices. These relationships were obtained in adult women about a decade after onset of menstruation. Thus, these results suggest that the age of sexual maturation is associated with automatic evaluative tendencies that putatively have long-lasting and far-reaching consequences for subsequent social development (cf. Caspi & Moffitt, 1991). However, we hasten to add that these findings are based on correlational data and should, therefore, be seen as a starting point for a closer examination of the causal factors that mediate the relationship between the age at menarche and the implicit evaluation of men.

### *Possible Premenarcheal and Postmenarcheal Influences on the Implicit Evaluation of Men*

The literature on pubertal timing consistently suggests a connection between the age at menarche and negative

experiences with men, which in turn suggests a likely relationship between an early menarche and a negative evaluation of men. Although the present findings are in agreement with this assumption they can be ascribed to both early aversive experiences with the opposite sex that are assumed to trigger an early onset of menstruation (for an extensive review, see Ellis, 2004) and a discrepancy between the development of the reproductive system and the cognitive system as a consequence of early sexual maturation (cf. Dahl, 2004; Graber et al., 1996; Petersen & Taylor, 1980; Sisk, 2006).

Typically, marital quality and divorce seem to have a stronger impact on father-child relationships than mother-child relationships (e.g., Booth & Amato, 1994; Lewis, Maki, & Papacosta, 1997). Low paternal involvement is not solely associated with an early menarche but also with less trust in the father and a worsening father-daughter relationship even about 20 years later (King, 2002; Ahrons & Tanner, 2003). Moreover, it has been reported that low paternal involvement is associated with insecure attachment styles in young adult intimate relationships (van Schaick & Stolberg, 2001) and that fatherly affirmation has an influence on daughter's fear of intimacy and comfort with sexuality (Scheffler & Naus, 1999). Such findings suggest that a low father-daughter relationship quality might also have a negative influence on women's attitudes toward men.

Besides this paternal impact on pubertal timing, other aversive experiences with men, like childhood abuse, are associated with an early menarche (e.g., Romans et al., 2003; Trickett & Putnam, 1993; Turner et al., 1999; Zabin et al., 2005), and an early menarche and childhood abuse in turn are associated with intimate partner violence exposure in adolescence (cf. Foster, Hagan, & Brooks-Gunn, 2008). Thus, premenarcheal antecedents of an accelerated sexual development that are linked to negative experiences with the opposite sex seem to have also an influence on negative postmenarcheal experiences with men.

Furthermore, previous studies showed an interaction of pubertal timing and the social context on behavior and psychological functioning (e.g., Brooks-Gunn & Warren, 1985; Caspi, Lynam, Moffitt, & Silva, 1993; Gargiulo, Attie, Brooks-Gunn, & Warren, 1987; Miller & Gur, 2002). Caspi et al. (1993), for instance, reported that the behavioral problems of early maturers were pronounced in girls attending mixed-sex schools compared to girls attending all-girl schools. Importantly, these differences could not be explained by a pre-selection bias. Similarly, research by Gargiulo et al. (1987) has shown that also the effect of menarcheal status on dating behavior and body image was mediated by the social context within which it occurred (see also Brooks-Gunn & Warren, 1985). In view of these findings, it would be conceivable that the postmenarcheal environment mediates the relationship between the age at menarche and the implicit evaluation of men. Such environments might include different school contexts (i.e., same-sex vs. mixed-sex schools) or cultures with



different social norms regarding intersexual behavior. Future research in this direction may contribute information about the possible impact of premenarcheal and postmenarcheal experiences on the implicit evaluation of men.

### **Age at Menarche and the Implicit Evaluation of Women**

In Study 3, an earlier menarche was associated with a decreased egocentric distance estimation toward female voices, which might indicate a more positive evaluation of females the earlier the menarche. In view of this trend in Study 3, future research should also attempt to examine the consequences of menarcheal age for intrasexual relationships. It may be premature to draw strong conclusions on this single and unexpected finding. Nevertheless, the results from Study 3 are in keeping with previous research, which suggests that women react on perceived gender discrimination with an increased identification with women as a group (Schmitt, Branscombe, Kobrynowicz, & Owen, 2002). Similarly, research by Rudman and Goodwin (2004) has showed that a stronger automatic association of male gender with violence accompanied a pro-female bias. Relying on this finding, Rudman and Goodwin suggested that male intimidation affects gender attitudes. This is consistent with the results of Study 2, which showed a stronger association of males with threat in early maturers. Notably, Rudman and Goodwin reported also that people who favored their mothers or reported to have been primarily raised by a maternal caregiver had a more positive implicit attitude toward women. Although they did not measure pubertal timing, this finding is in support of the assumption that premenarcheal experiences, like father absence (e.g., Tither & Ellis, 2008), contribute to the relationship between age at menarche and the implicit evaluation of men.

### **Implications and Future Research**

Negative implicit intergroup attitudes can have undesirable consequences for social interaction (e.g., Cesario, Plaks, & Higgins, 2006), person perception (e.g., Maner et al. 2005), interpersonal relationship longevity (e.g., Towles-Schwen & Fazio, 2006), and medical decision making (e.g., Green et al., 2007). Therefore, future work should examine to what extent evaluative tendencies that are linked to the age of maturation might affect different aspects of intersexual relationships both in private and professional domains.

Moreover, we believe that implicit measures of the type used here are a useful addition to the methodological repertoire in research about menarche and pubertal timing. It is known that unobtrusive measures of evaluation, as we have used here, are considerably correlated with automatic or spontaneous behavior, whereas explicit self-report measures of attitudes typically show a higher correlation with controlled and deliberative behavior (e.g., Frings & Wentura,

2003; Towles-Schwen & Fazio, 2006; Wiers et al., 2002). The automatic evaluation of men may govern the social behavior of women especially in situations with fewer control resources (Hofmann, Gschwendner, Castelli, & Schmitt, 2008).

Furthermore, many social cognitive measures, like the IAT, offer the possibility to deal with the problem of social desirability, which is of particular concern in sex research (e.g., Catania, Gibson, Chitwood, & Coates, 1990; Chillag et al., 2006). An IAT study by Gray, Brown, MacCulloch, Smith, and Snowden (2005), for instance, has showed that pedophiles had a stronger association between children and sex compared to nonpedophilic offenders who had a stronger association between adults and sex. Future research could use implicit measures, which are less prone to social desirability, to study the impact of pubertal timing on constructs such as body image (e.g., Compian et al., 2004) and parent-daughter affection (e.g., Ellis et al., 1999).

Regrettably, the object of the current research has not received much attention from social cognitive researchers thus far. Therefore, we hope this study stimulates further pubertal timing research on implicit cognitive processes, which previously could not be captured with more conventional methods (Fazio & Olson, 2003).

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